New Vistas on the Income Inequality-Health Debate: The Case of Canada's First Nations Reserve Population

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Abstract and Keywords

Abstract

Research Problem/Theory: Research on the social determinants of health of Canada's First Nations population has not focused on contextual-level determinants of health. The First Nation population is very diverse and the reserve communities in which they reside are complex mixes of various cultural and socioeconomic circumstances. The social forces of these communities operate to affect population health in addition to individual-level determinants. A multilevel model of Aboriginal health, including contextual and individual determinants, is presented with an emphasis on income inequality.

Methods/Data: This study uses the 2001 Aboriginal Peoples Survey and logistic hierarchical linear modeling to test hypotheses. The dependent variable is the self-rated health of respondents.

Findings: This analysis failed to detect any significant variation at the community level. Subsequently, a sequential logistic regression analysis was run. The first block—demographics—accounted for the bulk of explained variance in the model—12.0%. Next, lifestyle factors explained an additional 0.3% of the variance in the dependent variable while formal health services and social support accounted for 1.7% and 0.6% respectively. Finally, culture did not contribute to explaining self-rated

health upon entering the model last. Increases in age were associated with higher odds of reporting poor health. High income and educational levels, as well as being male and labor force participation (particularly employment), were associated with lower odds of reporting poor health. Divorced, separated, and widowed respondents as well as married respondents were more likely to report poor health than single respondents. Respondents who smoke and binge drink often were more likely to report poor health than non-smokers and non-drinkers. Interaction with a family physician in the last year had a negative effect on health. Access to traditional medicines, wellness, and healing practices was not significant in the model. Social support had a positive effect on self-rated health, with more support associated with lower odds of reporting poor health. Culture was not a significant explanatory variable in the model.

Conclusions: The determinants of First Nation's health do not appear to deviate in any important way from those established in research for the general population.

Keywords: First Nations, Aboriginal, health, income inequality, contextual effects, community effects, individual effects, reserves, multilevel, logistic regression, 2001 Aboriginal Peoples Survey, social determinants, Canada, policy.

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Chapter 1: Introduction and Statement of Problem

1.1 Introduction

Aboriginal outcomes are one of the areas ripe for research and social intervention. Why? A quick review of the literature shows us that this group is plagued by numerous social problems. Of course, social problems are usually defined in reference to some standard or specific group. Recent publications from White, Maxim, and Beavon (2003; 2004a; 2004b) examine a cross section of Aboriginal issues, such as health, crime, demography, and economic development, and systematically frame these issues in a comparative manner, that is, relative to the greater Canadian society. The main conclusion is that the *relative* standard of living of the Aboriginal segment of the population is well below what we would expect in Canada. The pattern is striking: in an adaptation of the United Nations Human Development Index (HDI) to measure Aboriginal conditions in Canada, it was found that Canada scores near the top of the international HDI rankings, but Registered Indians living on-reserve rank at the 79th level in the world (Beavon and Cook 2003; White, Beavon and Spence 2007).

Perhaps the most crucial disparity between the Aboriginal population and Canadian society is in the realm of health. It was Henri-Frédéric Amiel who said "Health is the first of all liberties." Indeed, our ability to fully participate in society and function as active citizens is premised upon the state of our health. Given the cardinal role of health in our overall well-being, the poor health of the Aboriginal population relative to the greater Canadian society is startling (e.g., Health Canada 1999; Health Canada

2002a; Norris and Siggner 2003; Royal Commission of Aboriginal People 1996; Young et al. 1999). Recent data paints a clear picture. Aboriginals experience lower life expectancy and self-rated health, and higher rates of morbidity, chronic disease, suicide, injury, and mortality than the greater Canadian population. For example, using data from the First Nations and Inuit Regional Health Survey, the prevalence of the major chronic diseases, including diabetes (3.3:1, 5.3:1)[1], heart problems (3.0:1, 2.9:1), cancer (2.0:1, 1.6:1), hypertension (2.8:1, 2.5:1), arthritis/rheumatism (1.7:1, 1.6:1), is reported to be much higher among the First Nation population than the general population (Young et al. 1999). Those who suffer from chronic disease are more likely to rate their health as poor, and given the implications of chronic disease, such as disability, activity limitation, and increased demand for personal care, this is a serious concern. Similar prevalence patterns for First Nations versus the general population hold for a host of other illnesses, including pertussis (2.2:1), rubella (7:1), tuberculosis (6:1) shigellosis (2.1:1), and genital Chlamydia (7:1). In terms of life expectancy, using the 2001 Census and Aboriginal Peoples Survey, Registered Indian males live 7.4 years less than the total Canadian male population while this differential for females is 5.2 years (Norris and Siggner 2003). In terms of overall self-rated health, Aboriginals are less likely to rate their health as excellent or very good than the total Canadian population. The health outcomes for Aboriginals are not, however, homogeneous: a comparison of the total Canadian population to reserve and non-reserve areas shows a marked gradient in self reported health and many chronic

[1] The first ratio refers to First Nation males versus the general population of males, and the second ratio refers to First Nation females versus the general population of females.

conditions such as high blood pressure and diabetes. Their pattern is distinct: the total Canadian population experiences the best health followed by Aboriginal people residing in non-reserve areas, and finally Aboriginal people on-reserve who are primarily Registered First Nations (Norris and Siggner 2003).[2]

There are, however, many puzzles left to solve before these disparities can be eradicated. According to the Royal Commission of Aboriginal People (1996), expenditures on health and social services delivered to Aboriginal people at all levels of government exceed those delivered to Canadians generally on a per capita basis, with a ratio of 1.6 for health, 1.3 for social development, and 5.5 for housing, yet the health and well-being of the former continue to lag far behind the latter. Commissioners concluded that the main impediment to improving the health outcomes of Aboriginal people is not the amount of money spent but how it is spent.

The development of efficient health interventions is premised upon our knowledge and scope of the determinants of health processes. This work attempts to identify the mechanisms that may aid in explaining these systematically poor social outcomes. Overall, the evidence suggests that the largest determinants of population health rest outside of the scope of the dominant biomedical model and health care system; in fact,

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[2] The First Nation population is growing significantly with a birth rate of 23.4 births per 1000 population, which is more than twice the rate in Canada. It is also a young population with 61.1 percent of the First Nations population under 30 years of age in 2000 as compared with 38.8 percent for the Canadian population (Health Canada 2002a). Thus, the sheer size of this rapidly growing young population makes the issue of health outcomes a policy issue of paramount importance.

they are rooted in the social world. This would suggest that a much greater emphasis should be placed upon untangling the social determinants of health. This approach asserts that the prevailing Western biomedical model, with its narrow focus on the health care system as a determinant of health, fails to capture the complex nature of the health of Canadians; that is, it ignores the other key factors that influence the health status of individuals and populations, including the social determinants of health. The conceptual complexities of the determinants of health have been developed in recent years. Comprehensive models have been put forth that address a broad spectrum of health determinants (Evans and Stoddart 1990, 1994; Hancock, Labonte and Edwards 1999; Hertzman, Frank, and Evans 1994); however, the poor health of the Aboriginal population continues to be a key social problem that has not received its share of attention.

1.2 Aboriginal Research

Aboriginal health research has suffered the same fate as other issues pertaining to this group of Canadians—there has been a shortage of work done, and what has been done is from a narrow perspective. Young (2003), in his review of the research in Canada, found that the attention to human biology (particularly), genetics, and environmental contaminants has received much more attention than other determinants, especially social. In addition, there exists a disproportionate amount of small-scale non generalizable work, as well as quantitative literature that documents gaps and trends, and epidemiological evidence on the prevalence of high risk lifestyle behavioral

patterns (e.g., Band et al. 1992; Beavon and Cook 2003; Bramley et al. 2004; Lavallee, Clarkson, and Paradis 1994; Norris and Siggner 2003; O'Sullivan and McHardy 2004; Waldram, Herring and Young 1995; Young 1994), but very little generalizable *causal* work has been carried out. Inadequate theorizing and the limited availability of good data have contributed to this research gap.

Further, the diversity of Aboriginal people tends to be missed in discussions across a variety of audiences and arenas. It is, however, imperative to highlight the diversity of histories, cultures, and socio-economic circumstances of the Aboriginal population to adequately address the various needs of these people. The degree of intra Aboriginal differences is truly significant. For example, Chandler and Lalonde (2004) have demonstrated this diversity in their work on suicide in British Columbia, where it was found that some communities have rates 800 times the national average while more than half of the province's First Nations bands have not experienced a single youth suicide in about fifteen years. Given the concentration of Aboriginal people geographically, it is essential that we unveil and understand the diversity of these communities and the outcomes that they produce. What makes one First Nation community healthier than another? In the case of Aboriginal health, the foundation for health and disease in individual communities is a largely unknown area of research.

1.3 Social Contexts and Income Inequality: Back to the Basics of Sociology

In recent years, community level variables have demonstrated their theoretical utility and capacity to explain a variety of social phenomena. These community influences are not merely the sum of the individual-level characteristics of members of the community; instead, they represent the milieu that exists outside of the individual and can include such things as the physical structures (e.g., design of housing developments) as well as the social structures (e.g., public meeting places, mechanisms for income redistribution and opportunities for exchange and interaction) of a community (Lomas 1998). Income inequality is one contextual-level variable that has been the focus of significant attention internationally.

Even a superficial review of the research published in academic journals and government publications across a range of areas indicates the popularity of this contextual variable. The evidence in support of its explanatory power is notable. In fact, one recent review of the impact of income inequality by Wilkinson and Pickett (2006), which examined 168 analyses in 155 papers, found that approximately three quarters of the analyses were either partially or wholly supportive of significant findings.[3] Despite the vastness of the literature, virtually no research has examined the effect of income inequality on various outcomes for Aboriginals, including health

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[3] The pathways through which income inequality affects mortality and health are not fully understood; however, the organization and quality of the social fabric has an unmistakably prominent role in determining population health.

outcomes.[4] Issues related to poverty and individual attributes have tended to be the focus of discussion. Meanwhile in many developed regions, relative poverty and social exclusion have become more widespread social indicators than absolute poverty. This has been the impetus for examining other socioeconomic determinants of health, such as social capital and income inequality. Thus, this research gap is an analytically important one with potentially significant policy implications. After all, increasing the health of the Aboriginal population is a practical policy goal. Social causes of health, such as income inequality and its effects are partially under the control of governments and, therefore, are amendable to change through redistributive policies and appropriate interventions (Kawachi and Kennedy 2002). Similarly, Daly et al. (1998:324) comment that "from a policy perspective, this type of research is critical. If inequality is shown to have a lasting impact on outcomes like health, then it may be beneficial and efficient to minimize inequality instead of designing policies to correct differences in outcomes. In contrast, if inequality has little or no impact on measurable outcomes, then it will be placed in the realm of a social or moral issue rather than an economic one."[5] Therefore, establishing a true effect, its pathways, groups that it affects, and

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[4] There have been a few studies that have documented the Aboriginal population has a higher level of income inequality than the Canadian population, and perhaps most importantly, there are significant intra Aboriginal differences in income inequality with on-reserve (mostly Registered Indians) and Inuit faring worse than the off-reserve (mostly Non Registered) and Métis. In fact, the intra Aboriginal differences tend to be larger than between Aboriginals and the Canadian population (Bernier 1997; Drost and Richards 2003; Gee and Prus 2000; Jankowski and Moazzami 1994; Maxim et al. 2001).

[5] For a thorough discussion on reducing health inequalities in terms of morality/fairness, its widespread effects, governmental decision making, and cost-effectiveness, see Woodward and Kawachi (2000).

other dynamics are key considerations to ensure more successful policy interventions for governments.

Congruent with the individual ideology of Western society, individual risk factors, particularly rooted in a biomedical perspective, dominate the discourse in research and policy. Breaking from traditional inquiry, this mode of investigation seeks the determinants of healthy societies, focusing on the social milieu in which individual risk factors are observed. For some disciplines, such as sociology, the importance of social structure is a hallmark of inquiry. This dissertation focuses on the social determinants of health, with an emphasis on the effects of the socioeconomic characteristics of the social structure. A firm understanding of these determinants of health requires an examination of effects at all relevant levels of analysis. It is also essential to understand the manner in which potentially important individual characteristics vary in their effects by social context. Our knowledge of the social patterning of health outcomes as a result of these conditions is, without a doubt, important. In the case of Aboriginal health, the foundation for health and disease in individual communities is a largely unknown area of research.

My underlying model begins with the notion that the health of First Nations is structured by the social context in which they reside. Recent approaches to improving the health of Aboriginals have been critical of the biomedical approach, as well as the focus on individual risk factors, and emphasized the importance of the social

determinants of health (Raphael 2004; Royal Commission on Aboriginal People 1996). Despite the concerted efforts to address the conceptual shortcomings of traditional positions, there remains a deficiency in the Aboriginal health literature regarding the structural approaches to population health. I conceptualize the health of First Nations as existing as one of many outcomes that must be understood with a true sociological lens; that is, the context (community) in which health processes are occurring must be taken into account to understand the processes through which ill health is experienced. I argue that reserves are a meaningful contextual-level at which to examine ecological effects. Reserves are unique social spaces given their historical, cultural, political, and socioeconomic attributes. They are geographically meaningful places in which First Nations people live. This focus on-reserve comes at an appropriate time: according to the 2001 Census data (Statistics Canada 2004), there are about 1.32 million people who self identify as having Aboriginal ancestry. According to departmental data from Indian Affairs, the Registered Indian population is numbered at 703 800 in over 600 Bands, with approximately 419 800 (60%) on-reserve (Indian and Northern Affairs Canada 2004). The proportion of Registered Indians living on-reserve is projected to increase from an estimated 60% in 2001 to 75% in 2021. Thus, our understanding of the dynamics surrounding this group of Aboriginals and their communities would be profitable as the future on-reserve population increases substantially (ibid.).

Although I argue the importance of social structure in determining Aboriginal outcomes in this thesis, it will be shown that no significant variation between reserves was observed. Thus, contextual level variables do not appear to play any role in determining health outcomes given the data I had to work with. This rather surprising finding will, however, be discussed in great detail. The theoretical and empirical support for pursuing this line of inquiry will be laid out in depth and the conclusion will underscore the need for future work using this approach.

In summary, the volume of Aboriginal health research has been relatively small, with the biomedical model at the forefront for examining issues. Changes have, however, occurred over time. There has been no shortage of documented trends in the health of Aboriginal people, but, all too often, the diversity within the population has been neglected. Recently, descriptions of Aboriginal health have correctly been contextualized alongside other poor socioeconomic outcomes, as with the social determinants of health literature, although empirical models of these associations have been relatively rare. Within the application of the social determinants of health perspective to Aboriginals, there has not been much focus on the social contextual-level determinants of health and true multilevel studies are non-existent. Furthermore, there has been virtually no work done on the effects of socioeconomic contextual variables, such as income inequality, which have shown great promise in the literature and are amendable to intervention.

1.4 Research Questions

There are three general research questions that this dissertation seeks to answer:

1) Does the socioeconomic context as indicated by the income inequality of Canada's First Nations reserves influence the health outcomes of its residents? If so, what is the underlying process by which this likely occurs?

2) Does the socioeconomic context alter the effect of individual-level influences on health, including social support?

3) What are the other key determinants of Aboriginal health?

1.5 Methodology and Statistics Overview

This research adds to the existing work on Aboriginal health and the social determinants of health through the analysis of the 2001 Aboriginal Peoples Survey. This is the second post censal survey of its kind and is probably the richest source of comprehensive information available to date on Aboriginal people. Data on a multitude of topics including health, language, lifestyles, housing, and socioeconomic conditions enables one to include many theoretically relevant variables in the analysis—a rarity in First Nations research. This survey also solves two key problems with many national surveys: the exclusion of on-reserve First Nations and the issue of small numbers of First Nations in the sample size to generate statistically significant and substantively meaningful results.

This rare look at the social determinants of health in the context of First Nations people using a combination of individual and contextual-level variables is best carried out using a multilevel statistical modeling framework. In this study, the outcome measure is the self-rated health of respondents, that is, "In general, would you say that your health is excellent, very good, good, fair, or poor?" The key independent variable is income inequality. Other relevant variables include community socioeconomic status, as well as several individual-level variables, including age, sex, education, marital status, labor force status, income, smoking and alcohol consumption habits, access to traditional medicine, healing and wellness practices, interaction with a medical doctor, social support, and culture. An important cross-level effect is also examined, that is, between income inequality and individual social support.

The analytic methods used in this work include descriptive statistics and multilevel logistic regression analysis. Descriptive statistics include the calculation of contextual socioeconomic variables, including income inequality within all of the communities (reserves) in the Aboriginal Peoples Survey. These measures include the Gini coefficient, the coefficient of variation, and Theil's index of entropy. Multilevel statistical analysis is used for the main analysis; it is a relatively complex way of determining effects of nested data at various levels. Statistically, the nested structure of the data makes it unamendable to traditional methods, because the elements are not independent. What this means is that individuals in the same community, state, province, and country, are not independent in the sense that they are exposed to many

of the same things; that is, all individuals within a particular social space are exposed to the same contextual-level variable, income inequality. The answer to this problem is to model all relevant variables at various levels simultaneously–hierarchical linear modeling. Hence, contextual-level variables and individual-level variables can be modeled together with their effects disaggregated. In this case, a 2-level model is tested with individual respondents at level 1, nested within communities (reserves) at level 2.

1.6 Description of Chapters

This dissertation is organized in the following manner: Chapter 2 is a critical review of the literature on the social determinants of health in Canada, including a history of the work on Aboriginal health. Emphasis on the work related to income inequality is given strict attention. Chapter 3 presents the theoretical/conceptual framework and model as well as related hypotheses. Methodological issues are dealt with in Chapter 4, including an overview of the dataset, sampling strategy, weighting of cases, missing data, independent/dependent variables, as well as a discussion of the statistical methods for testing relevant hypotheses. Chapters 5 will discuss the issues related to calculating income inequality within the population of interest, including the appropriate level to measure this variable, equivalence scaling, and level of analysis (individual, family), and this will be followed by a description of the degree of income inequality within each of the Aboriginal communities of the sample. Next, the findings of the statistical analysis to assess the hypotheses will be addressed in Chapter 6. In

the final chapter, a summary of the results and key issues are discussed, including research contributions, limitations, policy implications, and avenues for future research.

Chapter 2: Literature Review

2.1.0 Introduction

What are the key determinants of health in Canada? The definition of health created by the World Health Organization (2001) states that "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." Interestingly, the World Health Organization's approach to health is closely aligned with the holistic one advocated by Aboriginal people (e.g., Royal Commission on Aboriginal People 1996). This increasingly popular approach asserts that the dominant Western biomedical model, with its narrow focus on the health care system as a determinant of health, fails to capture the complex nature of the health of Canadians; that is, it ignores the other key factors that influence the health status of individuals and populations, including the social determinants of health. This chapter begins with a critical overview of the determinants of health in Canada, with an emphasis on how the social determinants provide the context in which to understand Aboriginal health. Next, the literature on one salient socioeconomic determinant of health—namely income inequality—will be given more in-depth attention, and finally I will concentrate in the last part of the chapter on the issue of income inequality in the Aboriginal context and the implications for an Aboriginal health research agenda.

2.2.0 Determinants of Health – Biomedical Domination

The theoretical frameworks for understanding health are worth noting in contextualizing the discussion.[6] The health care system continues to be the primary focus for improving the health of Canadians. Debates on health tend to focus on the various parts of the *Health Care Act*, such as accessibility and public administration. This is indicative of the importance Canadian society places on the health care system and is reflected in the biomedical approach to health studies. In fact, the biomedical model continues to be the main focus for improving population health. This model can be summarized as viewing illness and disease as an individual condition of the human "machine," with a focus on pathology, physiology, and biochemistry, which is independent of our socioeconomic and cultural milieu (Chernomas 1999; Frankel, Speechley and Wade 1996; Mishler et al. 1981). It is a value free endeavor, representing a positivist science that seeks the laws of medicine and the isolation of germs and genes. Health is determined by forces and processes that are biological—nothing more, nothing less. Whatever nature is unable to explain is seen to be a product of lifestyle and personality characteristics. The dominance of this perspective is perhaps best exemplified in Canada by the allocation of vast societal resources towards the health care system; for example, health care spending has been growing since 1975, and the percentage of Gross Domestic Product assigned for health care spending has risen from 7.0% in 1975 to 10.1% in 2003, where hospitals, drugs, and health professionals account for the bulk of costs while public health (e.g., food and

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[6] For a detailed historical perspective on the determinants of health see Frank and Mustard (1994).

drug safety, health inspections, health promotion, community mental health programs, public health nursing, measures to prevent the spread of communicable disease, and occupational health to promote and enhance health and safety of workers) accounts for 5.6% of total health care spending (Canadian Institute for Health Information 2005).[7]

Despite its dominance, the biomedical perspective has come under much scrutiny by those who underscore the greater importance of the social determinants of health (see erudite compilations and works by Coburn, D'Arcy and Torrance 1998; Evans, Barer, and Marmor 1994; Frank and Mustard 1994; Marmot and Wilkinson 1999, 2001, 2006; Mirowsky and Ross 2003; Raphael 2004). De facto, an enormous body of evidence problematizes the utility of the biomedical model. For example, historical evidence reveals that increases in modern day life expectancy preceded the development of effective medical and surgical treatments for the declining causes of death (Evans 1994; McKinlay and McKinlay 1977); medical resources including doctors and hospitals per capita explain little of the variance in infant mortality controlling for socioeconomic resources (Kim and Moody 1992); inequalities in health have been stable or increasing despite the creation of universal access to medical care across many countries (Evans 1994; Hertzman, Frank and Evans 1994; Marmot, Kogevinas, and Elston 1987; Townsend, Davidson, and Whitehead 1992); and the amount spent on health care is weakly correlated with population health (Frankel,

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[7] Hospitals, drugs, and health professionals occupy the categories "secondary prevention" (screening and early detection) and "tertiary prevention" (treatment and restoring function) in the health literature while public health initiatives are focused on "primary prevention" (risk factors, exposures, and education).

Speechley and Wade 1996). This last point is illustrated most clearly in the United States, the richest country in the world, which spends the most of any nation on health care, yet the life expectancy is shorter than most developed nations, including some that are only half as affluent.[8]

The centrality of the social determinants of health is perhaps best exemplified by the epidemiological transition. In short, this transition describes the differences in the causes of death over time as a function of the degree of economic development. Rises in living standards (e.g., wages, consumption, working hours, and sanitation) resulted in a decline of the common causes of death in the 19th century, that is, infectious diseases (Chernomas 1999).[9] These have been replaced by degenerative diseases such as cancer and cardiovascular disease.[10]

Distinguishing the health effects of various social and economic processes has been an increasingly vital component of population health research. For example, Wilkinson (1994) observes an important discontinuity between wealth and health in developed

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[8] For more on issues related to the efficacy of for profit systems, equity and the case of the United States, see Armstrong et al. (2003).

[9] The transition occurred irrespective of medical science, that is, mortality from infectious disease reduced considerably before immunization and medical treatments were available (ibid.).

[10] One constant is that health has always followed a gradient; that is, health tends to best among those at the top of the socioeconomic ladder and decreases with each step down. In terms of the transition, the historical record shows that those higher up the social ladder were most likely to survive infectious diseases, and during the transition diseases of affluence (e.g., heart disease, stroke, lung cancer) eventually became diseases of the poor (ibid).

countries.[11] He has found that health in developed societies tends to be non-responsive to increases in absolute material living standards; thus the curve of increasing life expectancy and GNP per capita levels off when we examine developed countries (Wilkinson 1994; 2005). In fact, in some developed regions, relative poverty and social exclusion have become more widespread social indicators than absolute poverty. This has been the impetus for examining other socioeconomic determinants of health, such as social capital and income inequality.

Overall, the evidence suggests that the most influential determinants of health rest outside of the scope of the biomedical model and health care system; instead, they are rooted in the social world. This would suggest that a much greater emphasis should be placed upon untangling the social determinants of health.

2.2.1 Health Promotion: Expanding the Notion of Health Determinants

The focus on health determinants outside of the health care system in Canada can be traced to the rise of health promotion and the implications of this paradigm (Labonte 1994). This approach to health was launched in the Lalonde Report in 1974; it cited the importance of individual behaviors and health education programs in improving the health of Canadians, and it revealed some of the problems with traditional medical

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[11] This is not surprising when one examines the evidence; for example, citing evidence from the Social Security of Britain, Wilkinson (1994) explains that in 1992, the absolute living standards among the poorest 20 percent of the British population were quite high, as 72 percent had central heating, almost all had televisions and refrigerators, 72 percent had telephones, and almost 60 percent had videocassette recorders.

interventions. Next, the Shifting Medical Paradigm Conference in 1980 gave rise to the critique of lifestyles of Canadians and laid the foundation for two perspectives: self responsibility and structural critiques. The Beyond Health Care Conference in 1984 promoted issues such as healthy public policy, healthy cities, and the entry of politicized health promotion into the mainstream of practice. Finally, The Ottawa Charter for Health Promotion in 1986 addressed issues brought forth by social movements, including creating supportive environments (i.e., health professionals removing the structural barriers that prevent individuals from making healthy choices); developing personal skills (i.e., professionals educate and empower unhealthy groups); reorienting health services (i.e., shifting the allocation of funds from costly medical procedures that benefit the individual to broader social welfare programs that have an effect on population health); building healthy public policy (i.e., using health public policy to alter all social policy); and strengthening community action (i.e., defining the problems of a community as a group and acting to bring about social change).

Although the health promotion movement has successfully shifted society's focus to some of the social determinants of health, there have been numerous problems with the paradigm. Becker (1993) suggests that the health promotion/disease prevention movement has created numerous undesirable developments:

- The allocation of finite societal resources to a relentless search for "risk factors;"

- Premature advice to the public regarding the uptake of numerous health-related behaviors, with great lack of success, frequent reversals of advice, and unfulfilled promises concerning what such behaviors would achieve for the adopters;
- A public more confused and skeptical with regard to public health advice;
- A scientific community that rushes tentative findings into print coupled with a media that facilitates this process and exacerbates the problem;
- A self-reflective approach to health that fosters victim-blaming and stigmatization while ignoring the key social, economic, and environmental issues that have major impacts on health;
- Amplifying our preoccupation with the well-being of the individual instead of promoting the welfare of the greater society.

He suggests that the health promotion movement can make many contributions to society if it can acknowledge and confront the macro context of, and influences on, health and well-being. Keeping in mind the dominant ideology, of Western nations, that values individualism, it is no surprise that individual behaviors continue to be at the forefront of much research as opposed to structural influences.

2.2.2 Moving Towards a Comprehensive Model of Health Determinants

The increased scope of the health research and policy arena, as brought about in significant part by the health promotion movement, has served to balance the

monopolistic biomedical approach and highlight its inadequacies. The complexities of the determinants of health have been further articulated in recent years.

Comprehensive models of the determinants of health have been put forth that address a broad spectrum of health determinants (Evans and Stoddart 1990, 1994; Hancock, Labonte and Edwards 1999; Hertzman, Frank, and Evans 1994). Coming from health economics and social epidemiology, a strong criticism of "provider dominance" as discussed by Evans and Stoddart (1990, 1994) offers a complex model of health with interaction effects between genes, the social and physical milieu, the health care system, prosperity, and individual behavior/biology. Other models capturing the key determinants of health have been articulated by Hertzman, Frank and Evans (1994), whose discussion revolves around the multiple "patterned heterogeneities" in health status, and Hancock, Labonte and Edwards (1999), who focus on six determinants of health. While these models are different in some respects, they share a common thread: broadening our understanding of the determinants of health. Nevertheless, their weaknesses have been debated in the literature (Hayes 1994; Coburn et al. 2003; Raphael and Bryant 2000).[12] For example, the model by Evans and Stoddart (1994) has been criticized for privileging economic prosperity at the cost of social relations and the distribution of resources.

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[12] See Ridde (2004) for a critical cross-national comparison of health models.

As Frank and Mustard (1994) discuss, theories about determinants of health are far reaching: how illness/health is defined, what policies are initiated, and the allocation of resources. This is clearly seen in a report released in September 1999 by the Ministers of Health from Canada's federal, provincial, and territorial governments, where the commitment to a broader approach to determinants of health was solidified and policy objectives/resource allocation followed suit (Canadian Public Health Association 1999). The report emphasized those determinants of health which are responsible for poor health among particular groups in society. In particular, race/ethnicity, sex, age, and socioeconomic status were deemed to be important determinants of health status. The policy recommendations were numerous and included the following:

- Investing in early childhood (e.g., urge the government and local communities to support healthy pregnancy, preschool learning, good parenting, and quality child care);
- Improving the health of Canada's Aboriginal people (e.g., increasing support to the Aboriginal population in their quests for improving their health);
- Improving the health of Canada's young people (e.g., urge businesses and government to provide jobs and job training to young people, and urge schools and communities to provide smoke-free, safe and healthy places where teens can meet and be active);
- Renewing our health services (e.g., improve access to dental care, homecare, prescription drugs, and mental health services for those who do not have

insurance, and work with other sectors that have a big impact on health, such as housing, social services, and education);

- Helping all Canadians obtain a solid education, literacy skills and a good income (e.g., protect our health, social, unemployment and tax policies, increase the number of jobs and improve wages, and prevent homelessness and hunger) (ibid.).

Recently, the Public Health Agency of Canada (2005) has outlined its population health approach that "acts as a unifying force for the entire spectrum of health system interventions—from prevention and promotion to health protection, diagnosis, treatment and care—and integrates and balances action between them." It acknowledges the plurality of health determinants, including income and social status, social support networks, education, 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. This approach goes beyond trying to improve the health of subpopulations, as it includes building a sustainable and integrated health system, increasing national growth and productivity, and strengthening social cohesion and citizen engagement (ibid.). Theoretically, the linkage among these health determinants is far from clear, and one practical problem with this approach is that health encompasses everything, leaving us with an overwhelming sea of possibilities. Nevertheless, we have seen that the manner in which health is defined in Canada has

expanded significantly with researchers and government pushing a more comprehensive approach to health determinants. The theoretical, policy, and program implications have been dramatic although biomedical approaches still maintain their dominance.[13]

2.2.3 The Primacy of Social Structure

Research on the health status of populations has evolved from the traditional biomedical model, with its narrow focus on the biological processes of the individual. There are now approaches that call on us to address the social determinants of health. However, the epidemiological model, one of the primary modes of investigation in health research, is guilty of restricting scope of practice of the more progressive approaches. The classical epidemiological model focuses on the patterns and etiology of specific diseases. The objective is to identify causes and risks for specific diseases, typically with a person, place, and time model. Ideally, interventions are derived from this process of identifying and targeting risky behaviors (Roht et al. 1982). Hertzman, Frank, and Evans (1994) argue, however, such studies and interventions do not undermine the fundamental inequalities in health status across time. Researchers must, instead, shift their foci to address issues that are commonly missed in examining the social determinants of health (ibid.). In particular, the authors suggest that research must focus on the sources of "heterogeneity" in health status which include the following: reverse causality; differential susceptibility; individual lifestyle; physical

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[13] See Conrad (1992) for a related discussion on the issue of medicalization, power, and social control.

environment; social environment (and psychological response); and differential access and response to health care services. Moreover, an approach that addresses the fundamental differences in health status, which is independent of the predominant diseases of the time, would be most useful. This type of investigation deviates from the existing epidemiological research into illness causation because it does not seek to reveal the risk factors for only one disease; it proposes to study the determinants of overall health across space and time.

In response to the criticisms leveled against traditional epidemiology, with its focus on individual risk factors, Kawachi (2002) underscores a structural social epidemiological approach. Breaking from traditional inquiry, this mode of investigation seeks the determinants of healthy societies, focusing on the social milieu in which individual risk factors are observed. For some disciplines, such as sociology, the importance of social structure is a hallmark of inquiry. Far from being new, the effect of the social environment on health has long been recognized (see Durkheim 1979). Durkheim's work on suicide provides a classic sociological, social structural, investigation that has influenced the development of this paradigm and could help clarify more recent structural approaches to health.

In his work *Suicide: A Study in Sociology*, Durkheim attempts to illustrate the power of structure on individual action through an examination of suicide; indeed, suicide, a private act is seen to have distinct social causes. He poses the question, how is it that

individuals come and go, yet suicide rates tend to exhibit a high degree of stability over time among various groups and regions. Durkheim stresses that he is not interested in suicides particular to the individual (e.g., motives and ideas); instead he examines the social environments (e.g., family and political society) in which varying rates of suicide occur. This understanding, he argues, enables us to understand how ultimate social causes are individualized and manifest themselves via suicide. Having discounted the causes of suicide as a result of the psychic characteristics of individuals and the type of physical environment, Durkheim concludes that social causes—social structure, norms, and institutions—must explain suicide rates. His thesis is that the levels of integration and regulation in society determine suicide rates, and he provides a basis for categorizing suicide into different types, which reflect the underlying social causes: egoistic, altruistic, and anomic.

Egoistic suicide is a product of a lack of social integration, that is, as the various institutions of society, including the religious, domestic, and political, lose their integrating force. The consequences are that the individual becomes too independent from the group, and so the unifying force, society, becomes secondary to the interests of the individual. He examines religion and finds that Protestants exhibit higher suicide rates than Catholics. Protestantism is characterized as relatively more liberal than Catholicism because it promotes individual free inquiry rather than a collective set of beliefs and practices. This leads Durkheim to assert that Catholicism is more integrated than Protestantism, which explains the lower suicide rates.

Altruistic suicide, in contrast, occurs because of excessive integration, which results in the individual losing his/her individualism. Thus, altruistic suicide is characteristic, although not exclusively, of lower societies which results from the individual's unhappiness in the world. He/she strives for those goals outside of the immediate world. Melancholy results and is accompanied by notions of faith and hope as well as actions of exceptional magnitude. Altruistic suicides can be associated with the ideas of honor and prestige as witnessed, for example, in the army.

Lastly, Durkheim identifies the third type of suicide–anomic. Anomic suicide is especially chronic in the economic world and results from a lack of social regulation. Durkheim explains that poverty and prosperity both have the same result; that is, they are crises which disturb the collective order. The institutions of the past become unable to provide the necessary needs of individuals. Durkheim states that individuals can only live if the gap between needs and means are close. The regulating force which sets limits upon his/her needs is society; however, when the limiting process is not successful the result is pain, unhappiness, and a decreased desire to live. Unlike animals whose physical nature and material environment sets the limits on needs and means, humans have the special capacity to reflect and, therefore, continuously increase desires. There are no limits to such thought, and so the attainment of goals becomes impossible which leaves the individual unhappy. Thus, there must be limits set outside of the individual which constrain needs, desires, and goals–society.

Thus, the study of suicide provides an example of the explanatory power of society in accounting for individual social phenomena. Durkheim illustrates that suicide is not an issue exclusively explicable by psychologists and individualists; instead it is directly related to the *degree of integration and regulation* in society. This idea of suicide as dependent upon the structure and conditions of a society is a significant contribution to our understanding of population health outcomes. His influence can be seen in the work of others, including Geoffrey Rose.

In what is perhaps one of the most cogent arguments for a structural focus on health outcomes, Rose (1992) begins with the approach of the biomedical model that targets "high risk" groups. He argues that these efforts are futile. Why? Even if interventions are successful, which they typically are not, there will always be a new set of individuals to replace those who exit the "high risk" group since the conditions which produce "high risk" are not changed. Thus, he concludes that the key determinants of health of a society are a product of the mass characteristics of the whole; in other words prevention requires a shift of the whole population not some sub group. This idea is worth considering further.

Since behaviour is socially determined, societal level norm effects are naturally of great significance. Rose (ibid.), for example, found that the variation around any society's norms as conveyed with a normal curve is constant, and so the process of differentiation reflects the point at which the societal norms rest; in other words,

differentiation comes within the range of variability characterized by the bell curve. For example, according to Rose (ibid.) the proportion of people at risk of high blood pressure is a function of the average blood pressure in a population; the proportion of heavy drinkers reflects the average alcohol consumption per head of the population while the proportion of people who suffer from obesity is related to the average ratio of weight to height. The implications are vast as this suggests that policies and programs must become more comprehensive and change the entire distribution of various social outcomes to reduce "at risk" rates in the population. Social norms set strict limits on diversity; indeed, our lifestyles tend to be governed by the range of what is acceptable within our milieu. In a society where most people do not exercise enough, this behaviour becomes the norm and those health conscious individuals who deviate from this norm are classified as "exercise freaks." Similarly, moderate eating and alcohol consumption are seen as the norm in many societies, with the assumption being that most people cannot be wrong. However, this general agreement should not be confused with healthy! For example, in a rural Nigerian community the custom had been to rub cow dung into the umbilical stump of newborns. The result was a high mortality rate as one third of infants died from tetanus. Hence, Rose (ibid.) suggests that we must change the majority to redefine what is considered normal in society.

Strong evidence for a structural approach can be seen in the United States's Multiple Risk Factor Intervention Trial (1982), a large-scale experiment with 12 866 men to reduce coronary heart disease death rates through a special intervention program

aimed at altering high risk behaviours. The results concur with the approach by Durkheim (1979) and Rose (1992): After an average follow up of seven years, despite some positive changes, the results were largely disappointing as many of the subjects in the special intervention group did not change their behaviours, and mortality from coronary heart disease was not significantly different than the control group. Why? Many lifestyle habits are influenced by the norms of a particular society and the behavior of one's peers. As Rose (ibid.) states, a high risk preventive strategy fails to change the situations which determine exposure or attack the underlying causes of a particular health problem; instead it offers protection from a dangerous situation to those individuals who are most vulnerable, usually with little success.

This structural approach has been echoed by others such as Link and Phelan (1995) and Becker (1993). They argue that the ideological foundation of Western society is premised upon the individual, which leads to a focus on health as an individually determined phenomenon whose fate is a function of individual behavior. Link and Phelan (1995) pose the question, "what puts people at risk of risks?" and they distinguish between proximate causes of disease, such as diet, cholesterol, hypertension, and lack of exercise, and distal or fundamental causes of disease, including social conditions. The main difference is that the latter focuses on the context in which lifestyle decisions and health processes take place. Thus, focusing on intervening mechanisms or finding band aid solutions will fail to break the link between a fundamental cause and its negative outcomes. In other words, to understand

health outcomes, one must contextualize risk factors and strive to change impediments to healthier behavior. Gaining support for collective action to combat the underlying causes of a problem is very difficult since the perception of need of the public tends to be in personal terms (Rose 1992).

This survey of the research indicates that the possibilities for ecological effects are numerous, with the only limitations being the imagination of the researcher and of course the pervasive problem—good data.[14] A central reason for focusing on ecological effects is the widespread exposure of the population to the "social contaminant;" thus, even a low effect size can have dramatic effects given the large segment of the population exposed (Lynch et al. 2004). Over the last decade, two related contextual effects have received a great deal of attention in the population health literature, income inequality (Wilkinson 1994; 2005) and social capital (Kawachi 1997). In both of these cases, the argument is that the organization and quality of the social fabric have an unmistakably prominent role in determining population health. One of the proposed links between these two determinants has received empirical support: inequality, a producer of hierarchies disrupts the degree of social capital (e.g., generalized trust and the degree of cohesion) in society which has a strong effect on health outcomes (Kawachi 1997). We will return to the income inequality-health link in greater detail in Section 2.4.0. This line of thinking has been

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[14] The use of the term "ecological variables" can refer to somewhat different variables. See Blakely and Woodward (2000) for a strict discussion and classification of ecological variables which encompasses the use of the term across several disciplines.

most useful in developed countries, forcing us to rethink the way we organize the socioeconomic landscape from a moral and practical standpoint.

The aforementioned work in this area has one common theme: social structure exhibits a very powerful force over its constituents and such an approach enables us to account for the durable patterns in rates we observe across various population health outcomes. As mentioned above, income inequality and health will receive more strict attention in Section 2.4.0, but first I will provide an overview of Canadian Aboriginal health research having outlined the prevailing work in the greater context.

2.3.0 Aboriginal Health: A Broad Overview

To date there have been shortcomings in the literature with respect to the amount and scope of research concerning Aboriginal health. Aboriginal health research is underdeveloped and the research done is often particularistic and narrowly focused. Most of the early research conducted on the health of Aboriginal people is biomedical, composed of clinical observations and laboratory investigations (Waldram, Herring and Young 1995). With the World Health Organization's definition of health encompassing a much broader definition of health than simply the absence of disease, and the rise of the social determinants of health approach, the shift towards a more holistic view of health has been advocated. The Royal Commission on Aboriginal People (1996) underscored this holistic approach to health as congruent with the Aboriginal understanding of the concept. Since the Royal Commission on Aboriginal

People, research on Aboriginal health has accelerated, and there have been several new initiatives which have facilitated multidisciplinary research for studying the health of Aboriginals. One prominent initiative established by The Canadian Institutes of Health Research in Canada in 2000, called the Institute of Aboriginal People's Health, promotes research on Aboriginal health from a variety of approaches (social, environmental, genetics, ethical).[15] Given the short period in which this initiative has existed, one cannot expect a large body of research findings and many new research foci to surface immediately.

What is our current knowledge of Aboriginal health in Canada? Young (2003), in his review of the research in Canada, found that the attention to human biology (particularly), genetics and environmental contaminants has received much more attention than other determinants, especially social ones. This comes as no surprise given the history of health research: the biomedical orientation has been dominant although increasingly the social determinants perspective and comprehensive population health models have made a mark with time. Given the relative infancy of Aboriginal health research, it seems as though this area is following a similar path to the course of non Aboriginal research. My review of the research concurs with Young (2003), but I would add that there exists a disproportionate amount of small-scale non generalizable work, as well as quantitative literature that documents gaps and trends,

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[15] See the Canadian Institutes of Health Research webpage http://www.cihr-irsc.gc.ca/e/8668.html and Reading and Nowgesic (2002) for more details on this initiative.

and epidemiological evidence on the prevalence of high risk lifestyle behavioral patterns (e.g., Band et al. 1992; Beavon and Cook 2003; Bramley et al. 2004; Lavallee, Clarkson, and Paradis 1994; Norris and Siggner 2003; Waldram, Herring and Young 1995; Young 1994), but very little generalizable *causal* investigations have been carried out. This is no doubt a product of a lack of theorizing coupled with the scarcity and limitations of data to test hypotheses.

Another pattern emerges in the Aboriginal health literature: the diversity of Aboriginal people tends to be missed in discussions across a variety of audiences and arenas. This simplification of the Aboriginal condition is sometimes based on pragmatic grounds, but the danger of this process is far from benign. It is imperative to highlight the diversity of histories, cultures, and socio-economic circumstances of the Aboriginal population to adequately address the various needs of these people. Young (2003) states in his review of Aboriginal research that intra group differences are often overlooked, homogenizing the geographic, cultural, socioeconomic, and health status of Aboriginal people. Furthermore, the assumption is that the non Aboriginal group is the ideal or "normal" group for comparisons. While these Aboriginal/non Aboriginal comparisons demonstrate the lack of social justice for the former and can evoke shock given the striking disparities, as the frame of reference changes, our understandings shift. Waldram, Herring, and Young (1995:258-9) voice similar concerns in their work:

> Beyond the obvious and well-known need to understand the

> historico-cultural context of health, it is vital to appreciate that the concept of 'Aboriginal health' is itself a convenient but ultimately false representation of the problem at hand. It masks the rich diversity of social, economic, and political circumstances that give rise to variation in health problems and healing strategies in Aboriginal communities. If nothing else, this [work] should make it clear that health and health care patterns show extensive variation across the country, despite the tendency for national, regional, and provincial databases to create the impression of widespread trends and homogeneity of experience.

2.3.1 Aboriginal Health: What Has Been Examined?

The nature of life pre-contact and post-contact with Europeans has been a popular basis for understanding the effects of interaction on Aboriginal health and disease (Fortuine 1989; Jackes 1983, 1986, 1988; Larsen 1994; Larsen and Milner 1994; Saunders, Ramsden and Herring 1992). Much of the work supports the importance of the social determinants of health by illustrating the relationship among the social, economic, and political changes accompanying European contact and the conditions under which health and disease existed (Waldram, Herring and Young 1995).

Numerous aspects of the health care system have been examined in the context of Aboriginal people, such as the relations between providers and Aboriginal people (O'Neil 1986, 1990; Sherley–Spiers 1989), the utilization and availability of services (Fritz and D'Arcy 1982; Newbold 1997; Waldram, Herring and Young 1995), the role of Aboriginal medicine (Aboriginal Nurses Association of Canada 1993; Gagnon 1989; Jilek and Jilek-Aall 1991; O'Neil 1988; Young and Smith 1992), and perhaps most importantly, the issue of self-determination has received significant attention

(Bearskin and Dumont 1991; Culhane Speck 1989; Health Canada 1999; Lemchuk-Favel and Jock 2004; O'Neil 1988; Royal Commission on Aboriginal People 1996; Romanow 2002; Weaver 1972; Young and Smith 1992), with the pivotal question of whether Aboriginal control results in better health remaining unanswered. Although these issues are important, as outlined earlier, the effect of the health care system on population health tends to be overemphasized per the biomedical approach.

Nevertheless, this review gives the reader a flavor for the issues being studied, and perhaps the key point of this work is not health care per se, but issues surrounding health care being one of many manifestations of a pattern of social exclusion and inequality. Furthermore, the debates surrounding self-determination encompass more than health care, as they indict social, economic, political, and legal structures, and impact on issues relating to the essence of the relations between Aboriginals and the Canadian government since European contact.

The Royal Commission on Aboriginal People (1996) accentuated Aboriginal culture in framing social problems, defining them, and finding solutions for them. Over the past three decades, the relationship between culture and health has been given a fair deal of attention (Hagey 1989; Waldram 1993, 1997). While the research is very interesting, the generalizability of much of this work is in doubt given the qualitative methods used to examine this relationship. A rare attempt to fill this gap was undertaken by Wilson and Rosenberg (2002), who used one of the richest sources of

data, the 1991 Aboriginal Peoples Survey, to examine the extent to which culture[16] enhances health among Registered North American Indians. For the most part, they found no relationship between culture and health, but the authors correctly argued that this relationship was far from being established definitively. The pitfalls of quantitative survey research were addressed in their disclaimer of the results: the categorization of Aboriginal identity made it impossible to examine the relationship for different First Nations groups; the researcher was unable to distinguish the geographical region in which culture is experienced; indicators of cultural attachment were too narrow to adequately assess the existence of a relationship; and the conflation of traditional activities into one variable prevent one from fully teasing out the meaning of the effects. Future work on this issue is needed, but the release of the 2001 Aboriginal Peoples Survey as well as the First Nations and Inuit Regional Health Survey should enable researchers to shed more light on this potential health determinant.

The imposition of the narrow Western definition of health on Aboriginal people has been a pivotal issue. The concept of health was addressed in great depth in the Royal Commission on Aboriginal People (1996). The broad scope of the concept is exemplified in this excerpt:

> Aboriginal people from almost every culture believe that health is a matter of balance and harmony within the self and with others, sustained and ordered by spiritual law and the bounty of Mother

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[16] Culture includes participation in traditional activities, having spent time on the land, and the process of acquiring food through hunting, trapping or fishing.

> Earth. They have long understood that the well-being of people depends on the well-being of the air, water, land and other life forms. This belief has been confirmed by the findings of countless scientific studies of poor health in a compromised environment. Although the details of cause and effect have not been fully established, the general scientific conclusion is clear: human health depends largely on the condition of the natural environment and of the built environment. - Royal Commission of Aboriginal People (1996:184)

The National Aboriginal Health Organization (2001:3) endorses a similar idea of health in its vision to improve the "physical, social, mental, emotional, and spiritual health of Aboriginal peoples." Clearly, the Aboriginal notion of health and its determinants does not coincide with the biomedical approach but is closely aligned with the World Health Organization's definition of health as well as the social determinants approach to health. The implications of this definition of health are significant, as Elias et al. (2000) argue this First Nations holistic approach to promoting health can be seen as an act of self-governance.

2.3.2 Aboriginal Health Trends

The basic trends in health of the Aboriginal population relative to the greater Canadian society has received some attention (e.g., Kinnon 2002; Ng 1996; Norris and Siggner 2003; Royal Commission on Aboriginal People 1996; Waldram, Herring and Young 1995; Young 1994). I will not go into great depth (see aforementioned references), but provide a picture of the recent health trends for Aboriginal people in Canada. In short, although some measurable gaps have closed over time, Aboriginals experience poorer

health than the greater Canadian population. In terms of self-rated health[17], the Aboriginal population is less likely to report excellent or very good health than the total Canadian population at all ages (Norris and Siggner 2003). Objective measures of health concur with the self-rated health trends, with Aboriginals experiencing lower life expectancy, and higher rates of morbidity, chronic disease, suicide, injury, and mortality than the total Canadian population (ibid). For example, in 2000 the gap in life expectancy for Registered Indian males (68.9) and the total male Canadian population (76.6) was 7.7 years while the gap for Registered Indian females (76.3) versus the total female population (81.8) was 5.5 years.[18] Also, in 2000, the rates of chronic conditions, including arthritis or rheumatism, high blood pressure, asthma, and diabetes were, for the most part, higher among the Aboriginal population than the total Canadian population. Especially noteworthy is the gap between the Aboriginal population and the total Canadian population in terms of diabetes, with the rate double for the non-reserve Aboriginal population and 3.6 times greater for the reserve population (ibid.).

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[17] Much research has substantiated the utility of using self-rated health as a reliable and valid indicator of the concept health in terms of health problems, morbidity, mental health, health care usage, longevity, mortality, and the onset of disability for various cultural groups and a cross section of ages (Cockerham, Kunz, and Lueschen 1988; DeGeorge, Sobal, and Krick 1989; Garretsen, van Gilst, and van Oers 1991; Hagan et al. 1994; Idler and Benyamini 1997; Health Canada 1999; Kennedy et al. 1998; Mosteller 1987; Patrick and Bergner 1990; Wannamethee and Shaper 1991; Ware et al. 1981). Mossey and Shapiro (1982) and Maddox and Douglas (1973) have found that subjective assessments of health are an even better predictor of mortality than health as assessed by physicians. Furthermore, George and Clipp (1991) found that it is the main determinant of the quality of life for the majority of people.

[18] It is worth noting that the life expectancy among Registered Indians has increased dramatically over time, from 59.2 years in 1975 to 68.9 years by 2000 for males and from 65.9 years to 76.3 years over the same time period for females. Also, the gap in life expectancy between the total Canadian population and Registered Indians has decreased from 11.1 years to 7.7 years for males and 11.7 years to 5.5 years for females. These gaps are, however, still very important.

Thus, it appears that Aboriginal people have a lower health status in Canadian society, when measured subjectively or objectively, relative to the national level. The health outcomes for Aboriginals are not, however, homogeneous: the national population appears to be the healthiest at all ages followed by the off-reserve population and on-reserve population (ibid.). To gain a further appreciation for the diversity of health outcomes among Aboriginal people, Chandler and Lalonde (1998, 2004) documented the vastly different rates of suicide in British Columbia across communities; for example, some communities have suicide rates 800 times the national average while more than half of the province's First Nations bands have not experienced a single youth suicide in about fifteen years.

2.3.3 Aboriginal Health: Social Structure

Recent approaches to improving the health of Aboriginals have been critical of the biomedical approach, as well as the focus on individual risk factors, and emphasized the importance of the social determinants of health (Raphael 2004; Royal Commission on Aboriginal People 1996). Despite the concerted efforts to address the conceptual shortcomings of traditional positions, there remains a decisive deficiency in the Aboriginal health literature apropos of the structural approaches to population health.[19]

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[19] Researchers have not totally ignored this issue; in fact, some cite the community and context as an important consideration for their effects on health, such as Garro's (1995) and Willows's (2005) research on diabetes among Aboriginal people. Discussion of the social context of Aboriginal health outcomes may also be seen within the works related to self-determination (Kinnon 2002; Royal Commission on Aboriginal People 1996), with the focus on Aboriginal control over institutions and the supposed benefits therein. However, overall, one is hard pressed to find research that begins with the social context as the focus of theory/analysis and an empirical examination of the effects of this context on Aboriginal health.

The focus on individual-level determinants of health in the Aboriginal context is congruent with the historical approach to non Aboriginal health. Specifically, the prevailing ideology of Western society centers on the individual, yielding the dominant biomedical model with its focus on curing the individual and health promotion initiatives that centre efforts on changing individual lifestyles (Becker 1993; Link and Phelan 1995). Within the health literature, it has only recently become popular to discuss the social contextual effects of health as a unique determinant of health beyond the individual-level. Moreover, multilevel modeling has become computationally viable in more recent times, which allows the effects of health variables (determinants) at various levels to be distinguished from one another simultaneously (Goldstein 1995; Raudenbush and Bryk 2002).

In the case of Aboriginal health, the foundational causes and underlying determinants of health and disease in individual communities are largely unknown areas of research. Waldram, Herring, and Young (1995) underscore the need to use multiple lenses to understand Aboriginal health. These lenses allow us to look at the physiological, psychological, historical, sociological, cultural, economic, and environmental dimensions of human life. Applying a diversity of perspectives which take into account the contextual and individual determinants of health demands a multilevel approach. A similar argument was put forth by the Royal Commission on Aboriginal People (1996), which was critical of the dominant focus on the individual and suggested that an understanding of community norms and broad social conditions is

necessary for change to occur; de facto crime, alcoholism, sexual abuse, suicide are merely symptoms of a structural design.

Despite the paucity of research and focus on the social environment, there are a few exceptions worth noting. For Chandler and Lalonde (1998, 2004), communities that preserve and promote a sense of cultural continuity in their members tend to have lower rates of suicide; indeed, those features of the social environment that communities can exercise some level of control over serve to insulate members from increased risk of suicide. Others have argued for bringing back a Durkheimian approach to examine disease and suicide in First Nation-reserves, such as Carstens (2000). Mignone (2003) articulated a conceptual framework and derived a culturally relevant measure of social capital for First Nations. This work is based on the premise that social capital has been linked to health outcomes in the literature (Kawachi et al. 1997; Subramanian, Kawachi, and Kennedy 2001; Wilkinson 2005). O'Neil et al. (1999 as cited in Mignone 2003)[20] laid the foundation for this work in their research grant "Why are some First Nations communities healthy and others not?: Constituting evidence in First Nations health policy." They argued that any population health models for Aboriginal health must stress the importance of ecological level variables, such as social capital. Following up on earlier work, Mignone and O'Neil (2005) punctuate understanding the contextual nature of health in Aboriginal communities, through careful theorizing and refinement of culturally appropriate tools, with their

[20] I was unable to secure the research grant proposal which articulated the framework for Mignone's (2003) later work on social capital.

emphasis on social capital. Empirical tests of the relationship with health outcomes have not, however, been completed.

Researchers from the First Nations Cohesion Project at the University of Western Ontario have been promoting the development of comprehensive models for understanding population outcomes. White and Maxim (2003) propose that social fissures within and between First Nations communities and non Aboriginal communities, and reduced cohesiveness resulting from differential distributions of various forms of capital, affect outcomes for Canada's First Nations population. Empirically this model has yet to be tested with the primary limitation being the paucity of rich data. Tests of models focusing on income inequality, on the other hand, are amendable to analysis in the Aboriginal context as I shall demonstrate later. Finally, work by White, Maxim, and Spence (2004) begins with the question, what is the underlying context in which Aboriginals relate with one another, the natural environment, and the greater society? They argue that the "tie that binds" the milieu is the legal framework of society. Humans are social beings; hence, the rules we create structure our social relations and participation in the various institutions of society. The legal framework is, truly, one of the foundations of our civilization. For example, the right to own private property, the right to free speech, the right to vote, and the right to medical care mold our social institutions, political structure, and economic system. These rights reflect the principles of our society, enshrine our fundamental values, and influence our social processes. Thus, laws, treaties and agreements set the

structural frame in which other processes occur, including economic/social development as well as health and well-being. From our legal framework come policies and programs that affect the day-to-day lives of Aboriginal Canadians.

Overall, we can see that a few research works have extended in a structuralist direction, centering on the community/ecological contexts. Shifting focus to the social context in which health outcomes are created is an important link in the chain of understanding the health processes of Aboriginal people. Given the concentration of this group geographically, such as reserves across Canada, we must begin to unveil and understand the diversity of these socioeconomic contexts and the outcomes that they produce. What is now required are theoretical models of Aboriginal outcomes that are multilevel in nature and empirically test effects at all levels of analysis concurrently. Contextual and individual factors must be understood together and the statistical methods to draw out these differential effects must be appropriate. This work is intended to be a step in that direction.

Thus, in summary, the volume of Aboriginal health research has been relatively small, with the biomedical model at the forefront for examining issues. Changes have, however, occurred over time. There has been no shortage of documenting trends in the health of Aboriginal people, but all too often the diversity within the population has been neglected. Recently, descriptions of Aboriginal health have correctly been contextualized with other poor socioeconomic outcomes, per the social determinants

of health literature, although empirical models of these associations have been relatively rare. Within the application of the social determinants of health perspective to Aboriginals, there has not been much focus on the social contextual-level determinants of health and true multilevel studies are non-existent. Furthermore, there has been virtually no work done on the effects of socioeconomic contextual variables, such as income inequality, which have shown great promise in the literature and are amendable to intervention.

2.4.0 Income Inequality and Health: An Overview

As mentioned earlier, the focus on context is both a legitimate and important avenue for health research. Community level variables have gained prominence in the epidemiological and social science studies of population health over the last ten years. These community influences are not merely the sum of the individual-level characteristics of members of the community; instead, they represent the milieu that exists outside of the individual but influences him/her, and can include such things as the physical structures (e.g., design of housing developments) as well as the social structures (e.g., public meeting places, mechanisms for income redistribution and opportunities for exchange and interaction) of a community (Lomas 1998). The prominence of one contextual-level variable's effects on mortality and health has been the focus of great attention internationally, that is, income inequality (e.g., Chiang 1999; Coburn 2000, 2004; Fiscella and Franks 1997; Judge 1995; Kawachi and Kennedy 1997; Kawachi, Kennedy, and Lochner 1997; Kawachi et al. 1997; Kennedy,

Kawachi, and Prothrow-Stith 1996; Kennedy et al. 1998; LeClere and Soobader 2000; Lynch 2000; Lynch et al. 2000a; Lynch et al. 2001; Lynch et al. 2004; Muntaner 2003; Ross et al. 2000; Shibuya, Hashimoto, and Yano 2002; Smith 1996; Wagstaff and Van Doorslaer 2000; Wilkinson 1992, 1994, 2005)[21].

A quick glance at some of the research published in academic journals and government publications across a wide range of areas indicates the popularity of this contextual variable. The strength of the evidence in support of its explanatory power is debatable but noteworthy; in fact, a recent review of the income inequality evidence by Wilkinson and Pickett (2006), which examined 168 analyses in 155 papers, found that approximately three quarters of analyses were either partially or wholly supportive of significant findings. Lynch et al. (2004) examined 98 aggregate and multilevel studies and arrived at somewhat less definitive conclusions along with Subramanian and Kawachi (2004) and Wagstaff and Van Doorslaer (2000). One may wonder how such discrepancies may arise. As Lynch et al. (2004) acknowledge, the categorization of a study as wholly supportive, mixed, or providing no support at all is based on judgments that are arbitrary. That point is well taken, but we shall see that there is some consensus. Subramanian and Kawachi (2004) and Wagstaff and Van Doorslaer (2000) provide a more cautious interpretation in their review of studies based on methodological grounds. Of particular note, they indict many studies

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[21] The number of articles related to the effects of income inequality on health (broadly conceptualized) is numerous. See Lynch et al. (2004), Subramanian and Kawachi (2004), and Wilkinson and Pickett (2006) for a comprehensive list of all relevant studies.

demonstrating a strong association between income inequality and health for examining ecological associations only; thus, one is unable to distinguish true contextual from individual-level effects because of statistically incorrect modeling practices—single level models (see the list of single level ecological studies listed in Wagstaff and Van Doorslaer 2000 and Wilkinson and Pickett 2006).[22] Unlike the earlier ecological studies, the multilevel work has been more likely to show mixed results. By 2002, with the tides turning against an effect of income inequality, Mackenbach (2002) concluded that the evidence of an empirical association was vanishing over time. Nevertheless, despite the mixed results and idiosyncrasies of studies making comparisons difficult, including the varied modeling techniques used as well as the populations examined, levels of analysis, and outcome variables, the effect of income inequality on health cannot be ignored, and research on the issue continues to flourish.

Despite the vastness of the literature, virtually no research has examined the effect of income inequality on various outcomes for Aboriginals. Issues related to absolute poverty have tended to be the focus of discussion. This research gap is in an important one with potentially significant policy implications. It is this avenue that I wish to pursue in this dissertation. Before pursuing this line of research in subsequent chapters, there are some preliminary matters that must first be addressed. We shall

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[22] Another tangential review by Hsieh and Pugh (1993) on the connection between poverty, income inequality, and violent crime examined thirty four aggregate studies and found a significant association over a variety of conditions.

begin by discussing the salience of using an income inequality approach and examine in great detail the income inequality hypothesis, highlighting the material issues.

2.4.1 Why Income Inequality?

The dimensions of inequality in society are multiple, including class, sex, and race. What concerns us is the ways in which these "arbitrary" bases of differentiation manifest themselves through access to finite resources as well as unequal life chances and experiences. The key dimension of inequality is subject to debate, and many times it may depend upon the research question posed. Debates surrounding this issue are vast, and beyond the scope of this thesis (see Curtis, Grabb, and Guppy 2004; Grabb 2002; Grusky 1994; Parkin 1977; Tilley 1998; Turner 1988; Wright 1997).

To understand the meaning of inequality, social scientists attempt to capture the basis of hierarchies through a variety of measures. What makes the income inequality approach so useful? Wilkinson's (2005; Wilkinson and Pickett 2006) recent work provides some insight:

> 1) It is probably the most culturally valid and universal measure in existence that best captures "dominance hierarchies," which are characterized by one's access to scarce resources. Given that income is a necessity in a market economy to purchase goods and services, the way in which it is distributed by sex, race, age, etc., has consequences for all individuals within a society.

2) This measure is appropriate for capturing the extent of inequality in society. Since a poor income distribution has been linked to negative outcomes for all people in a society, including the poor and rich, the applicability of this perspective is widespread, unlike individual measures of income.

3) Income inequality is comprehensive in that it operationalizes meaningful differences between people, which can be based on any category imaginable.

4) From a practical standpoint, income information is commonly collected in surveys, which makes it easy to calculate income inequality measures and conduct comparative research across time and geographical regions.

Hence, the income inequality measure is a theoretically meaningful variable with distinct operational advantages, and we will now provide a look at its application in explaining health outcomes.

2.4.2 What is the Income Inequality Hypothesis?

As indicated above the number of studies examining the effects of income inequality on health are numerous, and studies that detail this broad body of work can be found in the references provided. I prefer to frame the literature in a manner that outlines the key issues across studies and that are relevant for the forthcoming work. Let us begin by specifying the income inequality hypothesis. According to Wilkinson (1994),[23] there has been an important shift in the well-established relationship between health

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[23] Although Wilkinson (1992) is widely associated with the effects of income inequality, the origins of this line of inquiry can be traced back to others such as Preston (1975), Rodgers (1979), Flegg (1979), and Steckel (1983).

and wealth; it reveals the fundamental change in the determinants and quality of health in modern societies. As he explains (1994:61), "This represents a transition from the primacy of material constraints to social constraints as the limiting condition on the quality of human life." Using aggregate Luxembourg Income Study data at the country level, Wilkinson (1992; 1999a) found that after a particular level of economic prosperity has been attained in a society—GNP per capita of $5000 US—the key determinant of inequality in health is embedded within the extent of income inequality. In fact, he discovered that the correlation between the income distribution and life expectancy is large with r=.0.86 while adjusting for absolute income levels. This phenomenon explains why health inequalities have not decreased in numerous developed nations despite rises in economic prosperity.[24, 25, 26]

2.4.3 Pathways: Psychosocial, Social Capital, Neomaterial, Statistical Artifact

The pathways through which income inequality affects mortality and health are not fully understood.[27] As put forth by Wilkinson (1999a), the hypothesized psychosocial

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[24] Wilkinson (1994) claims that among developed countries between one half and three quarters of the differences in average life expectancy is a result of the income distribution.

[25] Although the focus on material living standards should not be pushed aside, it is essential to recognize the importance of income inequality as a variable that may have importance beyond its original population—developed regions. For example, Ellison's (2002) study using 120 countries found that the distribution of income has a stronger effect among poorer countries.

[26] Later ecological studies by Judge (1995), Wildman, Gravelle, and Sutton (2003) and Lynch et al. (2001), based on better income inequality data generally yielded little support for the effect of income inequality. However, as I will discuss later, the debate is far from settled.

[27] Wagstaff and Van Doorslaer (2000) and Lynch et al. (2004) outline the popular hypotheses in the income inequality literature, many of which are small variations of one another:

pathway argues that social environments with a distinct hierarchy can be characterized as being less supportive and more conflictual, because hierarchies promote shame, disrespect, power, coercion, greed, and fears of incompetence and inferiority in relation to those in power. Physiologically such feelings can manifest themselves in numerous ways, such as raised basal cortisol levels and increased vulnerability to infectious and cardiovascular diseases. Socially, it is not uncommon to observe increased rates of violence, accidents, and alcohol related deaths in such societies. In contrast, environments with a less pronounced hierarchical structure are defined by notions of friendship, mutuality, reciprocity, and respect, which results in more positive physiological outcomes (ibid.). Hence inequality promotes negative relations and negative physiological outcomes for the individual. Wilkinson (1997) suggests that the psychosocial indirect effects include increased exposure to behavioral risk factors while the direct effects manifest themselves through the physiology of the individual by way of chronic mental and emotional stress. The underlying idea is that the manner in which individuals interpret and perceive their surroundings, that is, the bridge between the social environment and individual pathology, is key.

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a) The "income inequality hypothesis" maintains that there is a direct effect of inequality even after controlling for absolute income
b) The "absolute income hypothesis" stresses controlling for absolute income at the individual-level, which leaves no effect of income inequality.
c) The "relative income hypothesis" suggests that it is not the individual's absolute income that is crucial to determining health but their relative income to some comparative group average.
d) The "relative position hypothesis" emphasizes the individual's position in the income distribution (national, community, etc.) as key to health outcomes.
e) The "deprivation hypothesis" suggests that an individual's income relative to a poverty standard is what matters for health outcomes.

The case for relative deprivation and its associated psychosocial processes is demonstrated through the socioeconomic status gradient observed in developed countries. This gradient illustrates that, regardless of the actual wealth of an individual, it is the relative position within the social hierarchy that determines one's health status. For example, Marmot et al. (1987, 1991) found in the Whitehall studies, despite the good standard of living and job security of the sample (i.e., they were all civil servants), there was still a distinct socioeconomic status gradient with health increasing up the job hierarchy. In fact controlling for well-known risk factors of heart disease, such as blood pressure, cholesterol, and smoking, accounted for only one quarter of the gradient in heart disease observed between the bottom and top of the hierarchy. This phenomenon illustrates that poverty and material deprivation as well as traditional risk factors for disease cannot, in and of themselves, explain all the differences in health status by socioeconomic status—health status is influenced by socioeconomic status at all levels of the socioeconomic gradient. In other words, the poor health of those at the bottom of the hierarchy is not primarily a result of low absolute material circumstances; psychosocial consequences of occupying a low position in the social hierarchy play an essential role.

Social Capital

The contextual variable social capital has been given much attention over the last ten years for its ability to explain a large number of social outcomes, including health and economic development (Kawachi and Berkman 2000; Kawachi et al. 1997; Putnam

1993, 2000). The common theme is that the social environment, including the quality and quantity of networks of relations between people and the resources therein, civic participation, generalized trust, solidarity, cooperation, values and norms, obligations and expectations, have a very strong effect on outcomes. The similarities between social capital and income inequality are striking: both have proposed to explain a variety of outcomes and been the subject of much debate in the literature surrounding their determinants, consequences, measurement, and level of analysis (nation, state, community, individual). Far from surprising, attempts to integrate social capital within a causal chain with income inequality have been attempted (e.g., Kawachi et al. 1997; Kennedy et al. 1998).[28] In their ecological study, Kawachi et al. (1997) found that the relationship between income inequality and health is mediated by reduced levels of social capital (i.e., volunteerism and membership in voluntary groups). Indeed, it is believed that income inequality disrupts the relations between people as hierarchies become more pronounced and differentiation more apparent. This "culture of inequality" results in the breakdown of civil society, trust, cooperation, etc., and participation in the public sphere diminishes (Wilkinson 1999b).[29] Our understandings of the income inequality–social capital–health relationship are still not concrete for

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[28] Berkman and Glass (2000) have provided a useful conceptual framework for understanding the network of causality of health outcomes as related to social relations generally. In their model, social structural factors (macro) condition the extent, shape, and nature of social networks (mezzo), providing opportunities for psychosocial mechanisms (micro) which impacts health through various health/behavioral, psychological, and physiologic pathways. Unfortunately, the availability of data to test such comprehensive theories is rare and until recently methods (multilevel) to disaggregate effects were not available.

[29] The importance of one characteristic of cohesive societies, supportive social relationships, has been known for several decades to play an important role in health outcomes (see Berkman 1995; Berkman and Glass 2000; Cohen and Syme 1985; Lynch 1979).

four main reasons: a) rarely can one find studies that examine all three variables in the same analysis as the data is hardly amendable to this endeavor; b) the potentially differential meanings and effects of these contextual variables as they pertain to sub groups of the population, such as women or First Nations, are unknown; c) multilevel statistical analysis of this relationship has not been the modeling technique of choice, which limits our confidence in existing findings; and d) social capital is debatably an individual-level variable, whose effects could vary by social context (i.e., level of inequality).[30]

Neomaterial Approach

The neomaterial interpretation describes the negative effects of income inequality on health as reflecting differential health promoting exposures and resources in the material world, which are a function of absolute deprivation at the individual and community level (Lynch 2000). In other words, cumulative advantages accrue to individuals and communities that possess varying degrees of resources and health producing infrastructure. It is these advantages that determine health as opposed to the ill effects of psychosocial perceptions of relative deprivation.

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[30] While the issue of social capital as a determinant of health has been a popular topic in the literature (e.g., Bouchard, Roy, and van Kemenade (2005); Kawachi (1997); Kawachi, Kennedy and Glass (1999); Lomas (1998); Lynch et al. (2000b); Mignone (2003); and Veenstra (2001)), the focus in this work is on income inequality, but readers are encouraged to seek out the aforementioned sources and the references therein to fully appreciate the debates surrounding social capital.

Given the attribution of poor health outcomes to differential resources in accordance with the neomaterial framework, Muntaner and Lynch (1999) charge the Wilkinson (1999a) psychosocial approach to income inequality with being conservative (Neo-Durkheimian) for its lack of focus on what generates these differential resources, that is, class relations and political change. Further, Lynch (2000) argues that income inequality is but one of many manifestations of historical, cultural, political, and economic processes that affect health and are left largely unscathed in the psychosocial approach. Similarly, Coburn (2000) stresses the role of neo-liberalist (market-oriented) political doctrines which generate income inequality and undermine the welfare state. These criticisms carry hefty theoretical implications. Since income inequality is one of several possible explanatory variables of health and it is associated with a broad range of other ecological health determinants, such as poverty (Lynch et al. 2004), social capital (Kawachi et al. 1997), as well as medical care/protection/education expenditures, unemployment, and food stamps (Kaplan et al. 1996), one must critically examine which mechanism is responsible for poor health. The neomaterial approach argues that income inequality's relationship with health is contingent on the government's distribution and provision of other social resources with powerful health promoting effects. Hence, income inequality is not the culprit per se, but merely one of many symptoms of a social system. These other symptoms (poverty, welfare, spending), largely ignored in the psychosocial approach, are chiefly responsible for health outcomes.

Evidence of the neomaterial interpretation is demonstrated by the fact that the effects of income inequality on health appear primarily in high inequality countries (Lynch et al. 2004; Subramanian and Kawachi 2004). Thus, support for the association is found in the United States (Blakely, Lochner and Kawachi 2002; Kennedy, Kawachi and Prothrow-Stith 1996; Lochner et al. 2001; Soobader and LeClere 1999; Subramanian, Kawachi, and Kennedy 2001; Subramanian, Blakely, and Kawachi 2003), United Kingdom (Stainistreet, Scott-Samuel, and Bellis 1999) and Chile (Subramanian et al. 2003), while this does not appear to be the case in countries with less pronounced inequality, such as Denmark (Osler et al. 2002), Canada (Ross et al. 2000; Ross and Lynch 2004), Sweden (Gerdtham and Johannesson 2004), New Zealand (Blakely, O'Dea, and Atkinson 2003) and Japan (Shibuya, Hashimoto and Yano 2002). A neomaterial approach would argue that this is no coincidence given that many of the more equal countries champion generous socioeconomic agendas and provide residents with a set of institutionalized health promoting programs and policies, which are the main determinants of health and may cushion any effects of income inequality. Thus, the notion of a universal psychosocial effect of income inequality is doubtful, and whether it can be completely explained away by controlling for resources in the material world is an empirical question, with mixed results so far. In short, the neomaterial approach advocates changing the material conditions of individuals to truly reduce health inequalities (Lynch et al. 2000a).

Statistical Artifact of Individual Income

First, Rodgers (1979), and more recently Gravelle (1998) and Gravelle, Wildman, and Sutton (2002) have demonstrated that the associations between population health and income inequality may be a statistical artifact because of the concave functional form of the relationship between individual income and health.[31] In other words, for a given average income level, the average health of the population will be increased by narrowing the income distribution. This would mean a redistribution of income from high income individuals who stand to lose little in terms of their health through the reallocation process to those lower in the income distribution where the health gains will be large. Overall, the average health of the population will be increased. This is sometimes termed the "absolute income hypothesis" (Wagstaff and Van Doorslaer 2000). Conceding the importance of this relationship, Wolfson et al. (1999) have shown mathematically that the individual relationship cannot explain away the effect of income inequality in their examination of US states. Nevertheless, this point demonstrates that population data are unable to untangle the effects of individual income and income inequality, which are occurring at two different levels. Thus, any ecological effects cannot be definitively substantiated without modeling variation at the individual and contextual-levels simultaneously. The advent of algorithms to estimate hierarchical linear models is the appropriate manner to address this nested

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[31] Concavity implies that there are diminishing returns to health from increases in income.

data structure issue.[32] As stated earlier, single level ecological studies do not reveal the true magnitude of the effects of income inequality (Subramanian and Kawachi 2004 and Wagstaff and Van Doorslaer 2000).

In sum, the effects of income inequality on health have been examined using a variety of approaches, including psychosocial, social capital, neomaterial, and mathematical ones. The true relationship has not yet been established, but we can conclude that each of the approaches has some degree of empirical support. Studies have varied in their results for a number of reasons as outlined above. For the research at hand, we shall examine further a few key methodological issues before embarking on the current research agenda.

2.4.4 Data and Hypotheses

Given the varied nature of the data that is used to examine the effects of income inequality, we must be very clear about what we are testing. Wagstaff and van Doorslaer (2000) underscore this point in their review of the literature. They indicate that the nature of the data (population, community or individual-level) dictates the types of hypotheses that are amendable to being tested. They conclude that population level data (ecological analysis) tell us the least and individual-level data, including

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[32] The differential composition (i.e., individual characteristics) of geographical areas is a key consideration when examining geographic variations and attempting to capture ecological effects—or put another way, we must strive to distinguish the difference that a place makes versus what constitutes a place (Hauser 1970; Macintyre and Ellaway 2000; Subramanian, Duncan and Jones 2001). In fact, multilevel models are the only way one can distinguish true contextual variations from varying population compositions. For example, the effect of income inequality on health may simply be a product of poor income individuals, who tend to have poor health, living in unequal states. Hence, we must strive to analyze the data according to its hierarchical structure.

multilevel studies that examine the effects of different levels simultaneously, are the most informative. In the absence of multilevel analyses, conclusions regarding the association between income inequality and health are less definitive. As mentioned previously in Section 2.4.0, multilevel studies of income inequality have been more likely to show mixed results in terms of its effects.

2.4.5 (Over) Controlling for Variables in the Model

Most researchers in this area agree that that the effects of income inequality must be tested within a multilevel framework to truly gauge the magnitude of the effect (see Diez Roux 2001; Subramanian 2004; Subramanian and Kawachi 2004 and Ch 3 of this work). However, there is dissent with regard to what constitutes appropriate control variables. Wilkinson and Pickett (2006) contend that many of the studies that do not find a significant effect of income inequality are incorporating too many control variables into their models. Many of these control variables are thought to be theoretically relevant and must, therefore, be incorporated into the model to avoid specification bias although, sometimes, these variables appear to be misclassified or included in the absence of solid theory.[33] The difficulty lies in deciding when one is over-controlling within their model. For example, if income inequality reflects the degree of class differentiation in society, does it make sense to control for individual-level variables such as ethnicity and income if they are proxies for classification by class and markers of social position or status differentiation within a hierarchy as

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[33] Variables that are mediators and confounders must be distinguished theoretically NOT statistically.

captured by income inequality? The implications are far from benign. Wilkinson and Pickett (ibid.) found that about 57 percent of studies that were classified as unsupportive of the effects of income inequality began with a significant effect, but this disappeared after the introduction of control variables.

This issue is complicated by the need to separate out compositional effects (i.e., characteristics of those occupying the context) from true contextual effects, which requires controls at the individual-level. Moreover, one must control for other confounders at the contextual-level. Because trends in income inequality coincide with other social trends (e.g., poverty, spending on education and health, etc.) and dimensions of policy as mentioned above, distinguishing its unique effects is a difficult task. This point reminds us that theory must be the guiding force behind our work! At the very least, following the rules of science by explicitly positing a theoretically driven model with testable hypotheses and proceeding to examine empirical evidence can contribute to our relative understanding of the issue. Unfortunately, agreement on the "correct" model to test, including controls, mediators, and intervening variables, is currently far from unanimous, the evidence may be consistent with different approaches and there is not a single dataset that is detailed enough to allow all models to be fully tested.

2.4.6 Level of Measurement

The geographic level at which to measure income inequality has yet to be firmly established, but the gravity of this choice has been observed (Blakely, Lochner and Kawachi 2002; Soobader and LeClere 1999; Subramanian and Kawachi 2004; Wilkinson 2005; Wilkinson and Pickett 2006). Empirically, effects at the state level in the United States have been largely supportive of the association (Blakely, Lochner and Kawachi 2002; Kennedy, Kawachi, and Prothrow-Stith 1996; Lochner et al. 2001; Soobader and LeClere 1999; Subramanian, Kawachi, and Kennedy 2001; Subramanian, Blakely, and Kawachi 2003). As Subramanian and Kawachi (2004) note, these findings coincide with a theoretically appropriate level of analysis; that is, states are a politically meaningful level to examine ecological effects including income inequality and socioeconomic status. On the other hand, mismeasuring an ecological variable, that is, misidentifying "meaningful" contexts and including their attributes in a model to test effects, will likely yield no statistical association. This is largely a theoretical issue that must be tested empirically.[34]

Wilkinson (2005) and Wilkinson and Pickett (2006) have contended that one is more likely to get significant results when income inequality is measured over large areas,

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[34] In other words, if we observe contexts that are of no theoretical or practical significance in terms of their effects on constituents, given the research question at hand, we would not expect to find any associations between context and outcome. Contexts must be defined in a manner that is consistent with the research question as well as hypothesized causal pathways of interest. For example, if the contextual factors which affect a social outcome of interest across different regions is determined by social, economic, and political processes and decision making at the municipal level, but we mistakenly identify the provincial level for analysis, we will proceed to calculate contextual variables at an erroneous level which will yield nonsensical or no statistical associations with the dependent variable.

which was the case in their review of studies. They reason that if one's class position is truly defined in relation to others within the wider society, then breaking down geographical areas into smaller homogeneous units fails to capture this point. Hence, inequality would be expected to be smaller at lower levels of aggregation such as neighborhoods or cities as opposed to states or countries. Veenstra (2002a), for example, invoked this argument as a possible explanation for non-effects in his examination of coastal communities of British Columbia. He contended that the communities may be subsets of the greater context in which people tend to make relative comparisons.

Although the association between income inequality and outcomes does appear to vary with the level of aggregation, there is evidence that this cannot be attributed to smaller geographical areas being more economically homogenous than larger ones (Hou and Myles 2004). Moreover, the frame of reference in terms of relative deprivation cannot be rigidly assumed to be universal. After all, social class is a fluid concept and its meaning to those within the class structure as well as the relations that it fosters should not be taken for granted. Studies do, however, indicate to us that we are heavily influenced by our immediate surroundings. For example, Wilson and Daly (1997) revealed an interesting link between life expectancy, economic inequality, homicide, and reproductive timing in their work among 77 community areas of Chicago. Not only did income inequality significantly add to prediction of homicide rates, the authors found evidence supporting the idea that inequality exhibits its effects in part

through the individual's mental assessments of the future; that is, the socioeconomic milieu in which individuals exist affects their future outlook, which influences the timing of various life events (e.g., reproductive choices), and the degree to which risky and violent behaviors are adopted. Similarly, White, Spence and Maxim (2005) have found that Aboriginal communities play a key role in determining educational outcomes of residents through the networks of social relations, characterized by local specific community norms and attitudes. Kawachi, Kennedy and Lochner (1997) provide a striking example of local effects in their discussion of Roseto, Pennsylvania. This small community was the subject of great attention in the 1950s because of the anomalously good health of its citizens. This small Italian community had heart attacks at a rate 40 percent lower than expected given the prevalence of risk factors (e.g., smoking, diet, and physical activity), and this was attributed to the nature of the social relations (close knit) and norms (egalitarian ethos) of the community. Finally, Chandler and Lalonde (1998) explain the importance of localized effects in the case of Canada's indigenous people in their examination of vastly different rates of suicide across British Columbia. These examples do not discount that the proliferation of mass communication (television, radio, internet, etc.) may influence our conception of ourselves and situate us within the greater national and international hierarchy, but these same communication channels can also strengthen our awareness of our local context. Which is more important? The data would suggest that our day-to-day happiness, experiences, and perceptions are shaped above all by the proximate physical and social environment.

The debates over the most appropriate comparative group in relative deprivation research, which is directly related to the level of measurement of income inequality, is far from clear cut but studies continue to explore this issue. Recently, Dunn, Veenstra and Ross (2006) examined the effects of perceived and actual relative socioeconomic status on a few reference groups in Canada. They found an effect for perceived relative socioeconomic status when the reference group was other Canadians, but no effect when the reference group was the previous generation. In terms of actual relative socioeconomic status, all comparisons were significant, including the provincial and neighborhood reference groups. This research suggests that much more work is required to examine a much broader group of reference points, as defined by workplaces, social networks, clubs and associations, and other relevant social groups, for understanding psychosocial (relative deprivation) processes. This requires, however, a strong theoretical orientation and in-depth knowledge of the group dynamics under question. Thus, while the evidence is not clear, we should entertain the possibility that there is not one main comparison group, as this could vary by place, age, time, and race. Complicating matters further, our multiple roles and identities may amplify or mitigate our position within the hierarchy as operationalized by income.

I suggest, therefore, that it is important to exercise caution in choosing the level at which to measure inequality given the social meaning that we are attributing to it. Blanket assumptions about the Canadian context based on previous work are

problematic. There may be some unique considerations in the case of Canada; for example, the evidence of the effects of income inequality have not been statistically significant (La Porte and Ferguson 2003; McLeod et al. 2003; Ross et al. 2000; Veenstra 2002a), with some minor exceptions (Daly, Wilson, and Vasdev 2001; Hou and Myles 2004; Veenstra 2002a, 2002b).[35] Ross et al.'s (2000) cross-national study has shown that income inequality in Canada, as examined across provinces and cities, has no effect on mortality, unlike the states and metropolitan areas of the United States. This study is particularly interesting given the many similarities between these neighbors. Lynch et al. (2004) comment that there is a possibility that there was not enough power to detect an effect in the Canadian case; however, in their analysis of the work, there is a significant relationship between income inequality and health in the American case even when one simply looks at a subset of metropolitan areas that have similar income inequality values to Canadian cities. Why inequality does not seem to bear a significant relationship with health in Canada unlike its southern neighbor has been speculated by many to be attributable to differences in concentrations of poverty and affluence within the milieu (Ross, Nobrega and Dunn 2001), the structure of the labor market and redistributive policies (Sanmartin et al. 2003), and the universal health care system (Lynch et al. 2004). The issue of the level at which effects may manifest themselves is also a key consideration (Veenstra 2002a,

[35] Again, when summarizing whether effects exist, we run into the issue of comparability of the studies; for example, only the studies by McLeod et al. (2003) and Hou and Myles (2004) were multilevel studies, which allows us to disaggregate the context from individual effects. Moreover, the level of analysis includes the following: metropolitan areas (McLeod et al. 2003); census tracts (Hou and Myles 2004); coastal communities in British Columbia (Veenstra 2002a); provinces (Daly, Wilson and Vasdev 2001; La Porte and Ferguson 2003), provinces and cities (Ross et al. 2000); and health districts in Saskatchewan (Veenstra 2002b),

2002b). The null findings in traditionally more egalitarian countries may, indeed, imply a threshold effect, but this does not mean that income inequality does not matter for various groups, as differentiated by sex, religion, race/ethnicity, and age, occupying different places within the hierarchy of these societies or at various theoretically relevant levels of analysis.

In sum, we have many questions that remain to be answered with regard to the income inequality debate. What is clear, however, from the mountain of research that has been completed thus far is that while income inequality may not have the grand explanatory power initially thought, it may have effects in certain contexts. Universal effects no doubt lead to a simpler understanding of the relationships at hand, but such relationships are rarely found. Teasing out the effects of income inequality and the various contexts in which it operates is an ongoing exercise. As will be seen in Chapter 3, this work contributes to this debate by analyzing the intersection of ethnicity and income inequality given the unique situation of on-reserve First Nations in Canada.

2.5.0 Income Inequality in Canada's Aboriginal Population

This chapter has laid out the approaches to understanding population health generally, situated Canadian Aboriginal work within this research context, and discussed the effects of income inequality on health as a backdrop for the Aboriginal case I will be examining. Much research has been done in recent years on income inequality in

Canada. In fact, one of the richest sources of information can be found at Statistics Canada's Business and Labor Market Analysis Division, which has an entire series of papers devoted to low income and inequality (e.g., Frenette, Green, and Picot 2004; Hou and Chen 2003; Hou and Myles 2004; Myles 2000; Myles, Picot and Pyper 2000; and Picot and Myles 2005). Income inequality in the context of Canada's Aboriginal population has, however, received little attention in the literature.[36] I will now review the work that has been done in this area and report the income inequality measures common to some of the studies for comparative purposes (see Tables 2.1 and 2.2 for more details).

As seen in Table 2.1, Jankowski and Moazzami (1994) is the first known study to have examined income inequality among the Aboriginal population, using data collected by the researchers in 1993. The scope of their work is, however, limited because it is restricted to the Northwestern Ontario population. Nevertheless, their findings are useful. They used the total income from all sources to calculate the Gini coefficient. They found that the Native population had higher levels of income inequality, with a Gini coefficient value of 0.447, than Ontario (0.398) and Canada (0.400).

Bernier (1997) was the first to address the issue of intra wage dispersion among Aboriginal groups in a comprehensive manner across Canada. Using 1991 Census

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[36] On the other hand, descriptive work documenting differential earnings and total income between Aboriginals and the non Aboriginals is vast (Clatworthy, Hull, and Loughran 1995; DeSilva 1999; George, Kuhn, and Sweetman 1996; Norris and Siggner 2003; Pendakur and Pendakur 1996).

(PUMF) data, she examined differences in wage dispersion for the four main Aboriginal groups, that is, North American Indians on-reserve, North American Indians off-reserve, Inuit, and Métis as well as for the Canadian population.[37] Overall, she found greater inequality and polarization of the wage distribution among Aboriginals than Canadian workers as a whole, with a value for the Gini coefficient of 0.451 for the former and 0.407 for the latter. Intra Aboriginal comparisons were revealing: the Gini coefficient values for the Inuit (0.509) and North American Indians on-reserve (0.481) were markedly higher than for North American Indians off-reserve (0.465) and the Métis (0.456). Interestingly, inequality and polarization increased when the sample included those who had either positive annual earnings or positive annual income from unemployment insurance benefits. Some of the other measures of inequality and polarization found in the study are provided in Table 2.1.

Gee and Prus (2000) examined 1994 Survey of Labor and Income Dynamics (SLID) data, comparing income inequality across ethnic groups and sex for total earnings[38] and after tax income[39] as seen in Tables 2.1 and 2.2. Income inequality was found to be higher for women than men across all ethnic groups. In comparison to total earnings, the degree of income inequality was lowered when after tax income was used; thus, the effect of government transfers and taxation policies appear to be

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[37] Waged income only includes those who report positive annual earnings.

[38] Total earnings: income from wages, salaries, and self-employment before taxes for all workers.

[39] After tax income: income from employment, investments, and government transfers after taxes for all persons.

accomplishing the task of redistribution to some extent. Aboriginal[40] (0.42, 0.37) and Visible minority (0.44, 0.41) men had higher Gini coefficients using total earnings and after tax income respectively while British (0.40, 0.35), French (0.40, 0.34), and Other European (0.38, 0.34) males had lower levels of income inequality. In the case of Aboriginal women, they had the highest Gini coefficient values using total income (0.52) and after tax income (0.44) followed by Visible minority (0.43. 0.42) women. Similar to the case for males, the British (0.44, 0.41), French (0.44, 0.40), and Other European (0.44, 0.41) female ethnic groups had lower Gini coefficients for total earnings and after tax income respectively. Overall, the findings coincide with earlier studies: Aboriginals exhibit high levels of inequality relative to the Canadian population. The similarly higher inequality finding for visible minorities and Aboriginals relative to the other ethnic groups is noteworthy.

Similar to Bernier (1997), Maxim et al. (2001) provided a useful comparison of Aboriginal differences in income inequality using 1996 Census (PUMF) data. They examined wage and salary income as well as total income (see Table 2.2).[41] They looked at Registered Indians, Non Registered Indians, Métis, and Inuit as well as non Aboriginals. For wage and salary income, the levels of inequality in ascending order

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[40] On-reserve Aboriginals are excluded from the SLID sampling frame; thus, data for Aboriginals refers to an off-reserve sample only. One should, therefore, be cautious in making comparisons across studies as income dynamics are not constant across Aboriginal groups; for example, Status Indians are subject to a tax advantage if they live on-reserve and collect their income from work on-reserve.

[41] Maxim et al. (2001) performed two sets of analyses for wage and salary income and total income: positive wage and salary income; wage and salary income including zero income; positive total income, including income from all sources; and total income, including zero income.

as measured by the Gini coefficient were the non Aboriginals (0.44), Non registered Indians (0.48) and Métis (0.48), Registered Indians (0.50), and Inuit (0.53). For total income, the Non Aboriginal population had the lowest Gini coefficient at 0.46 followed by Métis (0.48), Non registered Indians (0.49), Inuit (0.50), and Registered Indians (0.51). Despite the slight differences in classification, the patterns were quite similar to Bernier (1997), including the increased dispersion with the "government top up" which is used for total income.

An article from the CD Howe Institute by Drost and Richards (2003) examined total income to provide estimates of income inequality using census data from 1986, 1991, and 1996 as seen in Table 2.2.[42] They broke down the population by on-reserve and off-reserve Aboriginals as well as non Aboriginals. In 1996, the Gini coefficient was lowest for the non Aboriginal population (0.472), and highest for on-reserve Aboriginals (0.524). Off-reserve Aboriginals were in the middle in terms of their relative income distribution with a Gini coefficient of 0.506. Thus, their findings are largely congruent with the other studies.

Using census data from 1985 to 1995, the authors were able to track changes in income inequality over that time period. They found that the Gini coefficient increased

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[42] Total income includes the following: total annual pre tax, post transfer income which includes wages and salaries, net income from self employment, investment income, government transfer payments, pensions and miscellaneous income such as scholarships and alimony.

Study	Source	Income	Category	Gini Index*	Coefficient of Variation	Exp.	FWP Index
Jankowski and Moazzami (1994)	1993 Northwestern Ontario Survey & 1991 Survey of Consumer Finances	Total	Canada	0.400			
			Ontario	0.398			
			Native Population (On/off-reserve, Status/ non Status Indians, Métis, General Registered, Other)	0.447			
Bernier (1997)	1991 Census (PUMF) & 1991 Aboriginal Peoples Survey	Wage & Salary	All Canadians	0.407	0.634	0.463	0.210
			Canadian with Aboriginal Origins	0.451	0.750	0.482	0.261
			North American Indians on-reserve	0.481	0.874	0.496	0.306
			North American Indians off-reserve	0.465	0.786	0.489	0.285
			Inuit	0.509	0.947	0.511	0.369
			Métis	0.456	0.784	0.485	0.272
		Wage & Salary + Unemployment insurance recipients	All Canadians	0.423	0.679	0.470	0.222
			Canadian with Aboriginal Origins	0.470	0.811	0.492	0.277
			North American Indians on-reserve	0.508	0.985	0.510	0.340
			North American Indians off-reserve	0.492	0.883	0.503	0.329
			Inuit	0.528	1.032	0.521	0.382
			Métis	0.484	0.879	0.498	0.305
Gee and Prus (2000)	1994 Survey of Labor and Income Dynamics	Total Earnings (The first number refers to males and the second bracketed number refers to females)	British	0.40 (0.44)			
			French	0.40 (0.44)			
			Other European	0.38 (0.44)			
			Aboriginal	0.42 (0.52)			
			Visible Minority	0.44 (0.43)			

TABLE 2.1 Canadian Aboriginal Income Inequality Studies Part I

Study	Source	Income	Category	Gini Index	Theil Index	Coefficient of Variation	Atkinson Index
Gee and Prus (2000)	1994 Survey of Labor and Income Dynamics	After tax	British	0.35 (0.41)			
			French	0.34 (0.40)			
			Other European	0.34 (0.41)			
			Aboriginal	0.37 (0.44)			
			Visible Minority	0.41 (0.42)			
Maxim, White, Whitehead, Beavon (2001)	1996 Census (PUMF)	Wage & Salary & Wage & Salary with zero incomes in brackets	Non Aboriginal	0.44 (0.59)	0.32 (0.64)	83.9 (115.5)	0.17 (0.40)
			Registered under Indian Act (Status)	0.50 (0.71)	0.42 (0.97)	94.8 (151.1)	0.22 (0.55)
			Non Registered Indians	0.48 (0.67)	0.38 (0.84)	90.6 (137.2)	0.21 (0.50)
			Inuit	0.53 (0.68)	0.48 (0.85)	101.3 (139.0)	0.28 (0.48)
			Métis	0.48 (0.65)	0.39 (0.79)	89.5 (130.9)	0.21 (0.47)
		Total & Total with zero incomes in brackets	Non Aboriginal	0.46 (0.49)	0.36 (0.42)	90.4 (96.3)	0.19 (0.24)
			Registered under Indian Act (Status)	0.51 (0.54)	0.44 (0.50)	100.5 (105.9)	0.23 (0.27)
			Non Registered Indians	0.49 (0.52)	0.40 (0.47)	95.6 (101.8)	0.21 (0.26)
			Inuit	0.50 (0.54)	0.42 (0.50)	95.4 (103.5)	0.22 (0.28)
			Métis	0.48 (0.51)	0.39 (0.44)	94.1 (99.1)	0.21 (0.25)
Drost and Richards (2003)	1986 Census	Total	Non Aboriginal	0.458			
			On-reserve	0.482			
			Off-reserve	0.480			
	1991 Census	Total	Non Aboriginal	0.444			
			On-reserve	0.535			
			Off-reserve	0.468			
	1996 Census	Total	Non Aboriginal	0.472			
			On-reserve	0.524			
			Off-reserve	0.506			

TABLE 2.2 Canadian Aboriginal Income Inequality Studies Part II

for the on-reserve Aboriginal, off-reserve Aboriginal, and non Aboriginal groups over the ten year period by 0.042, 0.026, and 0.014 respectively. Most interesting in this work was the variation in the income distribution by region. The eight cities with the largest Aboriginal populations showed that they tended to fare worse in the West than the East as measured by central tendency and dispersion. What this implies is that regional level effects are at play that should be accounted for.

For the most part, these studies document similar trends; that is, the Aboriginal population has a higher level of income inequality than the Canadian population as measured by wage income or total income. Moreover, there are significant intra Aboriginal differences in income inequality with on-reserve (mostly Registered Indians) and Inuit faring worse than the off-reserve (mostly Non Registered) and Métis. In fact, the intra Aboriginal differences tend to be larger than between Aboriginals and the Canadian population!

In so far as these studies touch upon the issue of income inequality among the Aboriginal population, they do not measure it at a geographically advantageous level of analysis for fully understanding the ecological implications of it. For causal analyses, income inequality matters in as much as it can be conceptualized as a contextual variable that has some kind of meaning to the constituents of the area in question, such as relative deprivation. Despite the attention devoted in the literature to income disparities, and much less so income inequality, there have been no attempts to

the author's knowledge to *empirically link the latter to Aboriginal outcomes*. This gap is significant: inequality matters in so far as it has significant effects on social outcomes otherwise the utility of its documentation is questionable.

This chapter has assessed the literature on the determinants of health generally as well as the research that has been conducted on the Aboriginal population. The gaps in Aboriginal research are most notable in terms of the effects of contextual-level variables. Income inequality has shown much promise as a contextual explanatory variable of population health, with applications in the Aboriginal context non-existent. Chapter 3 will develop more clearly a conceptual/theoretical framework for understanding the social determinants of Aboriginal health at all relevant levels of analysis, outlining the mechanisms of influence and related hypotheses.

Chapter 3: Conceptual Framework and Hypotheses

3.0 Introduction

In this chapter, I present the conceptual framework and hypotheses that frame the research. I begin with a discussion of the underlying model and its rationale, illustrating the conceptual contributions this research makes to the understanding of the health of First Nations people, the role of socioeconomic determinants (income inequality) of health, and more generally the social determinants of health. I conclude the chapter with the hypotheses that will be tested using the 2001 Aboriginal Peoples Survey.

3.1 Developing a Model

Chapter 2 outlined the intra Aboriginal diversity of Aboriginal people in Canada, including the cultural, historical, economic, and demographic differences, making them a unique group to study. Interestingly, intra Aboriginal income inequality tends to be higher than income inequality between Aboriginals and the Canadian population, particularly among Registered Indians. This dissertation focuses on the social determinants of health, with an emphasis on the effects of the socioeconomic characteristics of the social structure. I argue that to develop an understanding of these determinants of health we should examine effects at all relevant levels of analysis. It is also important to understand the manner in which potentially important individual characteristics vary in their effects by social context. Understanding the social patterning of health outcomes as result of these conditions helps further our

understanding of Aboriginal health. The dissertation employs a structural focus that has its roots following the work of Durkheim (1979), Rose (1992), and Link and Phelan (1995), but it centers on the socioeconomic contextual determinants of health; specifically, it focuses on income inequality and draws upon and extends the work of key figures in the area, including Wilkinson (1996; 1999a; 1999b; 2005), Kawachi (1997), and Lynch (2000).

The underlying model begins with the notion that the health of First Nations is structured by the social context in which they reside. This logic raises two issues: what is a theoretically meaningful context or ecological unit for First Nations residents in Canada and what aspects of the context are important? The justification for treating social context (community) as meaningful for First Nations was presented in Chapter 2 (Chandler and Lalonde 1998; 2004; Mignone, 2003, White and Maxim 2003; White, Maxim, and Spence 2004; White, Spence, and Maxim 2005). White (2003) explains that Aboriginal communities have qualities of their own that are not captured by the popular but limited research that focuses on individual-level data. He provides an anecdotal example to make the point that we can interpret Aboriginal issues by framing them in terms of the community:

> If we examine some of the social and health population outcome patterns of Davis Inlet, we see that the tiny community has been plagued by alcoholism, gas sniffing, physical and sexual abuse, and suicide. The pinnacle may

> have come in 1992 when five brothers and sisters, along with an infant cousin, died in a house fire while their parents were out drinking. *At that time, an estimated 75% of the 168 adults of Davis Inlet were alcoholic.*
>
> -White (2003:5)

Indeed, I would argue that conducting research that uses both individual-level data and community context will contribute much to our understanding; the benefits have been discussed in great detail already. I argue that reserves (First Nations communities) are a meaningful contextual-level at which to examine ecological effects. Reserves are unique social spaces given their historical, cultural, political, and socioeconomic attributes. They are geographically meaningful places in which First Nations people live. Legally, reserves are pieces of land to be held by the government for the use and benefit of bands of Indians.[43, 44] Reserves can be host to a variety of initiatives and

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[43] According to the Indian Act (Department of Justice Canada 2006):

18. (1) Subject to this Act, reserves are held by Her Majesty for the use and benefit of the respective bands for which they were set apart, and subject to this Act and to the terms of any treaty or surrender, the Governor in Council may determine whether any purpose for which lands in a reserve are used or are to be used is for the use and benefit of the band.

(2) The Minister may authorize the use of lands in a reserve for the purpose of Indian schools, the administration of Indian affairs, Indian burial grounds, Indian health projects or, with the consent of the council of the band, for any other purpose for the general welfare of the band, and may take any lands in a reserve required for those purposes, but where an individual Indian, immediately prior to the taking, was entitled to the possession of those lands, compensation for that use shall be paid to the Indian, in such amount as may be agreed between the Indian and the Minister, or, failing agreement, as may be determined in such manner as the Minister may direct.

[44] According to the Indian Act (Department of Justice Canada 2006):

2. (1) "band" means a body of Indians

(*a*) for whose use and benefit in common, lands, the legal title to which is vested in Her Majesty, have been set apart before, on or after September 4, 1951,

policies that impact on the day-to-day lives of its constituents, for example, building of schools, and the creation of health projects. These social spaces are historically important locations for First Nations of Canada. There is a distinct set of social networks, norms, and attitudes which are formed within these geographical spaces (Mignone 2003; White, Spence and Maxim 2005). Therefore, it is prudent to entertain the possibility that variations in inequality may reflect local institutional arrangements within these social spaces. The importance of this context as operationalized in this study is also strategic given the demographic characteristics of the communities. According to the 2001 Census data (Statistics Canada 2004), there were about 1.32 million people who self-identified as having Aboriginal ancestry. According to departmental data from Indian Affairs, the Registered Indian population is numbered at 703 800 in over 600 Bands, with approximately 419 800 (60%) on-reserve (Indian and Northern Affairs Canada 2004). If the migration assumption is correct, the proportion of Registered Indians living on-reserve is projected to increase from an estimated 60% in 2001 to 75% in 2021. Thus, our understanding of the dynamics surrounding Aboriginal Peoples and their communities would be profitable as the future on-reserve population increases substantially (ibid.).

(*b*) for whose use and benefit in common, moneys are held by Her Majesty, or

(*c*) declared by the Governor in Council to be a band for the purposes of this Act;

In regards to the second issue, that is, identifying the contextual effects on health, I suggest that the health of First Nations on-reserve is influenced by the socioeconomic characteristics of the community. In particular, the income distribution plays an important role in determining community health. I have indicated that one of the problems plaguing the income inequality–psychosocial, relative deprivation approach is that the reference group for comparisons is far from clear cut. In Chapter 2, I noted that the evidence is not definitive, but we should entertain the possibility that there is not one main comparison group, as this could vary by place, age, sex, time, and race/ethnicity. Moreover, it is quite reasonable to assume that our multiple roles and identities may amplify or mitigate our position within the hierarchy as operationalized by income.

Studies indicate that we are heavily influenced by our immediate surroundings (Chandler and Lalonde 1998, 2004; Wilson and Daly 1997; White, Spence, and Maxim 2005). White, Spence, and Maxim (2005), in their international work on Aboriginal educational outcomes using a social capital lens, illustrated that Aboriginal communities are a key point at which outcomes are determined. This work indicates the power of a theoretically important proximate context on behavior and attitudes. I do not discount that the proliferation of mass communication may influence the conception of Aboriginal identity and situate individuals within the greater national and international hierarchy, and thereby generate psychosocial effects that must be understood at higher levels of aggregation. It seems likely, however, that those

features of their proximate surroundings (reserves) would play a primary role in shaping one's day-to-day experiences, happiness, feelings related to relative deprivation, and psychosocial health.

Thus, I underscore the point that race and ethnicity are foundational bases for inequality in Canadian society (Kalbach and Kalbach 2000), with First Nations a particularly interesting case in the Canadian context. Geographically, the reserve or First Nations community is a theoretically meaningful contextual-level at which to measure ecological effects on First Nations people. The implications of this approach are that contextual effects may differ within a country by the intersection of race and ethnicity and geography. Health is a process that is experienced within historically salient regions of space and time, which are characterized by social, economic and cultural differences. The Canadian Aboriginal context is particularly interesting as the meaning of inequality and its detrimental health effects in reserve populations may differ considerably from the greater society given the former's unique characteristics.

3.2 The Model

Figure 3.1 below illustrates the relationships among the variables of interest. We begin with the social context and identify two of its socioeconomic dimensions, that is, income inequality and community socioeconomic status. The model shows a direct effect of both ecological variables. Differences in the distribution of income have a direct psychosocial effect on the residents of First Nations reserves, by creating

marked differences in status between residents, which manifests itself in terms of antagonistic physiological outcomes. Although not the primary focus of this analysis, the socioeconomic status of the community also affects community health, with health promoting resources more readily available to residents as the socioeconomic status increases.

Cross-level effect modification is demonstrated. The general assumption is that the effects of income inequality are homogeneous; that is, income inequality does not alter the effect of any individual-level determinant of health. Sociologically, the effect of social structure is of importance in shaping the relations between people at the individual-level. This model suggests that income inequality mitigates the positive effects of social support on health since higher inequality societies tend to promote hierarchies and promote the "everyone for themselves" mentality. Previous work in the income inequality–health literature has operationalized the quality of social relations as social capital (community characteristic), and examined the effect of social capital as an intervening variable between income inequality and health outcomes (Kawachi et al. 1997; Kennedy et al. 1998). To my knowledge, there has been no study that examines the cross-level effect modification relationship between income inequality and a measure for social relations at the individual-level and health outcomes.

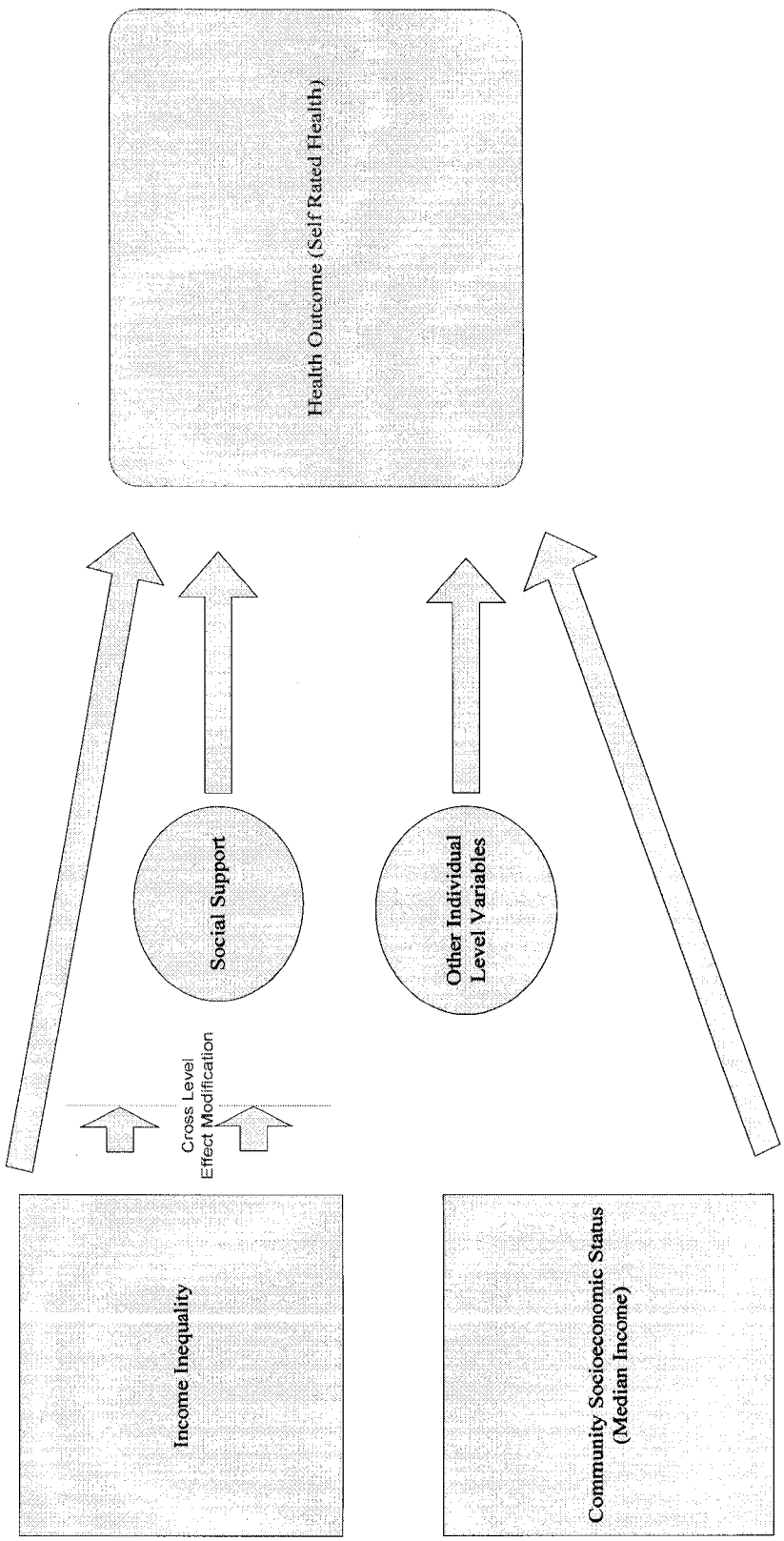

FIGURE 3.1 Model of Aboriginal Health

It is acknowledged that a direct cross-level effect and cross-level effect modification are incomplete causal chains since all ecological effects must be relayed through indirect cross-level effects (i.e., ecological variables affect individual variables that affect individual health). However, articulating the full causal chain should not necessarily be a precondition to yielding meaningful results for two reasons: a) information on all possible variables would have to be available in the dataset; b) reductionism is often unnecessary and could be counterproductive for identifying intervention points for public policy (Blakely and Woodward 2000). Thus, the degree to which one models the causal process, including various intervening variables, could be a pragmatic one. As Helman (cited in Blakely and Woodward 2000:369) comments "...the idea of cause has become meaningless other than as a convenient designation for the point in the chain of event sequences at which intervention is most practical." This model adopts this perspective; for example, the direct effects of income inequality on health would be consistent with a psychosocial interpretation of the detrimental effects of inequality (controlling for other relevant variables) as individual variables capturing the mental processes related to relative deprivation which would influence self-rated health are not available in the Aboriginal Peoples Survey.

3.3 Hypotheses

Given the conceptual framework and model presented above on the health of Canada's First Nations community /reserve populations, I have proposed to test several hypotheses as described below:

Q1. Does *household income* affect self-rated health for the First Nations population of Canada on-reserve, after controlling for confounding variables at the individual and contextual-level? (Neomaterial hypothesis)

H1. Household income has a positive effect on self-rated health with individuals reporting higher levels of income less likely to experience poor health.

Q2. Does *income inequality* affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level? (Income inequality hypothesis– psychosocial/relative deprivation interpretation)

H2. Income inequality has a negative effect on self-rated health, with higher levels of income inequality increasing the likelihood of experiencing poor health.

Q3. Does the socioeconomic status (measured by income level) of the community affect self-rated health for Canada's First Nations population on-reserve, after controlling for variables at the individual and contextual-level? (Neomaterial hypothesis)

H3. The socioeconomic status of the community has a positive effect on self-rated health, with higher socioeconomic status communities decreasing the likelihood of experiencing poor health.

Q4. Does the effect of social support on self-rated health for Canada's First Nations population on-reserve depend on the level of income inequality? (Cross-level interaction–individual community interaction hypothesis)

H4. The effect of social support on self-rated health is weaker as the level of income inequality in a community increases.

Q5. Does the respondent's sex affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H5. Males are less likely to report poor self-rated health than females.

Q6. Does age affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H6. Age has a negative effect on self-rated health, with older individuals more likely to experience poor health.

Q7. Does marital status affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H7. Marital status has a significant effect on self-rated health, with separated, divorced, and widowed individuals more likely to experience poor health than those who are single. On the other hand, married individuals are more likely to experience good health than those who are single.

Q8. Does labor force status affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H8. Labor force status has a significant effect on self-rated health, with the employed and unemployed less likely to experience poor self-rated health than individuals not in the labor force.

Q9. Does education affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H9. Education has a significant effect on self reported health, with individuals possessing low and medium levels of education more likely to experience poor health than those with high levels of education.

Q10. Does smoking behavior affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H10. Smoking behavior has a significant effect on health, with occasional and daily smokers more likely to experience poor health than those who do not smoke.

Q11. Does binge drinking behavior affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H11. Binge drinking behavior has a significant effect on self-rated health, with individuals who never binge drink, sometimes binge drink, and binge drink often more likely to report poor health than those who do not drink.

Q12. Does access to traditional medicine, wellness, and healing practices affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H12. Access to traditional medicine, wellness, and healing practices has a positive effect on self-rated health, with individuals reporting such access less likely to experience poor health.

Q13. Does interaction with a family physician or GP in the previous 12 months affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H13. Interaction with a family physician or GP in the previous 12 months has a negative effect on self-rated health, with individuals reporting such interaction more likely to experience poor health.

Q14. Does social support affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H14. Social support has a positive effect on self-rated health, with individuals reporting higher levels of support less likely to experience poor health.

Q15. Does the ability to speak or understand an Aboriginal language (culture) affect self-rated health for Canada's First Nations population on-reserve, after controlling for confounding variables at the individual and contextual-level?

H15. Culture has a positive effect on self-rated health, with individuals able to speak or understand an Aboriginal language less likely to experience poor health.

The aforementioned hypotheses will be tested using the 2001 Aboriginal Peoples Survey and the analytic design is presented in Chapter 4.

In sum, this framework and the hypotheses deduced will accomplish the following:

- Elaborate our understanding of the income inequality hypothesis.
- Estimate a statistically appropriate model to capture the various effects of the determinants of health at different levels, including income inequality. Income

inequality studies in Canada have generally been single level (ecological) – multilevel evidence will prove to be more reliable.

- Increase our understanding of the contingent relationships between structure and individual variables.
- Reveal any unique relationships between the intersection of race, ethnicity, and income inequality.

Develop a comprehensive model of the determinants of Aboriginal health.

Chapter 4: Data and Methods

4.1 Dataset

This research uses the 2001 Aboriginal Peoples Survey (APS) to test the proposed hypotheses. The APS is a post-census survey, which means that the selection of respondents was based upon their responses to the 2001 Census. For those respondents chosen for the APS, information collected from the 2001 Census was added to their responses. Aboriginal persons covered included North American Indian, Métis, and Inuit as well as on and off Indian reserves and settlements across Canada. It is the second survey of its kind, with the initial APS conducted in 1991. The survey was conducted in partnership between Statistics Canada and Aboriginal organizations (Statistics Canada 2003). As a source of Aboriginal data, it is probably the richest source of comprehensive information available to date on Aboriginal people. Data on health, language, lifestyles, housing, and socioeconomic conditions were collected to enable government and other stakeholders to understand the needs of this population. Moreover, the survey content, geographic coverage, and subpopulations of particular interest was determined in consultation with various Aboriginal groups. As an indication of its utility, the Royal Commission on Aboriginal Peoples (RCAP) recommended that this survey be conducted on a regular basis to address the ongoing conditions of the Aboriginal population (RCAP 1996).

The file used for this analysis is the 2001 APS Adult Microdata file. Access to this dataset was granted through the Research Data Centers (RDC) program, which is part

of an initiative by Statistics Canada, the Social Sciences and Humanities Research Council (SSHRC), and university consortia to help strengthen Canada's social research capacity and to support the policy research community. All statistical work was done within the University of Western Ontario's Research Data Centre.[45]

4.2 Sampling Strategy

The APS includes residents who occupy private dwellings in all of the provinces and territories while those in collective dwellings (lodging or rooming houses, hotels, motels, tourist homes, hospitals, staff residences, communal quarters, military camps, work camps, jails, missions, and group homes) are excluded from the survey (Statistics Canada 2003).

The strategy was to conduct the survey in the largest reserves of each province, which resulted in 44% of the entire on-reserve population being surveyed in each province. In other words, there was no randomness in the selection process and no randomness in the reserves that refused to participate. Some of the largest reserves did not participate in the survey and smaller reserves were then selected. In British Columbia, coverage of the reserve population was reduced because of the significant number of small reserves in the province, which would have been costly to sample. In total, 145 First Nations/reserve communities were selected for the APS and approximately 123 were surveyed (ibid.). The dataset consists of information for a sample of 18 890

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[45] Please note that the opinions expressed in this dissertation do not necessarily reflect the views of Statistics Canada.

individuals within 134 communities, with an average of about 141 individuals per community.

Most importantly, because the sampling strategy did not include smaller reserves, the data are not representative of the entire on-reserve population. A study was completed to evaluate the comparability of the data collected on the APS selected reserves to the entire on-reserve population. An examination of seven demographic variables found that the differences in the distributions of the variables were very small. The differences varied by region and the greatest differences were in Quebec and Ontario (ibid.).

4.3 Population

The analysis excludes some survey participants because they are not a part of the subpopulation of this research. The total sample size is 60 499, but only 18 890 individuals fit the definition of the study population, that is, on-reserve Aboriginals. It should be noted that about 96 percent of the on-reserve population has the Aboriginal status of Registered First Nation; hence, the results apply to that population.

There are two different on-reserve or off-reserve indicators in the APS, including the APS definition and the Census definition. The former definition is indicated in the dataset by the variable RESERVE, which covers all respondents 15 years of age and over. The differences between this variable and the CENRES variable are as follows:

all communities in the Northwest Territories as well as Chisasibi (Quebec), Deschambault Lake (Saskatchewan), La Loche (Saskatchewan), Pinehouse (Saskatchewan), Sandy Bay (Saskatchewan); Fort Mackay (Alberta); Pelly Crossing (Yukon), Old Crow (Yukon), and Ross River (Yukon) are considered "off-reserve" while they are considered on-reserve according to the Census definition. The Census definition is given by the variable CENRES and also covers all respondents 15 years of age and over. The on-reserve population is a derived census variable that is captured by using the Census Subdivision (CSD) type according to criteria established by Indian and Northern Affairs Canada (INAC). The on-reserve population includes all people living in any of the seven CSD types legally affiliated with First Nations or Indian Bands (Indian Reserves, Indian Settlement, Indian Government District, Terres reserves, Nisga'a Village, Nisga'a Land, Teslin Land), as well as selected CSDs of various other types that are northern communities in Saskatchewan, the Northwest Territories, and the Yukon Territory as identified in Table 7 of the Census dictionary (Catalogue No. 92-378-XIE).

The differences between the two variables in terms of frequency counts (weighted in brackets) can be seen in the table below:

	Aboriginal Peoples Survey	Census
Off-reserve	43 844 (785 779)	41 609 (776 146)
On-reserve	16 655 (72 215)	18 890 (81 848)
Total	60 499 (857 994)	60 499 (857 994)

* ( ) = weighted values

TABLE 4.1 On/Off-reserve Status as Defined by the APS and Census

The decision to use the CENRES variable is that it uses the criteria established by Indian and Northern Affairs Canada (INAC) to determine the on-reserve population. This is advantageous for many reasons, including the ease with which one may compare this work to other documents produced by INAC.

4.4 Weighting of Cases

All cases in the 2001 APS are weighted so that results can be generalizable to the population. The unweighted sample is 18 890. I rebased the weight variable to the sample size by dividing the weight for each person by the mean weight over the whole sample, which ensured the adjustments for sampling methods used were retained.

4.5 Missing Data

The researcher's data matrix typically contains values that are observed and missing. There are various ways of handling this missing data in the social sciences (Allison 2002; Little and Rubin 1987; Maxim 1999). This research project deals with missing data through the multiple imputation method, which is considered the method of choice of most statisticians in principle (King et al. 2001).[46]

Multiple imputation is simply the process whereby values for missing items are imputed into several datasets (5 to 10) that contain the same values for the observed

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[46] For an in-depth discussion of the advantages and disadvantages of each method of handling missing data, see the references cited above.

items and different values for the imputations. The analyst then analyses the full datasets, performing the analysis of interest, and proceeds to combine the results across the datasets. In contrast to most other methods for handling missing data, multiple imputation offers the following advantages: the estimates of the standard errors are more accurate; the validity of significance tests (α-levels) is maintained; and generating several estimates through the creation of several data sets maintains the idea that there is uncertainty in our estimates (Allison 2002; Maxim 1999).

Multiple imputation assumes that the data are Missing at Random (MAR),[47] conditional on the imputation model. Typically the multivariate normal model is invoked for the imputation process. The multivariate normal model assumes that all variables have normal distributions and that every variable can be represented as a linear function of all other variables, coupled with a normal, homoskedastic error term (Allison 2002). While seeming somewhat restrictive, this model behaves extremely well even in cases where variables have non-normal distributions and works just as

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[47] MAR is described as follows: data on variable Z are missing at random if the probability of missing data on Z is unrelated to the value of Z after controlling for other variables in the analysis. Data are not MAR if individuals with missing data on variable Z tend to have lower (or higher) values on variable Z than those individuals with non missing data, controlling for other observed variables. Determining whether this assumption is true is impossible given that we do not know the values of the missing data; thus, we cannot compare the values of individuals with/without missing data on variable Z to observe whether differences exist (Allison 2002).

A related assumption is that the missing data mechanism is ignorable, which means that the data are MAR and the parameters guiding the missing data process are not related to the parameters to be estimated in the model. In other words, the researcher does not need to model the missing data mechanism (ibid). King et al. (2001) add that the MAR assumption can be made more realistic and increase efficiency by including any relevant variables (causality is not an issue here) in the imputation process that aid in prediction of the distribution of each of the missing values beyond those used in the analytic model.

well as alternatives designed specifically for categorical or mixed data (Allison 2002; King et al. 2001; Schafer 1997; Schaefer and Olsen 1998). Allison (2002) describes the multiple imputation process under this model: variables with missing data are regressed on all other variables of interest, where the regression parameters are randomly drawn from the Bayesian posterior distribution. Next, the generated parameter estimates are used to produce predicted values for missing data. Then for each predicted value, a random draw from the residual normal distribution for that variable is added.

Allison (2002) claims that the difficult part of the imputation process, under the multivariate normal model, is getting random draws from the posterior distribution of the regression coefficients. One algorithm has been developed that accomplishes this task and is implemented in a specialized multiple imputation program developed by Gary King from Harvard University called Amelia, which will be used for this research project.[48] It implements a computational algorithm called EMis (Expectation Maximization with importance resampling), which runs between dozens and hundreds of times faster than the leading method recommended in the statistical literature yet yields the same answers while being easier to use (King et al. 2001). There are many features of the program that extend the approach as put forth in King et al. (2001), such as modules for high levels of missingness, small N's, high correlations, discrete variables, datasets with some fully observed covariates, compositional data, t

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[48] I wish to thank Dr. Gary King for his prompt responses to questions related to Amelia.

distributed data and data with logical constraints. Moreover, the user can specify imputations within logically possible ranges. Of special note, King et al. (2001) remark that their approach has one advantage over application specific methods (non ignorable data), that is, it is often robust to errors in the imputation model because of the separation of the imputation process from the analysis. Efficiency of the estimators increases with the number of estimates, *m*; however, an m value of 5 to 10 will typically yield estimators as efficient as $m = \infty$ (King et al. 2001; Maxim 1999; Little and Rubin 1987).

One of the disadvantages of multiple imputation is the extra computations that must be carried out. There are three main steps to multiple imputation: 1) impute; 2) perform the statistical analysis of interest; 3) combine the results. Thus, as outlined by King et al. (2001) the overall point estimate, $\bar{q}$, of some quantity of interest, Q, such as a mean, regression coefficient, predicted probability, etc., is given by the average of the m separate estimates, q_j, across data set j (j = 1, . . . , m):

$$\bar{q} = \frac{1}{m}\sum_{j=1}^{m} q_j$$

Similarly (ibid.), the variance of the point estimate is the average of the estimated variances within each completed dataset plus the sample variance in the point estimates across the sets (multiplied by a bias correction factor because $m<\infty$). Let $SE(q_j)^2$ denote the estimated variance of q_j from dataset j, and

$S_q^2 = \sum_{j=1}^{m} (q_j - \bar{q})^2 / (m-1)$ be the sample variance across the m point estimates.

Hence, the standard error of the multiple imputation point estimate is given by the square root of

$$SE(q)^2 = \frac{1}{m}\sum_{j=1}^{m} SE(q_j)^2 + S_q^2(1+1/m)$$

The missing data in this matrix for each variable is provided in Table 4.2. Each missing cell in the data matrix was imputed.[49] After the imputation process, five datasets were created that had no missing data.

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[49] Access to traditional medicine, healing, and wellbeing practices in a community had a relatively higher rate of non response than the other questions in the dataset. This was a result of a combination of "don't know" and non response, which could reflect that respondents simply did not understand the meaning of the question.

N = 18890	Valid		Missing	
	Frequency	%	Frequency	%
Variables				
Self-rated health	18 771	99.4	119	0.6
Age	18 847	99.8	43	0.2
Sex	18 890	100.0	0	0.0
Income				
Labor Force Status	18 304	96.9	586	3.1
Highest Level of Schooling	18 129	96.0	761	4.0
Marital Status	18 634	98.6	256	1.4
Smoking	18 189	96.3	701	3.7
Alcohol consumption in last year	18 002	95.3	888	4.7
Binge Drinking	17 262	91.4	1628	8.6
Access to traditional medicine, healing, wellbeing practices	14 718	77.9	4172	22.1
Interaction with family doctor or GP	18 388	97.3	502	2.7
Social Support - someone who shows you love	17 594	93.1	1296	6.9
Social Support – someone to have a good time with	17 626	93.3	1264	6.7
Social Support – someone to relax with	17 627	93.3	1263	6.7
Social Support – someone to do something enjoyable with	17 627	93.3	1263	6.7
Knowledge of Aboriginal Language	18 815	99.6	75	0.4
Persons in household	18 634	98.6	256	1.4

TABLE 4.2 Valid and Missing Cases of Sample

4.6 Statistical Technique

This research will use multilevel linear modeling to test the hypotheses (see Goldstein 1995; Hox 1995, 1998, 2002; Hox and Maas 2005; Kreft 1998; Raudenbush and Bryk 2002; Snijders and Bosker 1999). Multilevel modeling also known as random coefficient models, variance component models, and hierarchical linear models, is a popular technique that is used to analyze data with a hierarchical or clustered structure. It is similar to regression and generalized linear modeling, but it is able to take into account the nested structure of the data. In essence, a response variable at the lowest level is modeled as a function of explanatory variables at all existing levels simultaneously.

Clustered data can arise for a variety of reasons, including the research design (e.g., multistage sampling) and in many cases clusters are naturally occurring. Examples of naturally occurring clusters are students grouped within schools, children in families, or in the case at hand, individuals within a community. Variables can be measured at their natural levels or created through the process of aggregation/disaggregation (Hox 1995).

This analysis will use the Hierarchical Generalized Linear Model to model the outcome variable, self-rated health (good health vs poor health), a dichotomous or binary response, as a function of the ecological and individual-level variables.

4.7 Problematizing Traditional Approaches: A Rationale for Multilevel Modeling

The ecological approach to examining health issues is premised upon the idea that the health of persons is influenced by factors which exist outside of the individual. In other words, these factors are more than the measures of individual attributes and can include a variety of ecological variables such as the physical characteristics of a place or attributes of groups (Blakely and Woodward 2000; Susser 1994). Whether it is environmental pollutants, income inequality, or the prevalence of infectious disease, we know that these characteristics influence health. Aggregate analyses are, however, constrained by the ecological fallacy, that is, making inferences at the individual-level based on findings from the aggregate level (Robinson 1950). Thus, definitive statements of association should not be made about the units at the individual-level based on the relationships observed at the aggregate level, and any theories of the mechanism through which contextual-level variables affect individuals cannot be tested.

Despite the relatively well-known critiques of using ecological data, less attention has been paid to the problems of using individual data. Individual data analysis has become the popular mode of investigation in the social sciences. This is not, however, without its problems. Individual data are subject to what is termed the atomistic or individualistic fallacy, that is, any associations found between variables at the individual-level may not be congruent with those at the aggregate level (Alker 1969). Moreover, theoretically, decontextualizing individuals from the contexts in which they

live is very troubling. Sociologists have long underscored that individual behavior can be understood within the social context in which it occurs.[50] Politically, the concentration at the individual-level tends to coincide with neoliberalism and puts all responsibility on the individual for his/her health.

An assumption that one makes at the individual-level of analysis is that all individual effects are the same everywhere (e.g., the effect of an individual's education or income is constant irrespective of the context), that is, they do not differ by context, which is very unlikely. Technically, by ignoring the nested structure of the data, we assume that we have more information than we really do as the independence of observations assumption in classical statistical modeling is violated, which leads to an underestimation of the sampling variance and biased significance tests. After all, we expect individuals in the same context to be more similar than individuals from different contexts, with the degree of homogeneity varying between contexts.[51] Multilevel models are a solution to these problems. We can model both general relationships between contexts and particular relationships in specific places.

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[50] Sociology has largely shifted towards individual analysis despite the centrality of social structure in so many of its theories.

[51] The degree of homogeneity of a cluster is measured by the intraclass correlation. Survey clustering and its effects on variance estimates is far from new (Kish 1965). The design effect (Deff) is the ratio of the operating sampling variance to the sampling variance that applies to simple random sampling. In the case of simple cluster sampling, where cluster sizes are equal, deff = $1+\rho(n_{clus}-1)$ where ρ is the intraclass correlation and n_{clus} is the cluster size (Kish 1965 and Hox and Maas 2005). Any value for the cluster size larger than one will result in a deff greater than one, which means that standard statistical formulas will underestimate variance and lead to an inflated Type I error rate.

The utility of multilevel modeling is observed when one attempts to capture true contextual effects, taking into account the demographic composition of the spatial entities we are exploring. This deserves further investigation. Although we may observe variations among places with respect to health outcomes, the question of whether the spatial differences reflect real area effects or merely differences of the characteristics of the individuals residing within those areas is left unanswered in ecological analysis (Moon et al. 2005). Indeed, the key is to distinguish the difference that a place makes versus what constitutes a place (Hauser 1970; Macintyre and Ellaway 2000; Subramanian, Duncan and Jones 2001). In other words, do people with similar characteristics experience the same health outcomes across different regions? Separating out compositional effects from true contextual effects requires controls at the individual-level. In fact, multilevel models are the only way one can distinguish true contextual variations from varying population compositions. For example, the effect of income inequality on health may simply be a product of poor income levels of individuals, who tend to have poor health, living in unequal states. Hence, we must strive to analyze the data according to its hierarchical structure.

In sum, the process of distinguishing the various levels at which the numerous determinants of health operate in a multilevel framework enables us to treat the contexts of a model as a random sample from the larger population. Thus, the inferences made pertain to all contexts in the population. This means that the variation between contexts is modeled as variable, that is, as a random property relating to the greater population (Moon et al. 2005). In the case at hand, reserve communities will be

treated as a sample from a population and the different intercepts and slopes are thought of as coming from two distributions at a higher level. These models are composed of two parts: fixed – a mean value of each distribution (average slope and intercept across all contexts) and a random part which is simply the variances that describe the amount that specific context slopes and intercepts differ from the average.

4.8 Multilevel Modeling: Key Practical Issues

Multilevel models enhance our ability to accurately answer a broader range of research questions. However, there are a few key issues that the researcher must exercise great caution in addressing. First, there are numerous ways that *n* people may be allocated into non-overlapping ecological units of varying sizes and configurations, and with each arrangement there are different possible statistical results of association (Moon et al. 2005). The importance of choosing theoretically relevant and sociologically meaningful contextual units is important. All too often these contexts are based on administrative criteria and the result is that the defined areas are arbitrary locales with relatively no meaning to the individuals residing within them (ibid). Second, to model multilevel data, the analyst requires variables that capture all relevant measures at every level of interest. In the two level multilevel model, this is simply the compositional individual-level characteristics and the contextual variables. Unfortunately, datasets rarely possesses all possible variables of interest to a researcher. This issue is particularly pertinent in the case of the First Nations population. Nevertheless, the APS is, as mentioned previously, as comprehensive as it

gets for the Aboriginal population. Third, there must be identifiers which distinguish the context in which every observation resides. Fortunately, through the use of microlevel data from Statistics Canada, identifiers are present in the dataset enabling the matching of individuals to their reserve communities.

4.9 Sample Size

In the multilevel context, the issue of sample size is important. Estimates and their standard errors will become more accurate as the sample size at all levels is increased (Moon et al. 2005). Research on this issue has been carried out by only a few scholars (e.g., Hox and Maas 2002; Maas and Hox 2005). Estimation methods that are usually used in multilevel analysis are "maximum likelihood," which are asymptotic and therefore require a large sample size. The precision of estimated ecological effects is somewhat complicated by the complex interaction between covariances and the intra-class correlation and most importantly the design effect, which is an indication of the degree to which standard errors are underestimated (Kish 1965). While there is no golden rule, there is some consensus on this issue. It is generally the case that the restriction is usually placed at the higher level sample size; that is, having a large number of groups is much more important than a large number of individuals per higher level unit (Blakely and Woodward 2000; Hox and Maas 2002; Maas and Hox 2005).

Kreft (1996) recommends the 30/30 rule, which states that one should aim for at least 30 groups with at least 30 individuals per group. These are relative minimums in that they mark a "best core" sample. Hox (1998), in his review of the literature, concludes that this rule may only be relevant if the research interest is fixed parameters (e.g., B_0, B_1, etc.). In the case of cross-level interactions, the number of groups should be larger, that is, the 50/20 rule (50 groups, with 20 individuals per group). If a researcher is interested in the random part (i.e., the variance and covariance components), then the 100/10 rule (100 groups with about 10 individuals per group) may be more appropriate. Thus, as the model become more complicated and insightful, the data requirements increase, particularly at the higher level.

In the present analysis, the multilevel structure of the data is comprised of 18 890 individuals (level 1) nested within 134 First Nations communities (level 2). Based on these numbers, it appears that the sample size should be reasonable for testing the hypotheses of this research, including the cross-level interaction effect.

4.10 Software

There are several pieces of software used for this analysis. The general statistical analysis was carried out using SPSS 15.0 and Microsoft Excel 2003. I also used the software program AMELIA, a specialized program for handling missing data,

LISREL 8.7 to conduct an ordinal factor analysis, and HLM 6.04 to conduct the multilevel statistical modeling.[52]

4.11 Independent Variables

Readers are encouraged to see Appendix A for a list of the original questions, answers, derived variables and recodes associated with each variable. Self-rated health can be affected by variables at the individual and contextual-level. The variables in this analysis have been carefully chosen based on their importance in the literature. This step is important as the effects of a misspecified model including omitted variable bias can be significant.[53] To gauge the effect of the contextual variable, potentially important variables, including confounders, must be included at all levels of analysis. The variables are grouped into six different categories: Demographic (age, education, income, sex, marital status, labor force status); Lifestyle (smoking and alcohol consumption habits); Health resources (interaction with a family physician/GP and access to traditional medicines, healing or wellness practices); Social support (belonging/associative support); Culture (language ability); and Contextual (average income and income inequality).

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[52] HLM 6.04 is one of the most user friendly pieces of software for multilevel models. However, there were many problems that were encountered with the software, particularly when specifying non linear models, which will hopefully be sorted out in later versions. I appreciate the timely responses from Scientific Software International.

[53] See Raudenbush and Bryk (2002) for a discussion of the effects of a misspecified model in the context of a multilevel framework.

Demographic

Age is a good indicator of biological senescence. All of us age physically and eventually our bodies will deteriorate and we will die. The majority of young people are in good health and it is inevitable that the majority of older people will suffer from disease and disability (Mirowsky and Ross 2003). The rate of biological decline and its upper limit is subject to debate,[54] but the biological consequences of aging are definite (Perez-Campo et al. 1998; Sapolsky 1998). This variable is continuous in this analysis.

Education has been found to be a determinant of health or related to health, with higher levels resulting in better health outcomes for a variety of reasons, such as increased socioeconomic status, employment opportunities, personal control, learned effectiveness, etc. (Kunst and Mackenbach 1994; Mirowsky and Ross 2003; Ross and Wu 1995, 1996; Williams 1990). Education is operationalized with three levels: low education; medium education; and high education.

Income has received much attention in the literature as a determinant of health (Ecob and Davey Smith 1999; Lynch and Kaplan 2000; Wolfson et al. 1993). Not only is this variable indicative of one's standard of living, but it provides access to resources in a

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[54] The rate of biological decline can be understood by three mechanisms: time is an accumulator on molecules, cells, and tissues (e.g., chromosomes have ends that are called telomeres which get shorter each time the cell divides, and as it becomes too short to divide and replenish tissue the ability to function is lost); stress and disease expedite the aging process; those with a history of exposure and problems are more likely to have their health disadvantages amplified (Mirowsky and Ross 2003).

market society that contribute positively to health. Support for socioeconomic status preceding ill health and predicting mortality has been well documented (Blane, Davey Smith, and Bartley 1993; Wolfson et al. 1993). It is measured as a continuous variable via economic family income.[55] To take into account differences in family composition, the square root equivalence scale is used (see Chapter 5 for more details on this variable). The effects of household income on health diminish as the level of income increases; thus this will be reflected in the analysis by using the natural logarithm of household income (see Deaton 2001).

Labor Force Activity: Participation in the labor force has a positive effect on health, particularly when one is employed (Dooley, Prause, and Ham-Rowbottom 2000; Murphy and Athanasou 1999; Ross and Mirowsky 1995). Independence and personal development as well as psychological wellness tend to be derived from employment (Dooley, Prause, and Ham-Rowbottom 2000; Mirowsky and Ross 2003; Murphy and Athanasou 1999). The healthy worker effect is also a factor, whereby healthy

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[55] The income of Aboriginal people in Canada is somewhat complicated given the following programs and policies available to status Indians (see Indian Affairs Canada 2006), which directly affect their standard of living:

- exemption from income tax for income earned on-reserve
- partial exemption from federal and provincial sales tax
- free medical benefits not covered by universal provincial medical insurance,including dental care with no means test
- subsidized housing on-reserve
- post-secondary education support plus incentives and scholarships
- immunity from seizure of real or personal property on-reserve

Because this study is only examining the on-reserve population, which is composed of status Indians for the most part, these issues related to income are "controlled."

individuals are more likely to participate in the labor force and become employed, since holding a job requires a certain degree of physical robustness and health status (Garcia and Checkoway 2003; Dahl 1993). The result is that those not in the labor force or unemployed tend to report poorer health than individuals who are employed based on a selection effect. This variable has three categories: employed, unemployed, and not in the labor force.

Sex: This variable refers to the biological construct male/female. Historically, Aboriginal women tend to be in better health than Aboriginal men although this depends on the health indicator examined (Norris and Siggner 2003). For example, life expectancy at birth in 2000 was 70.8 for Registered Indian females and 68.9 for Registered Indian males (ibid.). If we look at the broader literature, a higher rate of mortality is observed for males than females at all ages. This has been attributed to biological processes, as evidenced by the excess mortality of males in the first week of life, as well as social processes, such as higher exposure to occupational and environmental risks (Frankel, Speechley and Wade 1996). On the other hand, females have higher rates of morbidity and use of health services than males for a number of reasons, including differential perception and response to symptoms (ibid.). In terms of self-rated health, since females tend to have higher rates of morbidity, it would be likely to observe lower self reported health compared to males.

Marital Status: The state of being married, relative to individuals who are single, widowed, separated or divorced, has been found to have a protective effect on health for a number of reasons, including economic efficiency, orderliness and regulation of risky behaviors, and emotional social support (Anson 1989; Hu and Goldman 1990; Kim and McKenry 2002; Lillard and Waite 1995; Simon 2002; Umberson 1987, 1992). There are also reported effects of selection that may account for the positive association between marriage and health, with healthy people being more likely to be selected into marriage (Glenn and Weaver 1988; Mastekaasa 1992); however, Ross, Mirowsky and Goldsteen (1990) have found quite convincingly that the positive effects of marriage on health account for most of the association. This variable has three categories: divorced/separated/widowed, married, and single.

Lifestyle Habits

Alcohol Consumption[56]: Heavy alcohol consumption-binge drinking-is related to a number of health problems in the short-term and long-term. These consequences are a function of the degree of binge drinking over time. Long-term health consequences include chronic diseases such as cirrhosis of the liver, pancreatitis, various cancers (liver, mouth, throat, larynx and esophagus), high blood pressure, and psychological disorders. Behavioral consequences include accidents, poor social behavior,

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[56] The term "drink" refers to any of the following:
-one bottle or can of beer or glass of draft
-one glass of wine or a wine cooler
-one drink or cocktail with one and a half ounces of liquor

drunkenness, unsafe sex, depression, and suicide (Alcohol Concern 2003; Center for Disease Control and Prevention 2006). Binge drinking is defined as having 5 or more standard drinks in a row, where a standard drink is a 12 oz. beer, 5 oz. glass of wine, or 1.5 oz. of spirits (Addictions Foundation of Manitoba 2004). A recent meta analysis has even problematized the popular adage that moderate alcohol consumption has positive health effects for mortality in terms of all causes and coronary heart disease (Fillmore et al. 2006).[57] Thus, any alcohol consumption would have a negative effect on health. It should be noted that alcohol abuse has been addressed as a major health concern among First Nations in Canada (Health Canada 1998).

Smoking: The effect of smoking on health is far reaching. It is associated with cardiovascular disease (heart disease, cerebrovascular disease, peripheral vascular disease, abdominal aortic aneurysm, and hypertension), cancer (lung cancer, laryngeal cancer, oral cancer, esophageal cancer, bladder and kidney cancer, carcinoma of the pancreas, stomach cancer, cervical cancer, hematopoietic cancer), pulmonary disease (chronic obstructive pulmonary disease, respiratory infections), sexual and reproductive problems (lower fertility in women high risk pregnancy, low birth weigh babies, sudden infant death syndrome), peptic ulcer disease, dental diseases (gum disease and tooth loss), eye diseases (cataracts) and osteoporosis (McBride 1992; Sherman 1991, 1992; Surgeon General 2004). Broonum-Hansen and Juel (2001)

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[57] The meta-analysis was based on 54 published studies and found that systematic misclassification error was committed by including people who had reduced or stopped drinking (associated with aging and ill health) with abstainers. Based on the studies that were error free, the positive effects of moderate alcohol consumption appear to be non-existent.

found that at age twenty the life expectancy of a heavy smoker is seven years less than someone who has never smoked. Not only does smoking reduce the time period over one's life span that he/she reports good health, but it increases the chances of reporting longstanding illness over the life course as well as the number of years in poor health. Thus, it is associated with lower self-rated health (Froom et al. 2004; Segovia, Bartlett and Edwards 1989). This issue is of particular importance in Canada as noted in a report by Health Canada (2002b) in its review of the literature: not only is tobacco use the single most preventable cause of death and disease, but its misuse (non traditional tobacco use) among the Inuit and First Nations population is estimated to be double the Canadian population, contributing to detrimental health conditions and lowered life expectancy among a significant number of children and adults in those communities (ibid.).

Formal Health Promoting Services

Family medicine: Having seen or talked on the telephone with a family doctor or general practitioner about physical, emotional or mental health over the last 12 months should be a significant variable in the model. This effect on self reported health will likely be negative for two main reasons: individuals will seek out the medical system when they are ill or for preventative purposes (i.e., check ups). In terms of the former, the health care system tends to draw individuals who are suffering from health issues which disrupt their normal function. Hence, those individuals with health problems are

more likely to utilize health care services.[58] In terms of preventative medicine, check ups as well as secondary prevention have been shown to have no effect on maintaining health (Canadian Task Force on the Periodic Health Examination 1988; Ross and Wu 1995); in fact, finding early signs of pathology, increases rates of illness, among other things, and the net benefits of such detection are highly questionable given the evidence.[59,60]

Traditional Medicines, healing, wellness practices: The availability of First Nations, Métis or Inuit traditional medicines, healing or wellness practices in one's city, town or community could have a potentially positive effect on health, given the historical record of these practices (Royal Commission on Aboriginal People 1996).

Social Support

Social Support: The importance of one characteristic of cohesive societies, supportive social relationships, has been known for several decades to play an important role in health outcomes (see Berkman 1995; Berkman and Glass 2000; Cohen and Syme

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[58] See Pincus (1998) for a discussion on the connection between socioeconomic status and utilization of health services.

[59] This debate is somewhat tangential to the analysis, but the reader may wish to follow up on it in greater detail. A well referenced and clearly articulated overview of the issue is presented in many sources including Mirowsky and Ross (2003) as well as Coburn, D'Arcy and Torrance (1998); Evans, Barer, and Marmor (1994); Frank and Mustard (1994); Marmot and Wilkinson (1999, 2006); and Raphael (2004).

[60] In fact, Mirowsky and Ross (2003) explain that because higher status individuals are more likely to go for check ups, the socioeconomic status gradient in rates of illness is suppressed given that low status individuals with the same early signs of pathology are less likely to be diagnosed.

1985; Lynch 1979; Callaghan and Morrissey 1993; Helgeson 1993; Sarason and Sarason 1985). [61] Social support's role in this analysis is twofold. First, I wish to examine the effects of income inequality on the social relations–health link, via a cross-level interaction; in other words, I will be examining how social contexts, which vary by their degree of income inequality, mitigate the positive effects of individual social support on health. The second use of the social support measure is to assess the individual-level effect of social support on health.

Social support is a complex concept with many dimensions. The multidimensionality of the social support concept is acknowledged in the literature; for example, early seminal works in the area by House (1981) discusses instrumental assistance (goods or services); emotional concern (liking, love, empathy); information about the environment; and appraisal (information for self evaluation) while tangible support (instrumental assistance), appraisal support (someone to talk to about problems), self esteem support (availability of a positive comparison when comparing oneself with others) and belonging support (availability of people one can do things with) are presented by Cohen and McKay (1984)[62].

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[61] The term "social networks" is sometimes equated with social support, but Berkman and Glass (2000) address the importance of distinguishing between these related but different concepts. In short, social network theory is premised upon examining the social structure of the networks of relations between people, and using this set of links to understand the norms, attitudes, behaviors, life chances/opportunities, and binds that shape those within the network (see Granovetter 1973; Wellman 1993). Social support is perhaps best viewed as a functional component of a social network (Doeglas et al. 1996; Schwarzer and Leppin 1991).

[62] See Cohen, Underwood, and Gottlieb (2000), Sarason and Sarason (1985) and Vaux (1988) for a comprehensive look at the various dimensions of social support and related debates. There is a

Given the complexity of this concept, my focus is on the dimension of social support that most closely resembles what has been termed "belonging" in the literature (see Sarason and Sarason 1985). In my conceptualization, belonging is associated with the availability of people who care enough about you to engage in a variety of mutually satisfying activities. It is assumed that the items in the APS measure this unidimensional trait, which is operationalized by the following:

Could you tell me how often each of the following kinds of support are available to you when you need it:

- Someone who shows you love and affection (**SHOWLOV)**
- Someone to have a good time with (**GOODTIME)**
- Someone to get together with for relaxation (**RELAX)**
- Someone to do something enjoyable with (**ENJOY)**

The possible responses are listed below, coded as 4, 3, 2, and 1 respectively:

- All of the time
- Most of the time
- Some of the time
- Almost none of the time

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difference between support that is perceived to be available if needed (subjective) and the objective existence of these support resources. This work adopts the view that one's appraisal of a situation as threatening/non threatening is premised upon the perception of support rather than the real availability of it (Cohen et al. 1985).

Another theme in the social support research is the difference between the structure of social networks (e.g., how many friends do you have?) and the functions that they may serve (e.g., do you have someone to do something enjoyable with?). As Cohen et al. (1985) warn, combining these items together into a single support index leaves one with scores that have a conceptually weak meaning. My work focuses on the functions of existing networks.

Combining these items into a scale is a task that requires great care. Most importantly, we must be clear about the concept we are measuring and whether the observed variables are appropriate indicators of what we are trying to capture. The assumption of unidimensionality can be tested using a few different methods.

First we begin with the simple approach. An examination of the correlations between variables in Table 4.3 supports combining the scores to create one scale which taps into the concept of social support: "belonging." I have presented three measures of correlation: Pearson's r, Spearman's rho, and Kendall's tau. Attention to the correlation coefficients for ordinal data—Spearman's rho and Kendall's tau—are most appropriate given the ordinal nature of the responses. All correlations are higher than 0.57, which provides some evidence to combine the variables. Although the correlation matrix supports the combining of items to develop the scale, there are a few problems with this approach. In particular, one should ensure with greater certainty that the items do, indeed, measure a unidimensional latent variable. If this is not the case, there will be validity problem as the composite variable will not be measuring what it is supposed to be. As well, the assumption is that the items should be weighted equally (Maxim 1999; Joreskog 2004). Thus, an even better case can be made to combine the items to form the scale by conducting a confirmatory factor analysis within the structural equation modeling framework.

Pearson's r	SHOWLOVE	GOODTIME	RELAX	ENJOY
SHOWLOVE	1			
GOODTIME	0.6454	1		
RELAX	0.593	0.6984	1	
ENJOY	0.6112	0.729	0.7986	1

Kendall's Tau	SHOWLOVE	GOODTIME	RELAX	ENJOY
SHOWLOVE	1			
GOODTIME	0.6322	1		
RELAX	0.5784	0.678	1	
ENJOY	0.5942	0.7054	0.7832	1

Spearman's Rho	SHOWLOVE	GOODTIME	RELAX	ENJOY
SHOWLOVE	1			
GOODTIME	0.6676	1		
RELAX	0.6172	0.7176	1	
ENJOY	0.6312	0.7408	0.8164	1

TABLE 4.3 Correlation (Pearson's r, Kendall's Tau, Spearman's Rho) Matrix of Items for Social Support Scale (N=18890)

Given that the scale of the variables is ordinal (i.e., all of the time, most of the time, some of the time, almost none of the time), the numbers associated with the categories should not be treated as though they are on an interval scale; instead the numbers are simply labels for a set of ordered categories (Joreskog 2004). The use of ordinal variables within a structural equation framework demands alternative techniques to those used for continuous variables, which I will discuss briefly.[63]

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[63] For ordinal variable x, it is assumed that there is an underlying continuous variable x*. The continuous variable x* has a range from $-\infty$ to $+\infty$ and represents the attitude underlying the observed ordered responses to x. x* assigns a metric to the ordinal variable (Joreskog 2004).

If x has categories *1,2,...,m* then the relationship between x and x* is

$$x = i \Leftrightarrow \tau_{i-1} < x^* < \tau_i,\ i = 1, 2, \ldots, m,$$

where

$$-\infty = \tau_0 < \tau_1 < \tau_2 \ldots < \tau_{m-1} = +\infty$$

Given the non-normality of the distribution of the data, an asymptotic covariance matrix is used, as opposed to a sample covariance matrix from a multivariate normal distribution. The asymptotic covariance matrix requires a large sample to estimate. One rule of thumb is that if there are many zero cells in the bivariate contingency tables then the sample size is considered too small. A sample size of 18 890 should be large enough, and an examination of the bivariate contingency tables, which does not show any zero cells, reinforces the adequacy of the sample size. The Weighted Least Squares method is used for this analysis based on the polychoric correlations and its asymptotic covariance matrix (Joreskog 2004).

In short, this confirmatory ordinal factor analysis supports combining the items to form one scale. There does not appear to be a need to differentially weight the items given the magnitude of the relationship between the latent variable "belonging" and its four observed variables (see Figure 4.1).[64]

I will briefly report the key findings from the confirmatory ordinal factor analysis below. Generally, the process involves two steps:

1) Estimate polychoric correlations and their asymptotic covariance matrix in PRELIS
2) Use matrices in LISREL to estimate the model with weighted least squares.

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and τ_i are parameters called threshold values. For m categories, there will be m-1 threshold parameters, that is, $\tau_1, \tau_2, \ldots, \tau_{m-1}$.

[64] In fact, an analysis with differential weights did not change the results of the study.

Polychoric correlation is the correlation ρ of the underlying variables x_1* and x_2*, given that the *underlying* variables x_1* and x_2* are normal with zero means and unit variances and are assumed standard bivariate normal. This assumption can be tested using bivariate marginal data (ibid.). Joreskog (2004) has developed an RMSEA measure of population discrepancy for this purpose that is based on the non central chi-square distribution. The goal is for the p-value of RMSEA to be not significant. In this analysis, for each pair of variables, the hypothesis of approximate underlying bivariate normality was not rejected for any pair of variables, that is, $\alpha > 0.05$.

As seen in Table 4.4 the polychoric correlations are all relatively high with magnitudes well above 0.7, which supports the idea that they are tapping into the same construct. Once the model has been specified and estimated, we must assess whether it is a good fitting model. A χ^2 statistic is generated based upon the function minimum when the solution has converged. This value is multiplied by N-1 where N = sample

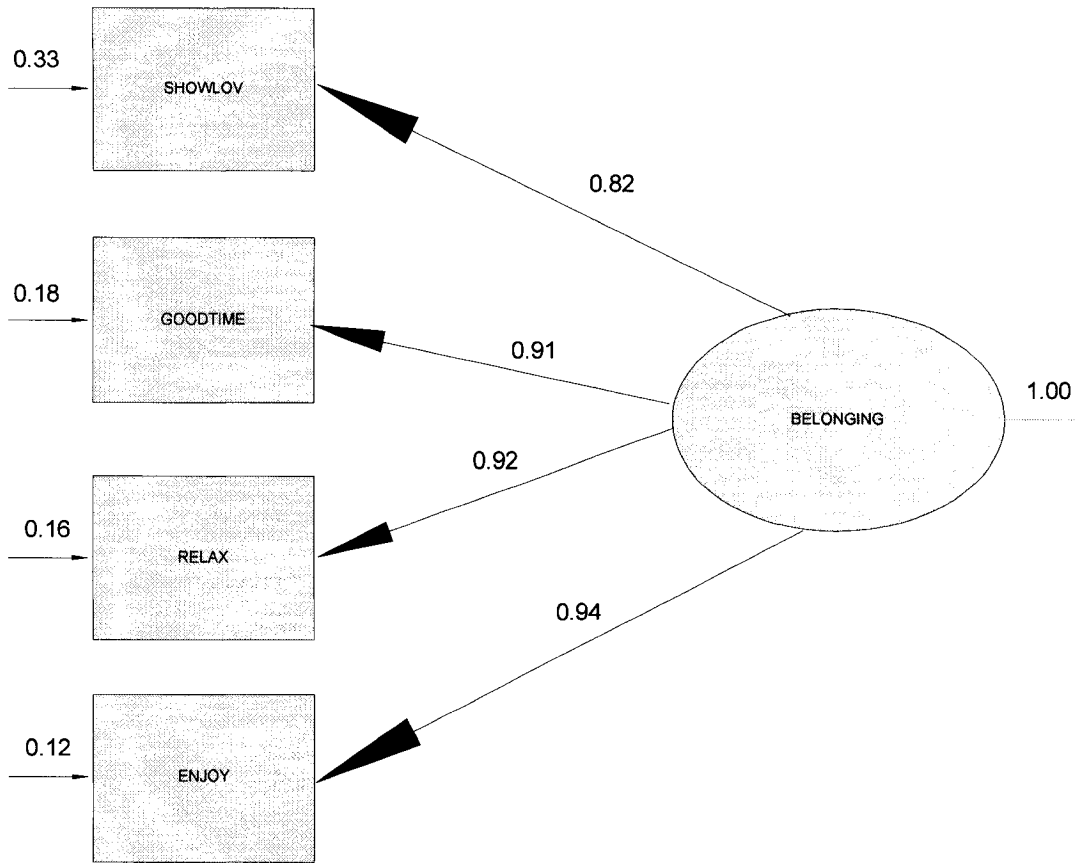
Pearson's r	SHOWLOVE	GOODTIME	RELAX	ENJOY
SHOWLOVE	1			
GOODTIME	0.770	1		
RELAX	0.7256	0.8036	1	
ENJOY	0.7400	0.8282	0.8776	1

TABLE 4.4 Polychoric Correlation Matrix of Items for Social Support Scale (N=18890)

size. This χ^2 is then evaluated with degrees of freedom as follows: total number of degrees of freedom – the number of parameters estimated. Within the structural equation modeling framework, the degrees of freedom reflect the amount of unique

information in the sample variance/covariance matrix minus the number of parameters to be estimated.

The goal of structural equation modeling is to develop a model that fits the data well; therefore, one seeks a non significant chi-square value. Chi-square values are, however, dependent upon sample sizes; thus, large sample sizes and trivial differences can cause the chi-square value to be significant. It is common practice to examine fit indices that eliminate or minimize the effect of sample size. Tabachnick and Fiddell (2001) state that there is no single correct index to report although Hu and Bentler (1999) recommend two types of fit indices, that is, the standardized root mean square residual (SRMR) and then a comparative fit index (see Figure 4.1). The SRMR is the average difference between the sample variances and covariances and the estimated population variances and covariances. The SRMR is between 0 and 1 with values less than or equal to 0.08 indicating a good fitting model. In this case, the SRMR was 0.02, which indicates that the model fits well. Comparative fit indices are premised on the idea of comparing nested models. In terms of comparative fit indices, two of the most popular ones, the Non-Normed fit index (NNFI) and the Incremental Fix Index (IFI) are used to assess the fit of the model, ranging from 0 to 1 with values greater than 0.90 indicative of a good fit. In this case both fit indices are equal to or greater than 0.99.



df = 2
Standardized root mean square residual (SRMR) = 0.02
Non-normed fit index (NNFI) = 0.990
Incremental fix index (IFI) = 0.997

FIGURE 4.1 Ordinal Confirmatory Factor Analysis Model

In summary, there has been empirical support for the effects of social support on health outcomes. This work proposes a measure of social support that can be used in examining the individual effects on health as well as the cross-level interaction effects of income inequality on health (i.e., the effect of social support on health varies by the degree of inequality in a society). An ordinal confirmatory factor analysis supports the use of the proposed social support scale which is theoretically based and

operationalized by four items in the 2001 Aboriginal Peoples Survey. The scale ranges from 4-16 with higher numbers indicating greater levels of reported perceived social support.

Culture

Language: The ability to understand or speak an Aboriginal language is a measure of one's ethnic and cultural identity (Fishman 1989). Attachment to Aboriginal culture, including reclaiming lost cultural identity, is thought to have a potentially positive effect on health (Hagey 1989; Health Canada 2005; Royal Commission on Aboriginal People 1996; Waldram 1993, 1997), but the results are far from definitive (Wilson and Rosenberg 2002)[65].

Contextual Variables

The issue of intra Aboriginal differences has already been discussed. I have also addressed the importance of measuring income inequality at a theoretically meaningful level, given the hypothetical manner in which it operates as well as the population under discussion. This work focuses on a specific subgroup of Aboriginal people, that is, the on-reserve population.

Income inequality as discussed earlier is a contextual-level variable that has had much success in explaining a variety of social outcomes, including population health

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[65] See Chapter 2 (literature review) for more on the issue of culture and health.

(Wilkinson and Pickett 2006). It is the main independent variable of this analysis. One may ponder the relative importance of an income inequality approach given the relatively poor socioeconomic status of Aboriginal people, particularly the on-reserve population. However, Ellison's (2002) study using 120 countries found that the distribution of income has a stronger effect among poorer countries. This analysis will use the Gini coefficient to measure income inequality, with higher inequality having a detrimental effect on health outcomes. As covered in Chapter 5, the Gini coefficient has many practical advantages as a measure of inequality although as will be discussed, the choice of inequality measure does not appear to have an impact on the relationship between income inequality and health.

Community Median Income: As a measure of central tendency, the median is less vulnerable to the effects of outliers or extreme skew than the mean. Higher median community income means more direct and indirect health producing resources are available to residents (Lynch 2000).

4.12 Dependent Variable

The dependent variable will be the self-rated health of respondents, that is, "In general, would you say that your health is excellent, very good, good, fair, or poor?" This measure of health is a subjective assessment by the respondent as opposed to objective measures which include observable phenomena that may be quantified. Subjective health status is probably the most widely used and cost-effective way to

describe the health status of individuals. Much research has substantiated the utility of using self-rated health as a reliable and valid indicator across numerous studies for diverse cultural groups and ages for health problems, morbidity, mental health, health care usage, longevity, mortality and the onset of disability (Cockerham, Kunz, and Lueschen 1988; DeForge, Sobal, and Krick 1989; Garretsen, van Gilst, and van Oers 1991; Hagan et al. 1994; Idler and Benyamini 1997; Health Canada 1999; Kennedy et al. 1998; Mosteller 1987; Patrick and Bergner 1990; Yacyshyn 2006; Wannamethee and Shaper 1991; Ware et al. 1981). Mossey and Shapiro (1982) and Maddox and Douglas (1973) have found that subjective assessments of health are a better predictor of mortality than health as assessed by physicians. Furthermore, George and Clipp (1991) found that it is the main determinant of the quality of life for the majority of people. Mirowsky and Ross (2003) comment that reports of subjective health have an unusually high level of reliability for a single question; that is, individuals tend to have a very good sense of their own health and are able to assess it with relatively little random error. [66]

Although self-rated health is measured as an ordinal level variable, there are numerous ways it can be treated. This is an important issue as the manner in which the variable is treated could change the results of the analysis. An examination of the literature that uses self-rated health as a dependent variable founds that it has almost always been

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[66] Reliability refers to the amount of information that a measure carries relative to the degree of random noise. Typical survey questions of an individual's state have a reliability of 0.3 while Mirowsky and Ross (2003) found in their work that self-rated health has a reliability of 0.58.

dichotomized (e.g., excellent, very good, good vs. fair and poor). While the process of dichotomizing self-rated health is not necessarily incorrect, this should not be done without explicit justification.[67]

Self-rated health is often collapsed into a dichotomous variable, and this practice is usually done in the absence of any rationale. In general, the process of collapsing variables has received much attention in the literature, and although it is valid, there is a cost in terms of loss of information, and the ordinality of the data is ignored, which may result in reduced statistical efficiency (Agresti 1984; Ananth and Kleinbaum 1997). Empirically, the consequences appear to be rather benign. A rare study on the issue by Manor, Matthews, and Power (2000) found similar results regarding size and significance of main effects, type of association and interaction effects when self-rated health was modeled as a dichotomous variable via logistic regression compared to methods that maintained the ordered nature of the data, including polytomous regression, cumulative odds, continuation ratio, and adjacent categories models. They concluded that a relatively large sample size (n=7 000 in their study) should address

[67] The case of treating the variable as continuous is also worth discussing, but this is far from the norm in the literature and the few cases the author has come across have shown that the differences compared to ordered categorical analysis and logistic regression are moot (e.g., Hou and Myles 2004). Let us entertain the issue of treating the variable as continuous. It is quite often the case that researchers will use numbers to code categories into which individuals identify themselves; however, we are reminded that these numbers are nothing more than codes. In the case at hand, respondents are asked to rate their health with the categories "excellent," "very good," "good," "fair," and "poor." These categories are ordered or ranked. The process of arbitrarily associating the values 1, 2, 3, 4, and 5 with the categories does not automatically make the interval between two values have a quantitative interpretation. Indeed, such a mistaken assumption credits the coding scheme with more meaning than justified. As Bartholomew et al. (2002) point out this embellished meaning may not be as serious in practice, as they argue that the correlation between the ranks of two sets of variables is in many cases quite close to product moment correlation of the true underlying values that constitute the ranks.

power and efficiency issues. Similarly, a simulation study by Armstrong and Sloan (1989) comparing logistic regression to the cumulative odds and continuation ratio models found only a small reduction in power in the dichotomous case although an equal split between categories was used. Overall, the practice of dichotomizing is supported within the context of a large sample size. Not only do the logistic regression results tend to be robust, but the model's simplicity and widespread use makes the process of dichotomization an acceptable one.

Keeping these issues in mind, I have decided to dichotomize self-rated health for this study by collapsing the categories poor/fair and excellent/very good/good.[68] This is based on several key points: 1) this is a common practice in the literature and will facilitate the direct comparison of results; 2) parsimony dictates that we should always adopt the simpler model when it explains as much as the more complex one; 3) the ease of interpretation of the binary logit model without compromising results makes it advantageous; 4) studies show that dichotomizing is acceptable with large sample sizes, which we have in this case (N=18 894).

This chapter has discussed several important methodological issues pertaining to this study. Issues related to the dataset, population, weights, missing data, and the rationale

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[68] Several studies in the income inequality-health literature have dichotomized self-rated health in this manner (Blakely, Lochner and Kawachi 2002; Kahn et al. 2000; Kennedy et al. 1998; Shibuya, Hashimoto, and Yano 2002; Subramanian, Blakely and Kawachi 2003; Subramanian and Kawachi 2003). Yacyshyn (2006) also found support for dichotomizing self rated health in her evaluation of using different metrics.

behind the use of multilevel modeling received strict attention. The variables included in this analysis were discussed including both their relevance as indicated by the literature and their operationalization in this specific study. Chapter 5 will be a prelude to the main analysis, describing the theoretical and methodological issues related to income inequality measures and calculating the relevant socioeconomic characteristics of interest for all reserve communities.

Chapter 5: Income Inequality of First Nations Reserves in Canada

5.0 Introduction

As mentioned in Chapter 2, the income inequality literature on Canada's Aboriginal population can be summarized as follows:

1) There are significant intra Aboriginal differences in income inequality with on-reserve (mostly Registered Indians) and Inuit faring worse than the off-reserve (mostly Non Registered) and Métis. In fact, the intra Aboriginal differences tend to be larger than those between Aboriginals and the non-Aboriginal Canadian population.

2) In so far as previous studies touch upon the issue of income inequality among the Aboriginal population, they do not measure inequality in ways that permit our understanding of the ecological implications. They are most often set at the national level or large areas of aggregation as well as by Aboriginal status.

For this research, income inequality will be measured at the reserve level using micro level data from the 2001 Aboriginal Peoples Survey. This process raises several important methodological issues which should be discussed before I proceed to looking at the principal issue, which is how variations in income inequality affect health outcomes across reserves.

5.1 Equivalence Scales

The economic well-being of an individual is dependent upon his/her household's income as well as the number of household members drawing upon those resources. While datasets may differ in the income variables provided to users, it is ideal to have some measure of family income to appropriately gauge one's economic wellbeing. When this information is available, economists typically apply equivalence scales before comparing raw incomes to adjust for differences in household size and composition. Accomplishing this task involves the use of equivalence elasticities, which refers to the power by which economic needs vary by the size of the household; in other words, we divide income by a measure of household size. The logic of this process is straightforward: the economic demands of a household grow with each additional member; however, this does not occur in a linear manner given there are certain economies of scale (see Atkinson, Rainwater and Smeeding 1995). Indeed, some of the needs of household members, such as electricity, cable, and telephone, are not simply a product of the number of people in the household. For example, in the case of a family of four, it is highly unlikely that the total telephone service costs for the household would be four times the cost of telephone service for a one person household, as most families tend to share the same telephone service. As well, some services are less expensive per unit as one utilizes more, such as natural gas.

Despite the widespread use of equivalence scales in the economic literature, there is debate about the correct equivalence scale to use and the degree to which this choice

affects inequality and poverty measures. The Central Statistics Office of the UK (1987) has claimed that the equivalence scale measures used in common practice do not appear to have much of an effect on results while Buhman et al. (1988) did find some sensitivities in their examination of Luxembourg family income data. Coulter, Cowell and Jenkins (1992) found a systematic relationship between the equivalence scale used and the degree of inequality and poverty observed (see also Banks and Johnson 1994; Jenkins and Cowell 1994). Complicating matters further, Hunter, Kennedy, and Biddle (2002) and Altman and Hunter (1997) warn researchers that the use of equivalence scales for the general Australian population are not appropriate for the Indigenous population. The reason they cite is the crucial differences in the household structure of the Indigenous population compared to the general population, which has a considerable impact on the appropriateness of the equivalency scale used.

In Canada, household structure for Aboriginals differs from the non Aboriginal population; for example, the percentage of seniors living with extended family is 15.6 percent for the former while this value is 7.4 percent for the latter (Statistics Canada 2001a). This means that Aboriginal families are more likely to be multigenerational than the non Aboriginal population. Hunter, Kennedy, and Biddle (2002) suggest that equivalence scales should recognize the differences in various family types across ethnic groups within a population otherwise poverty and inequality measures may be misleading. Depending upon the goal of the research, this may be a viable option; for example, a study of a subgroup of the Aboriginal population, such as on-reserve First

Nations across Canada, would likely make the equivalence scale issue less relevant given the relative homogeneity of the population. For the study at hand, this logic is followed given the focus on the reserve population.

5.2 Economic Family Income in the Sample

This study examines one specific group in Canada: the on-reserve First Nations population in Canada. Income is measured as total economic family income.[69] To take into account differences in family composition, the square root equivalence scale is used. This has been done in several Organization for Economic Cooperation Development (OECD 2005) publications and the Luxembourg Income Study (Atkinson, Rainwater and Smeeding 1995). The formula is seen below:

$$Y = \frac{I}{H^E}$$

The equivalized economic family income, *Y*, is the quotient of *I(Economic family income)/H (Household size)* . This square root elasticity (*E*=0.5) is halfway between

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[69] The choice to use Economic Family Income as opposed to Census Family Income is based on the fact that Economic Family Income uses a more liberal definition of the family (Statistics Canada 2001b). This point is important given the assumption that Aboriginal families may include a broader range of persons contributing to and/or drawing from the household than found in the Canadian population. In other words, there are going to be more cases where the housing and social structure creates multiple and/or extended family groups that are not defined as a family type under the Census Family Income definition; hence, the use of Economic Family Income appears to be more appropriate. Despite these definitional differences, I note that the correlation coefficient (Pearson's r) between the two types of family income is extremely high with a value of 0.991.

the two extremes, where E=0 refers to the unadjusted economic family income and E=1 is equivalent to using per capita economic family income.

5.3 Measures of Income Inequality

There are numerous indicators of income inequality. I will not enter into a detailed discussion on this topic, but it would be useful to address some of the main issues in the literature.

There are a few guiding principles that one should follow when selecting inequality measures (Allison 1978; Coulter 1989):

1) The Principle of Scale Invariance – when one uses different units to measure a variable, there should be no real change in its distribution. For example, examining income inequality between two countries should be independent of the currency used within each country.

2) The Pigou Dalton Principle of Transfers – inequality is decreased when income is transferred from a higher income unit to a lower income unit irrespective of the amount of the transfer or the relative ranking of the income units in the distribution (poor or rich). For example, government transfers or a progressive income tax system would result in such a transfer of income between income units of a distribution.

3) The Principle of Constant Additions – scale invariant measures of inequality should decline when a positive constant is added to all units in the distribution. In other words, if $50 000 is given to all individuals in a distribution, the measure of income inequality should decline.

Given the principles outlined above, there are three measures of inequality that will be discussed, including the Gini coefficient of inequality, the coefficient of variation, and Theil's index of entropy. This choice of measures follows Allison (1978) who comments that other measures of inequality either fail to satisfy the criteria outlined above, have very restrictive applications, or are simple monotone functions of the ones outlined.

The Gini coefficient of inequality is probably the most popular measure used in the literature. It is understood in terms of the Lorenz curve (Lorenz 1905). The Lorenz curve shows the relationship between the percentage of income recipients and the percentage of income they earn. The percentage of income earning units are plotted along the horizontal axis and the percentage of income in a system on the vertical axis (see Figure 5.1). Perfect equality is graphically displayed by a 45 degree diagonal; hence, "z" percentage of income recipients would possess "z" percentage of income. Complete inequality occurs when one income recipient possesses all income and everyone else none as seen by a Lorenz curve that lies directly on the horizontal and

vertical axes. The Lorenz curve cannot cross the line of perfect equality or absolute inequality. Note that if Lorenz curves intersect, one cannot rank the distributions in terms of their inequality.

The Gini coefficient is calculated as the ratio of the area between the Lorenz curve and the 45 degree line to the entire area below the diagonal. This ratio is expressed as a percentage or as the numerical equivalent of that percentage, which is always a number between 0 and 1. Higher numbers are associated with greater inequality.

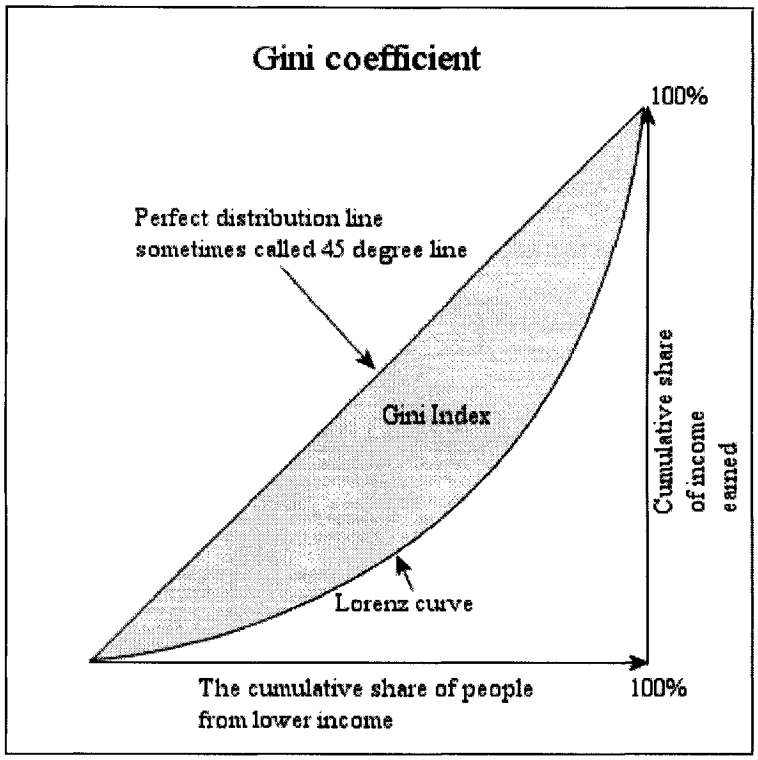

FIGURE 5.1 Gini Coefficient (Source: Wikipedia (2006))

The Gini coefficient is stated more formally as follows:[70]

$$G = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} |x_i - x_j|}{2 n^2 \mu}$$

The Gini measures dispersion (average absolute difference between all pairs of individuals) divided by twice the mean.

The coefficient of variation is one of the most intuitively easy measures to understand as it is simply the standard deviation (σ) divided by the mean (μ):

$$V = \frac{\sigma}{\mu}$$

This measure varies between zero and infinity; however, a simple transformation can create an upper bound for this measure, if so desired. Lower values are associated with less inequality.

Theil's index of entropy measure is based on the concept entropy, which is used in physics and information engineering. In the former it refers to the disorder or randomness in a substance or physical system while in the latter it measures the information content of a message, evaluated as to its uncertainty (Coulter 1989). It is given by the following formula:

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[70] It has been shown that the sample Gini coefficients need to be multiplied by n/(n-1) in order to become unbiased estimators for the population coefficients.

$$T = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i}{\mu}\right)\log\left(\frac{x_i}{\mu}\right)$$

n = number of people

x_i = income of individual 'i'

μ= mean income

This measure varies between zero and infinity; however, a simple transformation can create an upper bound for this measure, if so desired. Lower values are associated with less inequality.

Measures of inequality are far from identical as they each tend to be differentially sensitive to parts of a distribution (see Coulter 1989). The coefficient of variation is equally sensitive to transfers at all income levels. The Gini coefficient, however, is sensitive to transfers based upon individuals' ranks instead of numeric scores, which means that it is quite sensitive to transfers around the middle of the distribution and less so to transfers among the very rich or poor. Finally, for Theil's entropy measure, lower levels of income are most sensitive to transfers (Allison 1978). Several authorities state that the choice of measure can have an impact on one's conclusions (Allison 1978; Atkinson 1970; Coulter 1989). Allison (1978) cautions researchers that choosing a measure of inequality is really a choice among alternative definitions of inequality; it is not a choice among alternative measures of a single construct.[71]

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[71] Readers are advised to seek out many of the works cited for an in-depth examination of the issues presented as well as alternative measures of inequality which are ubiquitous in the literature.

How different are inequality measures used in practice? A study by Alker and Russett (1964) and Hou and Myles (2004) found high correlations between their measures of inequality, and an oft-cited article by Kawachi and Kennedy (1997) found no correlation coefficient below 0.86. Most importantly, the latter concluded that the choice of indicator could be essentially ruled out as having an impact on the results of numerous studies examining the relationship between income inequality and health. Their sensitivity analysis also found the differences between adjusting/not adjusting inequality measures (i.e., Gini coefficient) for taxes, transfers, and household size were benign.

5.4 Socioeconomic Characteristics of First Nations Communities

The socioeconomic characteristics of the communities were calculated in SPSS 15.0 and Microsoft Excel 2003, *based on equivalized economic family income*. An examination of Table 5.1 below reveals that all community socioeconomic characteristics vary considerably across reserves. The Gini coefficient ranges from 0.24 to 0.54 with a mean of 0.36; Theil's index of entropy ranges from 0.04 to 0.22 with a mean of 0.09; and the coefficient of variation ranges from 0.44 to 1.29 with a mean of 0.70. All three measures of income inequality yield similar results. This is not surprising given the high correlations between them (Pearson's $r = 0.91$ or higher as seen in Table 5.2), which coincides with the associations between inequality measures

found by Alker and Russett (1964), Hou and Myles (2004), and Kawachi and Kennedy (1997).

While not of primary interest in this analysis, another socioeconomic measure of the context, median/mean equivalized economic family income of the community, demonstrates the range of community socioeconomic status. [72] Again, we observe large differences between communities in terms of the mean community income with a value of $17911.46 and range of $8734.29 -$32080.56, as well as the median community income with a value of $15350.50 and a range of $4591.90-$29236.74. The correlation between income inequality and community socioeconomic status shows that high community socioeconomic status is associated with low levels of income inequality as seen in Table 5.2. Although the correlations between all measures of inequality and socioeconomic status are significant, the strength of the relationship is not large. This relationship will be examined in greater detail in chapter 6 within the hierarchical linear model.

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[72] The mean is the sum of the measurements divided by the number of respondents. It can be thought of as the "centre of gravity" of the data. The median divides the ordered dataset into two parts of equal numbers of subjects, half scoring below and half above that point. It is less affected than the mean by outliers or extreme skew.

Community Name	Mean Income ($)	Median Income ($)	Coefficient of Variation	Theil Coefficient	Gini Coefficient
Ahtahkakoop No. 104	13 623.02	10 900.02	0.7889	0.1156	0.3988
Alert Bay	21 158.11	19 057.79	0.6118	0.0796	0.3323
Alexis No. 133	17 825.89	15 766.85	0.5372	0.0629	0.2984
Alkali Lake No. 1	17 254.34	16 263.91	0.6352	0.0957	0.3519
Assiniboine No. 76	13 448.50	10 969.22	0.8078	0.1218	0.4061
Big River No. 118	11 896.85	10 257.10	0.7568	0.1011	0.3670
Blood No. 148	16 604.81	13 517.42	0.7662	0.1128	0.3992
Buffalo River Dene Nation No. 193 (Peter Pond Lake No. 193)	15 463.65	12 891.18	0.8453	0.1231	0.4051
Burnt Church No. 14	12 401.27	9 248.45	0.8078	0.1305	0.4251
Campbell River No. 11	26 086.25	23 984.13	0.6159	0.0816	0.3360
Canoe Lake No. 165	16 958.75	13 784.49	0.6626	0.0939	0.3644
Capilano No. 5	20 582.06	16 413.90	0.8261	0.1297	0.4211
Chehalis No. 5	18 824.24	16 538.19	0.6042	0.0754	0.3197
Chemainus No. 13	13 995.63	11 275.28	0.7037	0.0921	0.3593
Chemawawin No. 2	14 189.88	11 952.78	0.6280	0.0803	0.3392
Chicken	14 218.32	11 350.09	0.7021	0.1003	0.3790
Chisasibi	29 672.45	28 054.01	0.4350	0.0406	0.2418
Christian Island	17 183.19	12 436.57	0.8919	0.1451	0.4445
Clearwater River	18 051.45	14 911.17	0.6313	0.0727	0.3151
Cole Bay No. 3	12 052.17	10 701.97	0.6172	0.0810	0.3301
Cote No. 64	12 830.11	12 080.51	0.7145	0.1078	0.3879
Couchiching No. 16A	25 115.87	22 329.59	0.5307	0.0559	0.2806
Cowessess No. 73	17 234.35	16 583.73	0.6154	0.0823	0.3343
Cowichan No. 1	14 390.09	10 547.07	0.7906	0.1218	0.4076
Cross Lake	14 249.59	12 263.60	0.7704	0.1280	0.4213
Curve Lake First Nation No. 35	21 908.38	17 318.67	0.7266	0.1101	0.3894
Deer Lake	16 495.32	14 512.41	0.6183	0.0783	0.3216
Deline	18 429.83	15 536.88	0.5530	0.0679	0.3068
Deschambault Lake	12 954.47	11 334.81	0.5570	0.0571	0.2737
Devon No. 30	15 784.29	14 461.81	0.6313	0.0844	0.3462
East Moberly Lake No. 169	18 355.81	17 914.64	0.6432	0.0957	0.3589
Ebb and Flow No. 52	11 608.00	7 696.64	0.8936	0.1419	0.4410
English River No. 21	13 745.18	9 235.13	0.8920	0.1727	0.4834
Eskasoni No. 3	12 216.15	9 513.75	0.8912	0.1472	0.4460
Fairford No. 50	13 757.72	10 952.26	0.8135	0.1323	0.4275
Flying Dust First Nation No. 105 (Meadow Lake No. 105)	16 828.98	14 418.40	0.7064	0.0942	0.3626
Fort Good Hope	23 883.77	21 068.23	0.5324	0.0588	0.2875
Fort Hope No. 64	14 943.20	13 757.70	0.5630	0.0696	0.3110
Fort Liard	28 393.37	23 895.25	0.7173	0.0956	0.3619
Fort MacKay - DPL	32 080.56	29 236.74	0.7551	0.1029	0.3646
Fort McPherson	23 055.81	20 392.81	0.6736	0.0959	0.3676
Fort Nelson No. 2	26 082.34	21 621.79	0.7166	0.1043	0.3772

Community Name	Mean Income ($)	Median Income ($)	Coefficient of Variation	Theil Coefficient	Gini Coefficient
Fort Providence	24 242.96	18 961.82	0.7112	0.1059	0.3864
Fort Resolution	21 274.29	17 875.95	0.7124	0.0989	0.3659
Fort William No. 52	19 025.53	14 685.98	0.8412	0.1471	0.4489
Garden River No. 14	21 412.33	19 793.06	0.6744	0.1003	0.3710
Gitanmaax No. 1	22 790.70	19 194.52	0.6759	0.0962	0.3712
Gitsegukla No. 1	15 169.74	12 044.00	0.7178	0.0939	0.3612
Gitwangak No. 1	9 311.64	4 678.83	1.0774	0.2179	0.5441
Gordon No. 86	13 655.54	10 907.28	0.7121	0.1009	0.3794
Grand Council of the Crees / Grand conseil des Cris	27 093.04	25 242.97	0.4612	0.0482	0.2602
Hagwilget No. 1	19 813.62	17 996.81	0.6684	0.0940	0.3616
Hay River Dene No. 1	24 777.52	23 787.81	0.6030	0.0764	0.3192
Indian Brook No. 14	15 798.43	13 677.87	0.6921	0.0910	0.3513
James Smith No. 100	13 403.08	11 890.30	0.7235	0.0949	0.3553
John d'Or Prairie No. 215	12 920.72	9 502.76	0.7134	0.1090	0.3929
Kamloops No. 1	19 531.08	14 692.54	0.8428	0.1378	0.4379
Kettle Point No. 44	23 691.63	18 930.47	0.8512	0.1150	0.3796
Kitamaat No. 2	26 993.74	26 559.28	0.5337	0.0643	0.2985
Kitsakie No. 156B	14 803.70	12 593.69	0.6080	0.0646	0.2931
La Loche	12 883.48	10 770.84	0.7230	0.0986	0.3645
Lac La Ronge No. 156	16 120.09	14 907.69	0.5997	0.0773	0.3296
Lac Seul No. 28	16 299.40	16 260.21	0.5919	0.0842	0.3359
Lennox Island No. 1	21 826.12	16 302.27	0.8707	0.1447	0.4495
Little Pine No. 116	14 874.61	12 273.85	0.6933	0.0907	0.3543
Louis Bull No. 138B	13 297.87	11 847.77	0.5676	0.0676	0.3114
Makaoo(Part) No. 120	13 580.92	11 674.40	0.7008	0.0953	0.3684
Makwa Lake	14 105.39	13 176.53	0.5977	0.0684	0.2983
Millbrook No. 27	19 905.21	18 007.00	0.6197	0.0787	0.3336
Ministikwan	12 369.07	10 489.23	0.6368	0.0802	0.3277
Mission No. 1	28 906.76	27 006.53	0.6309	0.0772	0.3208
Mississagi River No. 8	21 654.00	18 842.26	0.6343	0.0827	0.3380
Mnjikaning First Nation No. 32 (Rama First Nation No. 32)	28 922.30	28 325.62	0.5425	0.0639	0.3004
Montana No. 139	12 570.55	11 619.12	0.9380	0.1777	0.4920
Montreal Lake	13 857.45	10 428.84	0.7831	0.1168	0.4039
Moosomin No. 112B	10 205.94	7 053.11	0.8073	0.1309	0.4248
Mosquito No. 109	11 595.99	9 774.04	0.5677	0.0650	0.3018
Musqueam No. 2	20 259.89	16 162.39	0.7978	0.1363	0.4366
Nanaimo Town No. 1	22 657.66	19 379.79	0.6266	0.0825	0.3403
Nelson House No. 170	17 510.84	14 688.90	0.6405	0.0811	0.3384
Nisga'a Nation / La nation Nisga'a	22 764.33	20 993.76	0.6176	0.0817	0.3373
Norway House No. 17	17 313.70	14 389.19	0.7210	0.1029	0.3782
Okanagan No. 1	22 208.43	20 223.37	0.6239	0.0874	0.3470

Community Name	Mean Income ($)	Median Income ($)	Coefficient of Variation	Theil Coefficient	Gini Coefficient
Old Crow	21 419.59	14 353.56	0.8407	0.1207	0.3953
Opaskwayak Cree Nation	17 504.82	12 707.18	0.8219	0.1302	0.4258
Oxford House No. 24	18 408.27	15 631.76	0.6422	0.0810	0.3386
Peepeekisis No. 81	12 690.83	11 705.70	0.7785	0.1183	0.3974
Peguis No. 1B	16 461.29	14 325.19	0.5809	0.0737	0.3185
Peigan No. 147	16 718.39	15 018.33	0.6079	0.0778	0.3286
Pelly Crossing	22 929.10	20 122.94	0.5884	0.0752	0.3286
Piapot No. 75	14 174.96	13 694.22	0.6766	0.0993	0.3652
Pikwakanagan (Golden Lake No. 39)	20 456.41	17 822.16	0.5658	0.0685	0.3147
Pinehouse	18 512.76	16 301.56	0.9113	0.1190	0.3748
Poundmaker No. 114	14 860.85	11 035.37	1.0179	0.1699	0.4759
Rae-Edzo	22 351.95	19 593.96	0.6651	0.0960	0.3622
Ross River	22 337.25	21 526.43	0.6127	0.0819	0.3377
Sagamok	18 622.30	16 388.19	0.6249	0.0817	0.3363
Samiajij Miawpukek	30 213.03	27 270.19	0.5072	0.0501	0.2665
Samson No. 137	8 829.02	4 591.90	1.1198	0.2148	0.5356
Sandy Bay	18 850.49	16 732.97	0.6014	0.0730	0.3163
Sandy Bay No. 5	13 110.69	10 563.63	0.7434	0.1034	0.3791
Sandy Lake No. 88	17 433.02	14 905.10	0.6144	0.0701	0.3101
Seabird Island	18 771.45	15 410.41	0.7025	0.0981	0.3734
Sechelt (Part)	16 418.48	16 382.81	0.7133	0.1209	0.4027
Seekaskootch No. 119	13 717.87	10 715.74	0.7247	0.0925	0.3560
Siksika No. 146	15 869.90	12 228.38	0.8036	0.1215	0.4109
Sioux Valley No. 58	14 438.62	11 471.61	0.7348	0.1031	0.3796
South Saanich No. 1	17 270.40	15 716.49	0.5766	0.0709	0.3198
Split Lake No. 171	15 946.89	13 850.65	0.5945	0.0709	0.3139
St. Theresa Point	16 852.00	13 896.38	0.7380	0.0874	0.3333
Standing Buffalo No. 78	13 309.99	10 800.46	0.8026	0.1224	0.4094
Stoney No. 142, 143, 144	11 754.72	10 285.02	0.5893	0.0757	0.3270
Stony Creek No. 1	8 734.29	7 239.97	0.8963	0.1634	0.4744
Stony Plain No. 135	19 863.80	16 611.02	0.7340	0.1103	0.3893
Sturgeon Lake No. 101	14 182.44	8 602.27	1.2935	0.2121	0.5050
Tache No. 1	14 518.32	12 458.29	0.7504	0.1085	0.3912
Tsahaheh No. 1	20 220.44	17 694.74	0.6371	0.0844	0.3458
Tsinstikeptum No. 9	24 310.27	21 916.13	0.6892	0.0817	0.3199
Tsulquate No. 4	14 111.51	14 175.96	0.6374	0.0794	0.3261
Tsuu Tina Nation No. 145 (Sarcee 145)	23 682.70	17 382.63	1.0158	0.1501	0.4258
Tulita	25 165.73	23 686.46	0.5524	0.0645	0.3010
Utikoomak Lake	15 053.64	11 791.08	0.9656	0.1414	0.4238
Wabamun No. 133A	17 366.11	13 648.86	0.7724	0.1110	0.3942
Wabasca No. 166, 166A, 166B,166C,166D	21 100.69	16 863.04	0.6944	0.0933	0.3582
Wapachewunak No. 192D	20 433.56	19 868.73	0.6143	0.0663	0.2869
Waterhen No. 130	15 698.67	12 506.38	0.6618	0.0840	0.3438

Community Name	Mean Income ($)	Median Income ($)	Coefficient of Variation	Theil Coefficient	Gini Coefficient
Waywayseecappo First Nation	13 421.84	12 616.78	0.6901	0.0842	0.3293
WhaTi	26 962.60	25 995.12	0.5461	0.0677	0.3032
White Bear No. 70	17 364.20	14 788.57	0.7312	0.1156	0.4057
White Fish Lake No. 128	15 945.23	14 533.50	0.5715	0.0681	0.3077
Wikwemikong Unceded No. 26	19 649.20	15 911.77	0.7204	0.0976	0.3651
Wiliiams Lake No. 1	20 336.97	19 337.33	0.6021	0.0785	0.3283
Woyenne No. 27	17 757.57	16 615.82	0.6685	0.0893	0.3468
Minimum	8 734.29	4 591.90	0.4350	0.0406	0.2418
Maximum	32 080.56	29 236.74	1.2935	0.2179	0.5441
Mean	17 911.46	15 350.50	0.7033	0.0993	0.3644

TABLE 5.1 Socioeconomic Characteristics of First Nations Communities

	Coefficient of Variation	Theil Coefficient	Gini Coefficient	Mean Income	Median Income
Coefficient of Variation	1.00				
Theil Coefficient	0.959**	1.00			
Gini Coefficient	0.917**	0.982**	1.00		
Mean Income	-0.182*	-.201*	-0.224**	1.00	
Median Income	-0.265**	-0.276**	-.299**	0.990**	1.00

Pearson's r based on N = 134,
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

TABLE 5.2 Correlation Matrix of Community Socioeconomic Characteristics

In Chapter 2, a table of all known studies of Aboriginal income inequality was presented. This work is not directly comparable to those studies for a number of reasons, including the level at which income inequality was measured. Nevertheless,

the overall trend of large First Nation community differences concurs with much of the work.

Let us quickly review what has been done in done this chapter. I have addressed the technical issues pertaining to the measurement of income inequality and described two important characteristics of First Nations communities (reserves), that is, income inequality and community socioeconomic status. Most importantly, these measures have been created at a theoretically and geographically meaningful level to the constituents of the communities.

Despite the attention devoted in the literature to income disparities, and much less so income inequality, there have been no attempts to the author's knowledge to *empirically link the latter to Aboriginal population outcomes such as health.* This gap is significant: inequality matters in so far as it has significant effects on social outcomes otherwise the utility of its documentation is questionable. Having documented the socioeconomic characteristics of 134 reserve communities across Canada, we will now proceed to examine the hypotheses outlined in Chapter 3 linking income inequality to First Nations health.

Chapter 6: Results

6.0 Introduction

In this chapter, the results of the study are presented, given the hypotheses outlined in Chapter 3. Descriptive statistics describe the sample in detail, and the multilevel model is given strict attention. A short discussion on the general linear model is provided with an emphasis on logistic regression. Model assumptions of the logistic regression model are presented, and a series of results, including, model fit, classification, interpretation of regression coefficients, and an analysis of residuals are set forth.

6.1 Descriptive Statistics

Descriptive statistics, including means and frequency distributions were run to provide an overview of the sample population (see Table 6.1). The composition of the sample was 49.9% male and 50.1% female. The respondents' ages ranged from 15-119[73] with a mean of 36.4 years. In terms of marital status, the majority of respondents were single (55.9%), followed by married (31.7%) and divorced/separated/widowed (12.4%). Most respondents reported low education (56.3%), followed by medium education (22.0%) and high education (21.6%). The average equivalized economic family income of the respondents was $18 050.97. Approximately 47% of respondents were not in the labor force while 40.0% of respondents were employed and 12.9% of

[73] It is no surprise that there are outliers in the age grid. In some communities, record keeping for age is not always accurate. The very elderly may not always know precisely when they were born.

respondents were unemployed. Most respondents—42.5%—smoked daily while 41.2% reported not smoking at all. Finally, 16.3% of respondents smoked occasionally. Binge drinking habits were reported as follows by respondents: 43.2% do not drink; 6.2% never binge drink; 39.8% sometimes binge drink; and 10.8% often binge drink. The majority of respondents—62.4%—reported seeing or talking with a family doctor or GP in the last 12 months while 37.6% did not. Approximately 72% of respondents had access to traditional medicine, healing or wellness practices in their communities and only 28% reported not having access to these resources in their community. The average level of social support in the sample was 13.3 with a possible range of 4 to 16 with the former being the lowest level of support possible and the latter the highest. Lastly, in terms of culture, 20.2% of respondents reported being unable to understand or speak an Aboriginal language compared to 79.8% of those who reported an ability to do so. In terms of contextual-level variables, across the 134 communities in the analysis, the Gini coefficient had a mean of 0.36 while Theil's index of entropy had a mean 0.09. Finally, the coefficient of variation had a mean of 0.70. In terms of the mean community income, it was found to be $17 911.46 while the median community income had a value of $15 350.50.

Dependent Variable	**Self-rated health (%)**	
	Good Health (Excellent/Very good/Good)	82.1
	Poor Health (Fair/Poor)	17.9
Independent Variable (Individual-level)	**Age, years (Mean)**	36.4
	Sex (%)	
	Male	49.9
	Female	50.1
	Marital Status (%)	
	Divorced, Separated, Widowed	12.4
	Married	31.7
	Single	55.9
	Income – (Mean $)	38409.05
	Equivalized Economic Family Income (Mean $)	18050.97
	Ln Equivalized Economic Family Income (Mean $)	9.45
	Labor Force Status (%)	
	Employed	40.0
	Unemployed	12.9
	Not in labor force	47.1
	Education (%)	
	Low education	56.3
	Medium education	22.0
	High education	21.6
	Smoking (%)	
	Daily	42.5
	Occasionally	16.3
	Not at all	41.2
	Binge Drinking (%)	
	Sometimes	39.8
	Often	10.8
	Never	6.2
	Do not drink	43.2
	Seen GP in last Year (%)	
	Yes	62.4
	No	37.6
	Access to Traditional	

Independent Variables (Individual-level)	**Medicine/Healing/Wellness Practices (%)**	
	Yes	72.3
	No	27.7
	Social Support (Mean)	13.3
	Culture: Ability to speak or understand an Aboriginal language(%)	
	Yes	79.8
	No	20.2
Independent Variables (Contextual-level)	**Income Inequality: Gini Coefficient (Mean)**	0.3644
	Income Inequality: Theil Coefficient (Mean)	0.0993
	Income Inequality: Coefficient of Variation (Mean)	0.7033
	Community Mean Income (Mean)	17911.46
	Community Median Income (Mean $)	15350.50
	Logarithm of Community Mean Income (Mean $)	9.7932
	Logarithm of Community Median Income (Mean)	9.6389

TABLE 6.1 Descriptive Statistics of the Sample

NOTE: N = 18890 (Individual-level Variables), N = 134 (Contextual-level Variables)

6.2 Multilevel Analysis: The Null Model

The first step in building a multilevel model is to assess the simplest or null model, that is, the model with no explanatory variables. The simplest model in hierarchical linear modeling is called a one way ANOVA with random effects (Raudenbush and Bryk 2002). This model serves several purposes, including the following:

i) Estimation of the grand mean;

ii) Partitioning of total variation into "within" and "between" communities; in other words, how much variation in the outcome lies within and between reserve communities?

iii) Providing a range of plausible values for the community means and a test of the hypothesis that the variability is null. The null hypothesis of no significant variation between communities is assessed. Formally, the hypothesis is H_o: $\tau_{oo}=0$ where τ_{oo} is the population variance among the community means;

iv) Information on the degree of dependence of the observations within each community (ICC).

The analysis was run in HLM 6.04. Given a dichotomous outcome, where "0" refers to good health and "1" refers to poor health, a hierarchical generalized linear model is required to model the outcome as a function of individual and contextual independent variables. Specifically, a hierarchical logistic regression model is appropriate to model this type of data (Raudenbush and Bryk 2002). To capture the magnitude of variation between communities in terms of poor health, a model with no predictors at level one or level two is estimated. With a Bernoulli sampling model and a logit link function,[74] the level 1 model is given by the following:

Probability of (Poor health$_{ij}$= 1 | β_j) = $\varphi_{ij,}$ where ij refers to individual 'i' in community 'j'.

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[74] The GLM and related link functions will be discussed in greater detail in Section 6.2.

Log $[\varphi_{ij} / (1- \varphi_{ij})] = \eta_{ij}$ and, therefore, the level 1 model is $\eta_{ij} = \beta_{oj}$

The level 2 model is $\beta_{oj} = \gamma_{oo} + u_{oj}$ where $u_{oj} \sim N(0, \tau_{oo})$.

The mixed model is given by $\eta_{ij} = \gamma_{oo} + u_{oj}$.

φ_{ij} is the conditional probability of poor health of individual 'i' in community 'j'
β_{oj} is the intercept of community j
τ_{oo} is the variance of β_{oj}
γ_{oo} is the grand mean of poor health for communities.
u_{oj} is the unique effect of community j on the mean of poor health; it is assumed to be normally distributed with a mean of 0 and variance τ_{oo}.

Fixed Effect	**Coefficient**	**S.E.**		
Average poor health of community, intercept, γ_{oo}	-1.513106	0.045242		
Random Effect	**Variance Component**	***Df***	χ^2	**p-value**
Community mean variance, τ_{oo} =var(U_{oj})	0.02089	133	142.44908	0.272

TABLE 6.2 Results from the One Way ANOVA With Random Effects Model

Fixed Effects

In Table 6.2, the estimate for the grand mean of poor health across communities is given by $\hat{\gamma}_{oo} = -1.513106$. This has a standard error of 0.045242 and yields a 95% confidence interval of -1.513106 +/-1.96(0.045242) = (-1.42493168, -1.60178032). Converting these values to probabilities, $\pi\ (x) = e^{\beta o} / 1 + e^{\beta o}$, where π of x is the probability of poor health for a given x, yields $\pi\ (x) = 0.22022/1.22022 = 0.180$ for the grand mean of poor health, with a 95% confidence interval of 0.167 and 0.194.

Variance Components

At the community level, τ_{oo} is the variance of the true community means, β_{oj}, around the grand mean, γ_{oo}. As seen in Table 6.2, the estimated variability of the community means is $\hat{Var}(\beta_{oj}) = \hat{Var}(u_{oj}) = \hat{\tau}_{oo} = 0.02089$.

It is useful to examine the degree of variation among communities in terms of their mean poor health levels by calculating the plausible range of values for those means. Under the normality assumption, 95% of the community means will fall within the range $\hat{\gamma}_{oo}$ +/- $1.96(\hat{\tau}_{oo})^{1/2}$, which results in -1.513106 +/- $1.96(0.02089)^{1/2}$ = (-1.2298, -1.7964). Converting these log odds to probabilities, 95% of the communities lie between 0.14229 and 0.2262 with respect to the probability of poor health.[75]

We can formally test whether the estimated value of τ_{oo} is significantly greater than zero. It has a large sample χ^2 distribution with J-1 degrees of freedom under the null hypothesis. As seen in Table 6.2 the test statistic has a value of 142.4498 with 133 degrees of freedom (J = 134 communities). The null hypothesis is quite plausible (p=0.271), which indicates that no significant variation exists between communities in terms of their health.

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[75] See Appendix B for a breakdown of health by each reserve community used in this analysis.

Intraclass Correlation

One useful auxiliary statistic typically reported is the intraclass correlation. The intraclass correlation is a measure with two interpretations: a) the correlation between two randomly drawn individuals in one randomly drawn group; b) the proportion of the total variability that is a result of the group level (Snijders and Bosker 1999).

In a multilevel Bernoulli model, the logistic distribution for the level one residual has a variance of $\pi^2/3 = 3.29$. Hence, for a two level logistic random intercept model with intercept variance τ_{oo}, the intraclass correlation is defined as follows (Snijders and Bosker 1999):

$$\rho = \frac{\tau_{oo}}{\tau_{oo} + \pi^2/3}$$

Substitution of the estimated variance components for their parameters yields 0.02089 / (0.02089 +3.29), which results in an intraclass correlation of 0.00631. Alternatively stated, 0.631% of the variance in health is between communities.

Thus, there is no statistically significant variation at the community level according to the test of the variance component as well as the intraclass correlation. In this case, the researcher proceeds by examining the simpler single level logistic regression model since the effects of clustering are insignificant and do not need to be modeled (Raudenbush and Bryk 2002; Snijders and Bosker 1999).

6.3 The General Linear Model and Logistic Regression

Before proceeding with the single level logistic regression model, I will briefly discuss the model in the context of the generalized linear model. The generalized linear model is described by three key features: a) the random component which is simply the outcome variable and its associated probability distribution; b) a systematic component refers to the manner in which the independent variables are combined in the model, which has the form $\alpha+\beta_1X_1+ \beta_2X_2+ \ldots+\beta_kX_k$ in both traditional linear regression and logistic regression, where α is the intercept, β are regression coefficients and *X's* refer to the predictors; c) the link component which indicates how the mean of Y is related to the linear predictor (Agresti 1990; Gill 2001; Long 1997).

In ordinary linear regression with a continuous outcome, the mean of Y (random component) is modeled directly as a linear function (systematic component) of explanatory variables, with the identity link (link function). In the case of a dichotomous outcome, such as in the present study, indicated by 1 (poor health) and 0 (good health), the probability that Y=1 is denoted as π (random component), where logit(π) is the logit link function of this probability and equal to the natural logarithm of the odds, that is, $\pi/(1-\pi)$. Hence, the linear relationship (systematic component) between logit (π) and the independent variables is given as follows:

$$\text{Logit}(\pi) = \ln \pi/(1-\pi) = \alpha+\beta_1X_1+ \beta_2X_2+ \ldots+\beta_kX_k$$

The interpretation is simply that the natural logarithm of the odds that Y=1 varies as a function of the linear predictor $\alpha+\beta_1X_1+ \beta_2X_2+ \ldots+\beta_kX_k$ (Agresti 1984; 1990; Gill

2001; Hosmer and Lemeshow 2000; Long 1997; Menard 2002; Tabachnick and Fiddell 2001).

6.4 Logistic Regression: Assumptions

Logistic regression is relatively free of restrictions but there are some key assumptions that should be checked to ensure the integrity of the model and estimated coefficients (Hosmer and Lemeshow 2000; Tabachnick and Fidell 2001).

First, the ratio of cases to variables must be adequate otherwise the results will tend to have very large parameter estimates and standard errors coupled with possible convergence failure issues (Tabachnick and Fiddell 2001). The output showed no extremely large parameter estimates or standard errors[76] (see Table 6.3); thus we have no reason to believe that we have problems related to empty cells.

Second, when using a goodness-of-fit test which compares observed with expected frequencies in cells, the expected cell frequencies for the discrete variables must be adequate otherwise the analysis may lack statistical power. It is recommended that all expected frequencies be no less than one and no more than 20% of cells have less than five cases (Tabachnick and Fidell 2001). An examination of crosstabs checked the

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[76] The presence of large parameter estimates and standard errors can also be evidence of the presence of outcome groups that are perfectly separated (ibid.).

adequacy of expected frequencies for all pairs of discrete predictors and no problems were found.

Third, logistic regression assumes a linear relationship between continuous independent variables and the log of the dependent variable (linearity in the logit), as per the logit link function discussed above (Hosmer and Lemeshow 2000; Tabachnick and Fidell 2001). No significant deviation from linearity was detected for any of the continuous variables--age, income, and social support--when graphical plots were examined.[77]

Fourth, multicollinearity must be absent from the model. In other words, no explanatory variable should be a perfect linear function of any other explanatory variables (i.e., one independent variable can be explained completely by another independent variable). In the presence of multicollinearity, it is impossible to estimate effects holding all other independent variables in the equation constant since every time one collinear variable changes, its "twin" changes in an identical manner. Consequently, estimation of an equation is impossible, no unique solution exists, and

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[77] There are several ways of testing for linearity in the logit, including the Box-Tidwell approach and the one used in this analysis, graphical plots (Hosmer and Lemeshow Tabachnick and Fiddell 2001). In short, following the procedure as set out by Hosmer and Lemeshow (2000), the quartiles of the distribution of the continuous variables were obtained and then a categorical variable with four levels using three cutpoints based on the quartiles was created. The multivariable model was fitted by replacing the continuous variable with the four level categorical variable (three dummies were created with the lowest quartile as the reference group). Next a plot of the estimated coefficients versus the midpoints of the groups as well as a coefficient equal to zero at the mid point of the first quartile was created. A line was drawn to connect the four plotted points. A visual inspection was conducted and the appropriate parametric form suggested by the plot was selected; in this case, the relationship between the logit and continuous variables was deemed, indeed, to be linear.

infinitely large sampling variances are observed (Studenmund 2000). The analysis did not show any evidence of multicollinearity, given the absence of convergence problems and the standard errors for parameters were not excessively large.

Fifth, there must be an absence of outliers in the solution. Outliers are observed when cases are not predicted well by the solution, which may result in poor model fit, and by a thorough examination of the residuals (Hosmer and Lemeshow 2000; Tabachnick and Fiddell 2001). There were no major problems related to outliers in this analysis, although a thorough treatment of the issue is provided in Section 6.9.

Finally, there is an assumption of independence of errors which means that the responses of different cases are assumed to be independent of one another (Tabachnick and Fidell 2001). There is no reason to believe that each response is not a product of a different unrelated case given the design of this study.[78]

Thus, the major assumptions of the logistic regression model were met by the data.

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[78] Study designs that would be problematic include matched case control studies as well as repeated measures analysis because the error terms would tend to be correlated.

6.5 Logistic Regression Model Overview

Having checked the major assumptions of the logistic regression model, the analysis proceeded with a sequential logistic regression analysis.[79] In sequential logistic regression, the researcher specifies the order of entry of blocks of predictors into the model. As each block of independent variables is entered into the model, it is assigned both unique and overlapping variability left to it at its point of entry. This means that the analysis examines whether variables have effects over and above those previously entered into the model to assess the extent to which they are predictive of health. Thus, we are able to assess the contribution of each set of independent variables to the model in terms of what it adds to the equation at its point of entry. Usually this sequencing is based on logical considerations. In the case at hand, we have five blocks of variables that were entered in their order of perceived importance in determining health. The blocks of independent variables were entered as follows: Block 1 – Demographic (Age, sex, income, marital status, labor force status, education); Block 2 – Lifestyle (smoking and alcohol consumption); Block 3 – Health resources (interaction with medical doctor and access to traditional medicine, healing, wellness practices); Block 4 – Social support (degree of belonging/association); and Block 5 – Culture (Aboriginal language skills).

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[79] Multiple imputation using Amelia was conducted yielding five multiply imputed datasets. The coefficients presented were averaged across the five datasets as described in Section 4.5 of Chapter 4. An in-depth analysis of each dataset, including assumptions was conducted on each dataset and yielded very similar results.

Once the model has been fit, we must assess the significance of the p variables in the model. In logistic regression, the log likelihood ratio test for overall significance of the p coefficients is used. Under the null hypothesis, the p slope coefficients for the independent variables in the model are equal to zero, and the distribution of the test statistic G will be distributed as chi-square with p degrees of freedom. The log likelihood is usually multiplied by -2 and presented as -2 Log likelihood (-2LL) for convenience, where -2LL is a positive value with larger values indicating worse prediction of the dependent variable. The difference between the -2LL of two models where one is nested within the other is distributed as a chi-square test statistic. Assessing the significance of blocks of variables, as this analysis proposes, is accomplished quite easily by examining this difference between nested models (with/without the block in question). For example, we can assess the significance of the first block by calculating the difference in -2LL of the constant only model and the model with the constant in addition to the demographic variables. Thus Chi-Square = {(-2 loglikelihood for smaller model)-(-2loglikelihood for bigger model)}, which would be 17773.351-15633.218 = 2140.133. This Block χ^2 = 2140.133 (df=9, p=0.000) is statistically significant and we can conclude that the demographic block adds significantly to prediction. Similarly, if we wish to assess the significance of the second block—lifestyle factors—to prediction, we would subtract the model with the constant and demographic block from the model with the constant, demographic block and lifestyle block and assess the result, distributed as χ^2, for statistical significance; that is, lifestyle factors Block χ^2 =15633.218-15587.245 = 45.973 (df = 5, p=0.000) is

statistically significant and, therefore, adds significantly to prediction. Table 6.3 shows the Block χ^2 for each of the five blocks in the model, which is simply the difference in -2LL of nested models as discussed above. The p-value associated with each block indicates whether it is statistically significant in terms of its contribution to the model given its entry point. Although this test indicates overall model fit, it does not tell us about the degree of improvement. The McFadden R^2 statistic is used for this purpose.[80] Having assessed the variables that should be in the model, the next step in the process is to examine how effectively the model describes the outcome variable, which is refereed to as goodness of fit.[81] The Hosmer-Lemeshow goodness-of-fit test evaluates the fit of predicted cases to observed cases. These results are all presented in the following section (see Table 6.3).

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[80] In terms of model fit, several R^2 analogues have been proposed in the literature for logistic regression models (Hosmer and Lemeshow 2000; Menard 2002). Tabachnick and Fiddell (2001) explain that these analogues are not identical to the R^2 linear regression interpretation of variance, but they do approximate it. Menard (2000; 2002) argues convincingly that the most appropriate R^2 analogue is McFadden's R^2. His rationale is based on several arguments which I will outline briefly. Conceptually, McFadden's R^2 is the closest R^2 analogue to ordinary least squares R^2 as it reflects the proportional reduction in the quantity being minimized (-2 log likelihood) or maximized (log likelihood). Another attractive feature of McFadden's R^2 is that it is independent of the of the sample size and the log likelihood or -2 log likelihood, as it only depends on the quantity being maximized or minimized. Next, McFadden's R^2 is not sensitive to the proportion of cases that have the outcome variable in question (i.e., good or poor health), and the measure varies between 0 and 1 unlike some other R^2 analogues. Finally, McFadden's R^2 is an appropriate measure for dependent variables that are polytomous or ordinal. Hosmer and Lemeshow (2000) do not advocate measuring the fit of a model based on R^2 analogues; instead they prefer that measure of fit be based on a comparison of observed to predicted values from the fitted model. When researchers do use these measures, they should be warned their magnitudes tend to be particularly low and may be best used to evaluate competing models.

[81] Formally, a model is deemed to "fit" when summary measures of the distance between observed and predicted values for all cases are small and the contribution of each case, with its observed and predicted values, to the summary measures is unsystematic and small in comparison to the error structure of the model (Hosmer and Lemeshow 2000).

6.6 Results of the Model Fit

Block $\chi^2(9, N=18890) = 2140.133$, $p=0.000$, and McFadden $R^2=0.120$, with the introduction of the demographic variables. With the introduction of the lifestyle habits block of variables, Block $\chi^2(5, N=18890) = 45.973$, $p=0.000$, and McFadden $R^2=0.123$, indicating significant improvement with the addition of smoking and binge drinking habits. Next, health resource variables were added to the model, Block $\chi^2(2, N=18890) = 297.928$, $p=0.000$, and McFadden $R^2=0.140$, indicating significant improvement in the model beyond demographic variables and lifestyle habits. In the fourth block, social support was introduced to the model and a significant effect was found with Block $\chi^2(1, N=18890) = 117.952$, $p=0.000$, and McFadden $R^2=0.146$. Finally, culture was added to the model to determine whether it had a significant effect beyond that of the other four sets of variables, and it was found to have an insignificant effect with Block $\chi^2(1, N=18890) = 0.255$, $p=0.613$, and McFadden $R^2=0.146$. Thus, the final model with all variables included accounted for 14.6% of the variance in self-rated health, with all blocks contributing significantly at their point of entry except the culture block.

The Hosmer-Lemeshow statistic was used to assess the goodness of fit of the model. It begins by putting the subjects into order by their probability on the outcome variable "1" (poor health), and then dividing the subjects into 10 groups/deciles according to their probabilities. Goodness of fit using the Hosmer-Lemeshow test is evaluated using a chi-square statistic by examining observed and expected frequencies, where a

non-significant finding is desired. It should be noted that P-values associated with a goodness of fit measure in the presence of large sample sizes are not very useful, as trivial deviations from the null hypothesis of a good fit will be deemed significant since the value of the chi-square statistic is proportional to sample size (Kuss 2007; Norusis 2005; Tabachnick and Fiddell 2001). Thus, the Hosmer-Lemeshow test may be informative in terms of the calibration of the model, but the researcher is warned to interpret it with great care (Norusis 2005). The literature is rather sparse with respect to addressing this issue; instead most of the focus is on the issue of low sample sizes, low power, and non significance (e.g., Kuss 2002).

In the case of the existing study, with a sample size of 18890, it appears to be the case that trivial differences are significant. With the introduction of every block in Table 6.3 we found a significant Hosmer-Lemeshow statistic, with p=0.000 in all cases, including the final model, χ^2 (8, N=18890) = 43.659, p=0.000. There are a few ways that one may proceed in the case of a significant Hosmer-Lemeshow test in the presence of a large sample size, including examining the deviations between observed and expected frequencies in the cells defined by the Hosmer-Lemeshow test, a thorough examination of the residuals, and consideration of misspecification (e.g., non linear and interaction terms, omitted variables, etc.) within the model. A careful examination of all three of these issues did not yield any further insights into the issue; hence, the significance of the Hosmer-Lemeshow test can confidently be attributed to

		Block χ^2, df, p-value	H-L Test, df, p-value	McFadden R^2	B	SE	Wald	Df	Sig	Exp (B)
Step 1	**Demography**	2140.133, 9, 0.000	44.558, 8, 0.000	0.120						
	Sex				-0.114	0.043	7.025	1	0.008	0.892
	Age				0.044	0.002	808.770	1	0.000	1.045
	Education						14.296	2	0.001	
	Education (Low)				0.214	0.058	13.767	1	0.000	1.239
	Education (Medium)				0.189	0.066	8.198	1	0.004	1.208
	Marital Status						6.676	2	0.036	
	Marital Status (Divorced, separated, widowed)				0.146	0.066	4.902	1	0.027	1.157
	Marital Status (Married)				0.117	0.052	4.975	1	0.026	1.124
	Labor Force Status						135.093	2	0.000	
	Labor Force Status (Employed)				-0.581	0.050	135.093	1	0.000	0.559
	Labor Force Status (Unemployed)				-0.243	0.068	12.662	1	0.000	0.784
	(LN) Income				-0.065	0.019	11.879	1	0.001	0.937
Step 2	**Lifestyle**	45.973, 5, 0.000	35.576, 8, 0.000	0.123						
	Smoke						28.267	2	0.000	
	Smoke (daily)				0.252	0.048	27.250	1	0.000	1.287
	Smoke (occasionally)				0.201	0.064	9.844	1	0.002	1.222
	Binge Drinker						15.190	3	0.002	
	Binge Drinker (sometimes)				-0.035	0.050	0.487	1	0.485	0.966
	Binge Drinker (often)				0.199	0.072	7.726	1	0.005	1.221
	Binge Drinker (never) [+]				-0.173	0.093	3.464	1	0.063	0.841
Step 3	**Health Resources**	297.928, 2, 0.000	48.088, 8, 0.000	0.140						
	Interaction with Family Doctor/GP				0.858	0.050	297.790	1	0.000	2.359

	Access to Traditional Practices				-0.040	0.047	0.741	1	0.389	0.961
Step 4	**Social Support**	117.952, 1, 0.000	43.488, 8, 0.000	0.146						
	Support (belonging/association)				-0.071	0.006	120.027	1	0.000	0.931
Step 5	**Culture**	0.255, 1, 0.613	43.659, 8, 0.000	0.146						
	Language				-0.027	0.054	0.256	1	0.613	0.973
	Constant				-2.352	0.219	115.811	1	0.000	0.095
	Full Model	**2602.241, 18, 0.000**	**43.659, 8, 0.000**	**0.146**						

Notes: Coefficients are from the final regression model

Coefficients for 'Reference' and 'Omitted' categories are not entered into the model to avoid singularity.

$^{+}p<0.07$ and in the case of the final regression coefficients, the coefficient is meaningful; therefore, we chose to interpret this coefficient

TABLE 6.3 Sequential Logistic Regression of Self-rated Health on Individual-level Predictors

Variable	Category	Parameter Coding		
		(1)	(2)	(3)
Sex	Male	1		
	Female	0		
Highest Level of Schooling	Low Education	1	0	
	Medium Education	0	1	
	High Education	0	0	
Marital Status	Divorced, Separated, Widowed	1	0	
	Married	0	1	
	Single	0	0	
Labor Force Status	Employed	1	0	
	Unemployed	0	1	
	Not In Labor Force	0	0	
Smoking Habits	Daily	1	0	
	Occasionally	0	1	
	Not at All	0	0	
Alcohol Consumption Habits	Sometimes Binge Drink	1	0	0
	Often Binge Drink	0	1	0
	Never Binge Drink	0	0	1
	Do Not Drink	0	0	0
Interaction with Family Doctor/GP	Yes	1		
	No	0		
Access to Traditional Practices	Yes	1		
	No	0		
Language	Yes	1		
	No	0		
* Dummy variables are created for m-1 categories of a nominal variable, where m indicates the number of levels				

TABLE 6.4 Categorical Variable Codings (Dummy or Indicator Coding)

the large sample size. [82]

6.7 An Additional Fit Measure: Classification

One intuitive method to summarize a fitted logistic regression model is a classification table although classification was not of central importance in this analysis. This table is produced by cross classifying the outcome variable with a dichotomous variable whose values are from the estimated logistic regression model probabilities. In order to obtain the derived dichotomous variable, a cut point, c, must be chosen and then each probability predicted from the logistic model is compared with c. Typically the cut point value is 0.5. In this analysis, the outcome variable is dichotomous, good health (0) and poor health (1), with an estimated probability of 0.5 or higher corresponding with membership in the group poor health, and an estimated probability of less than 0.5 corresponding with membership in the group good health. The logic is that the more accurately the model predicts group membership, the greater the weight of evidence of model fit; however, as Hosmer and Lemeshow (2000) warn, this is not necessarily the case.

Overall classification was not good as seen across Tables 6.5 to 6.10. Without any variables in the model 82.1% of cases were predicted correctly. Based on entrance of

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[82] In fact, I generated two random equally sized datasets with sample sizes of 9445, ran the same regression analysis, and found that the conclusions were quite similar to the full sample size analysis except the Hosmer-Lemeshow goodness of fit test was not statistically significant, indicating a good model fit. This also supports the conclusion that sample size was the cause of the significant goodness of fit test in the analysis of the full dataset.

the demographic block of variables, sensitivity was 15.5% and specificity 96.8%, with an overall correct classification rate of 82.2%.[83] After entrance of the lifestyle habits block the sensitivity was 15.9% and specificity 96.9%, with an overall rate of successful classification of 82.4%. The introduction of the health resources block increased sensitivity to 18.8% and specificity decreased slightly to 96.7%, with the overall rate of successful classification increasing to 82.7%. Entering the social support block increased sensitivity to 19.5%, specificity remained unchanged, and the overall rate of correct classification increased to 82.9%. Finally, the non significant culture block decreased sensitivity to 19.4% while leaving specificity and the overall rate of rate of correct classification unchanged. Classification was, therefore, not impressive.

Classification is sensitive to the relative size of the two component groups, with classification more likely into the larger group, irrespective of the model fit; in other words, classification tables should not be used to assess model performance because they depend in large part on the distribution of the probabilities in the sample (ibid.)

If we examine the 2 X 2 classification table of the final model, as seen in Table 6.10, there are some observations worth noting. Among the 1163 people predicted to experience poor health, probabilities ranged from 0.5002 to 0.8708 with a mean of

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[83] Sensitivity refers to the proportion of cases in the response category coded one (poor health) correctly predicted while specificity is the proportion of cases in the reference category (good health) correctly predicted.

0.6051. Among the 17 726 people predicted to experience good health, probabilities ranged from 0.0165 to 0.4998 with a mean of 0.1514. As a result of many people having probabilities close to the cutpoint, 0.5, we expect a considerable amount of misclassification.[84] We observe that 14 995 of the 17 726 individuals predicted to have good health actually did report good health, while 506 of the 1163 individuals predicted to have poor health were misclassified. Therefore, of the total 3388 individuals who actually had poor health, only 657 of them were correctly predicted yielding a sensitivity value of 19.4%.

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	15502	0	100.0
	Poor Health	3388	0	0.0
Overall Percentage				82.1
a. Constant is included in the model b. The cut value is 0.500				

TABLE 6.5 Classification Table – Constant Model

[84] See Hosmer and Lemeshow (2000) for more details although a simple example should help. In the case of dichotomous outcome, if we have n subjects who have the same probability of the outcome π, we know that the expected number of people who will develop the outcome is $n\pi$ while the expected number of people who will not develop the outcome is $n(1-\pi)$. Using a cut point of 0.5 to classify cases into the two categories, let's say we have 1000 subjects with a probability of $\pi=0.53$; thus, 1000 subjects would be predicted to develop the outcome π, but in a well calibrated model 530 (1000*0.53) individuals would actually develop the outcome while 470 (1000*(1-0.53)) individuals would be expected not to develop the outcome and would, therefore, be misclassified.

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	15001	501	96.8
	Poor Health	2863	525	15.5
Overall Percentage				82.2
a. The cut value is 0.500				

TABLE 6.6 Classification Table – Demographic Block

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	15024	477	96.9
	Poor Health	2848	540	15.9
Overall Percentage				82.4
a. The cut value is 0.500				

TABLE 6.7 Classification Table – Demographic + Lifestyle

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	14983	519	96.7
	Poor Health	2751	638	18.8
Overall Percentage				82.7
a. The cut value is 0.500				

TABLE 6.8 Classification Table – Demographic + Lifestyle + Health Resources

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	14995	507	96.7
	Poor Health	2729	660	19.5
Overall Percentage				82.9
a. The cut value is 0.500				

TABLE 6.9 Classification Table – Demographic + Lifestyle + Health Resources+ Support

Observed		Predicted		
		Self-rated Health		Percentage Correct
		Good Health	Poor Health	
Self-rated Health	Good Health	14995	506	96.7
	Poor Health	2731	657	19.4
Overall Percentage				82.9
a. The cut value is 0.500				

TABLE 6.10 Classification Table – Full Model

In sum, classification was not impressive as cases tended to be overclassified into the largest group: good health. Overall, given that classification was not a primary goal of this analysis the classification should, at best, only be seen as a possible supplement to assessment of fit (Hosmer and Lemeshow 2000).

6.8 Interpretation of Coefficients[85,86]

The logistic regression coefficients are presented for the final model, that is, with all variables in the model, broken down by blocks, as seen in Table 6.3 .[87] Using Table 6.3, we can derive the general equation for the logistic regression model:

Logit(poor health) = ln [probability of poor health/(1- probability of poor health)] = -2.352 + -0.114 Sex + 0.044 Age + 0.214 Low Education + 0.189 Medium Education +

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[85] The unstandardized regression coefficient, ***B***, is interpreted as the magnitude of the change in the dependent variable—the natural log of the odds or $\ln(\pi/(1-\pi))$—given a one unit change in the independent variable. This interpretation is, however, not intuitive. Thus, it is common practice to interpret the regression coefficients of a logistic regression model in terms of the magnitude of change in the odds of the dependent variable given a one unit change in the independent variable (Hosmer and Lemeshow 2000). Mathematically, this is achieved by taking the antilog of $\ln(\pi/(1-\pi))$, which is given in the SPSS output as e^B, an odds ratio.

[86] Dummy or indicator coding is typically used to represent the effects of nominal variables in logistic regression although other coding schemes are available (Hosmer and Lemeshow 2000). Dummy variables are coded as "1" or "0" where the former indicates membership in the category in question and the latter refers to everyone else. Dummy variables are created for m-1 categories of a nominal variable, where m indicates the number of levels. Before proceeding to assess the significance of each category, the nominal variable must have a significant effect to begin with. If statistical significance of the nominal variable is found, the significance of individual dummy variables is assessed, with each dummy variable interpreted as the effect of being in a particular category relative to the reference category. Only those dummy variables that are statistically significant relative to the reference group are interpreted. Thus, we can interpret the exponent of the logistic coefficient as the odds ratio where the predicted odds of the outcome (e.g., poor health) for the group with a score of 1 on the dummy variable is divided by the predicted odds of the outcome for the reference group with a score of 0, controlling for all other variables in the model (Hosmer and Lemeshow 2000; Menard 2002). See Table 6.4 for a listing of dummy variable coding used in this analysis.

For continuous variables, the idea of an odds ratio can also be applied although this is often referred to as a multiplying factor. Specifically, the odds ratio is the result of dividing the odds at one value of the independent variable (x_0) by the odds at x+1 (ibid.). When the odds ratio is greater than 1, this implies that there is an increase in the odds of the outcome (e.g., poor health) for a one unit increase in the independent variable.

[87] Although not shown, in large part, the estimated coefficients entered in earlier blocks did not appear to change in any significant way when subsequent blocks of variables were entered into the model. For example, the estimated coefficients of the demographic variables did not change significantly from block one to block five.

0.146 Divorced/Separated/Widowed + 0.117 Married + -0.581 Employed +-0.243 Unemployed + -0.065 LnIncome + 0.252 Smoke Daily +0.201 Smoke Occasionally + -0.035 Sometimes Binge Drink +0.199 Often Binge Drink + -0.173 Never Binge Drink + 0.858 Interaction with Family Doctor/GP+ -0.040 Access to Traditional Practices +-0.071 Support + -0.027 Language.

Demographic

Sex was significant in the model (Wald[88] = 7.025, df =1, p=0.008), with males less likely to report poor health than the reference category females. The odds of poor health for males were 0.892 times the odds for females.

The age variable was significant in the model (Wald = 808.770, df =1, p=0.000), with a negative effect on health. When age increases by one unit, the estimated odds of reporting poor health multiply by 1.045; in other words, they increase by 4.5%. If we examine the difference in age by forty years, those who reported an age of, for example, sixty years had odds of poor health equal to $(1.045)^{40} = 5.82$ times the odds of those who reported an age of twenty years. Alternatively stated, a forty year

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[88] There are several ways to assess the statistical significance of independent variables in the regression model. The most accurate is the likelihood ratio test, in which the logistic regression model is calculated with and without the variable in question. Most statistical packages often use the less computationally intensive Wald statistic to test the effects of individual variables. The main problem with the Wald statistic is that when b is large, the estimated standard error is inflated which results in a Type II error (i.e., failing to reject the null when a relationship exists) (Menard 2002; Tabachnick and Fiddell 2001). This analysis reports the Wald statistic, but through additional analysis it was found that any differences between the likelihood ratio test and the Wald statistic were inconsequential.

increase in age is associated with an increase in the odds of reporting poor health by 582%.

Education was significant in the model (Wald = 14.296, df = 2, p=0.001). Those respondents with low levels of education were significantly more likely to report poor health than the reference category, that is, those with high levels of education (Wald = 13.767, df = 1, p=0.000), with the odds of the former 1.239 times the odds of the latter. Similarly, respondents with medium levels of education were significantly more likely to report poor health those with high levels of education (Wald = 8.198, df = 1, p=0.004). The estimated odds of those with medium levels of education were 1.208 times the estimated odds of those with high levels of education.

Marital status was significant in the model (Wald = 6.676, df = 2, p=0.036). Divorced, separated, and widowed respondents were significantly more likely to report poor health than the reference category, single respondents (Wald = 4.902, df = 1, p=0.027), with the odds of the former 1.157 times the odds of the latter. Married respondents were significantly more likely to report poor health than single respondents (Wald = 4.975, df=1, p=0.026). The odds of those married were 1.124 times the odds of single respondents.

Labor force status was significant in the model (Wald =135.093, df = 2, p=0.000). Employed respondents were significantly less likely to report poor health than the

reference category, respondents not in the labor force (Wald =135.093, df = 1, p=0.000), with the odds of the former 0.559 times the odds of the latter. Unemployed respondents were significantly less likely to report poor health than those respondents not in the labor force (Wald = 12.662, df = 1, p=0.000). The odds of the unemployed were 0.784 times the odds of those not in the labor force.

The natural log (ln) of equivalized economic family income was significant in the model (Wald = 11.879, df =1, p=0.001), with a positive effect on health. When (ln) equivalized economic family income increases by one unit, the estimated odds of reporting poor health multiply by 0.937; in other words, they decrease by 6.3%. If we examine the range of the income scale, those who report the highest levels of income (i.e., 11.9829) have odds equal to $(0.937)^{13.1818}$ = 0.424 times the odds of respondents who report the lowest income (-1.1989). In other words, the odds of reporting poor health for the highest income earners are 57.6% lower than the lowest income earners.

Lifestyle

Smoking habits were significant in the model (Wald = 28.267, df=2, p=0.000). Respondents who smoke daily were more likely to report poor health than the reference category, non-smokers (Wald = 27.250, df=1, p=0.000), with the odds of the former 1.287 times the odds of the latter. Occasional smokers were significantly more likely to report poor health than non-smokers (Wald = 9.844, df=1, p=0.002). The odds of occasional smokers were 1.222 times the odds of non-smokers.

Binge drinking habits was significant in the model (Wald = 15.190, df=3, p=0.002). Respondents who sometimes binge drink were not significantly different than the reference category, non-drinkers (Wald = 0.487, df=1, p=0.485). Those respondents who binge drink often were significantly different than non-drinkers (Wald = 7.726, df=1, p=0.005), with the odds of reporting poor health for the former 1.221 times the odds of the latter. Finally, respondents who never binge drink were significantly less likely to report poor health than non-drinkers (Wald = 3.464, df=1, p=0.063).[89] The odds for respondents who never binge drink were 0.841 times the odds of non-drinkers.

Health Resources

Having seen a family physician or GP in the last year was significant (Wald = 297.790, df =1, p=0.000), with a negative effect on health. The odds of poor health for respondents reporting interaction with a family physician or GP were 2.359 times the estimated odds of those who did not report such interaction.

Access to traditional medicines was not significant in the model (Wald = 0.741, df=1, p=0.389).

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[89] Although the coefficient for those who never binge drink was not statistically significant at an alpha level of 0.05, it is significant at an alpha level of 0.1 and the coefficient is also meaningful; therefore, I chose to interpret it.

Social Support

Social support was significant (Wald = 120.027, df = 1, p=0.000), with a positive effect on health. When social support increases by one unit, the estimated odds of reporting poor health multiply by 0.931; in other words, they decrease by 6.9%. Thus, if we examine the range of the support scale, those who report the highest level of support (sixteen) have odds of reporting poor health equal to $(0.931)^{12} = 0.424$ times the odds of respondents who report the lowest level of support (four). In other words, the odds of reporting poor health for individuals with the highest levels of social support are 57.6% lower than the odds for individuals with the lowest levels of social support.

Culture

Finally, culture—the ability to speak or understand an Aboriginal language—does not appear to have any significant effect on health while controlling for the other variables in the model.

6.9 Residual Analysis

There are two main reasons for analyzing residuals in logistic regression: 1) identifying cases that the model fits poorly; and (2) identifying cases which significantly influence estimated parameters of the model (Menard 2002). These two issues will now be addressed in detail.

Based on the model, the residual for each case is given by the difference between the observed and predicted probabilities that Y=1 (poor health). Unlike linear regression, the error variance is a function of the conditional mean in logistic regression; therefore, the residuals are standardized by adjusting them for their standard errors. The result is a studentized residual which indicates how much a residual would be expected to vary due to sampling variability. The studentized residual is normally distributed with a mean of 0 and a standard deviation of 1.[90] Thus, one can expect to find approximately 95% of the residuals to lie between +/-2 standard deviations from the mean and 1% to lie outside +/-2.5 standard deviations from the mean. When the value for a case lies well beyond this range (i.e., highly improbable), this is an indication that the model fits poorly for that particular case. In this analysis, we would expect about 189 cases to have studentized residuals beyond +/-2.5, but it was found that only 67 cases had studentized residuals beyond +/-2.5, with the largest value 2.76. Cases defined as outliers (studentized residuals greater than 2.5) were examined for systematic differences from the remainder of the sample. It was found that compared to cases with expected residuals the outliers were as follows (see Appendix C for more details):

- Younger
- Possessed higher incomes
- Predominantly male
- More likely to be single
- Possessed low education

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[90] In SPSS 15.0, binary logistic regression presents this equivalent value as a deviance residual, which is approximately equal to a studentized residual (Menard 2002).

- More likely to be employed
- More likely to smoke, particularly daily
- More likely to drink and particularly sometimes binge drink
- Less likely to see a GP or family physician in the past year
- More likely to state having access to traditional medicine/healing/wellness practices
- Possess higher levels of social support
- More likely to understand or speak an Aboriginal language
- More likely to report poor health.

Thus, the model fits poorly for individuals with the aforementioned characteristics.

Influence refers to the degree to which predicted values or model parameter estimates change when an observation is removed from the dataset. Formally, influence = leverage x discrepancy (Fox 1997). For an observation and model parameter, DFBETAS will equal the change in the parameter estimate that results from deleting the observation divided by the standard error of the estimator for the adjusted dataset. As the magnitude of the absolute value of DFBETAS becomes larger, the influence of an observation on that parameter estimate becomes greater. All observations have a DFBETAS value for each parameter in the model. Typically values of DFBETAS larger than 1 suggest significant influence on that parameter estimate (Agresti 1997; Tabachnick and Fiddell 2001). An examination of the DFBETAS found no influential observations. Specifically, no values greater than 1 were observed. Alternatively, one may use the size adjusted cutoff $2/\sqrt{n}$ to identify relatively influential DFBETAS (Fox 1997). In the case at hand, the cutoff value was $2/\sqrt{18890} = 0.01455$. Using the size adjusted cutoff value of 0.01455 did not reveal any influential observations.

More broadly, the Analog of Cook's influence statistic is a measure that assesses the influence of an observation on the fit of the model; specifically it assesses the change in the $\hat{Y}$ predicted values for all the data that results from deleting that observation. It is based on standardized versions of the differences between the original predicted values and the new predicted values after deleting that observation (Agresti 1997). Typically values larger than 1 suggest significant influence on that parameter estimate (Agresti 1997; Fox 1997; Tabachnick and Fiddell 2001).[91] Despite the presence of some *relatively* high observations, their magnitudes were trivial in an absolute sense as none of the cases had values even close to 1.[92]

6.10 Summary

This chapter presented the results of this dissertation. I began by testing the null hypothesis of no significant variation between communities in a multilevel framework. I was unable to reject the null hypothesis, which indicates that there is no significant variation in health between First Nations communities to model. Therefore, individual health is not influenced by contextual variables in any significant manner in this analysis although this issue will be discussed in greater detail in the final chapter. So I proceeded with the single level logistic regression model.

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[91] The size adjusted cutoff is defined as follows: Relatively Influential Values $> 4/(n-k-1)$. In the case at hand, the cutoff value would be $4/ (18890-19-1) = 0.000212$

[92] It should be noted that the values of the measures of influence above tend to decrease as a function of sample size. This is a direct result of large samples absorbing discrepant data without changing the results substantially. Hence, one may wish to examine relatively influential points as observations generally have no strong absolute influence.

The assumptions of logistic regression were discussed and followed by a sequential regression analysis. All blocks of variables except for the culture block were statistically significant in terms of improvement of the model at their respective points of entry. A discussion on overall model fit and goodness of fit was provided, with a focus on issues related to sample size and the Hosmer-Lemeshow goodness of fit test. After careful consideration, it was concluded that the large sample size of the model made it highly unlikely to obtain a non significant goodness of fit test. An additional analysis using classification tables was provided. Classification was not good for those with poor health although this was not a point of major concern.

Next, the effects of individual variables were assessed based on coefficients of the final model. The effects were presented through the use of odds ratios. With the exception of access to traditional medicines/healing/wellbeing practices and the culture variable, that is, the ability to speak or understand an Aboriginal language, all variables had a statistically significant effect.

Finally a brief analysis of residuals was provided. In terms of the magnitude and frequency of the residuals, the number of outliers were within the range of what would be expected in a normal distribution with a sample of the size in this study although a few extreme outliers were observed. An analysis of these outliers for which the model fits poorly found that their characteristics were quite different from the rest of the sample. Measures of influence found no significant problems with any case.

The final chapter will discuss the results in greater detail, focusing on the key findings, and provide some concluding remarks on this study.

Chapter 7: Discussion and Conclusions

7.0 Introduction

This last chapter discusses the key results from the data analysis, including the multilevel and single level logistic regression models. Policy implications are given attention based on the findings of the study. A few shortcomings are given detailed attention, including temporality and a comparison of using general versus specific measures of health. Next, key contributions of this work are broken down as follows: theoretical, substantive, and policy. Finally, the direction of future research is discussed followed by a few concluding thoughts.

7.1 Multilevel Analysis

This is one of the few studies that focuses on the context of Aboriginal communities as a determinant of population health outcomes, and it is the only known study of the Canadian Aboriginal population to include a multilevel perspective and empirically test related hypotheses. This analysis failed to detect any statistically significant variation at the community level. In other words, when we decomposed the unexplained variation of the individual health of First Nations on-reserve, there was no significant variance component at the contextual-level. The implication of this finding is important: contextual-level variables, including income inequality and community socioeconomic status, are not important determinants of individual self-rated health given the data I had to work with. Thus, explaining variation at the individual-level

constitutes the main point of focus. There are, however, several considerations given the non significant results:

1) There is truly no statistically significant variation between communities in the population.[93] The results of this study support the case that individual characteristics are solely what matters in terms of health outcomes. Moreover, Aboriginal communities are not as unique as theorized, given that they do not appear to vary in any significant way from one another with respect to self reported health. Again this finding is based on the data we used. It may be the case that we would find variation given different data.
2) The dependent variable, health as operationalized by self-rated health, may not be capturing true variations in health between contexts. Given the extensive work that has been done on the measure self-rated health, we have little reason to believe that it is not a valid and reliable measure in the First Nations population. I would strongly suggest, however, that an analysis be conducted using other potentially relevant variables and datasets. In terms of relevant variables, it may be worthwhile to examine the sensitivity of other measures of health to variations across contexts. For example, if we could have access to Provincial health data, including mortality and morbidity information, we could construct an objective measure of health. A recent work by Wingert (2007) did find, however, that within the Aboriginal population, subjective and objective health measures were congruent.

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[93] Indeed, the 2001 APS, despite its shortcomings, is one of the most comprehensive and reliable sources of Aboriginal data available in Canada at the present time.

3) The sample is anomalous. If we recall, the statistical significance observed indicates the probability of obtaining a χ^2 statistic as large as the observed χ^2 test statistic for random variation between communities, if the null hypothesis is true. When the p-value is small we reject the null hypothesis that we cannot attribute to chance the observed variance between communities. On the other hand, when the p-value is large, we fail to reject the null hypothesis with the conclusion that there is not enough evidence to be sure that the variance is not attributable to random sample variation. The implication here is that this failure to reject the null hypothesis does not necessarily mean that the variance is not truly random, only that there is insufficient evidence to be confident that it exists. To our knowledge this is the first known study to formally test the hypothesis of significant variation between communities using a multilevel framework. The greater body of non Aboriginal evidence supports the effects of social context on health outcomes and there is also some limited evidence of community effects on Aboriginal people. Finally, theory should always play a defining role in any research program, and in the case at hand, there is a great deal of theoretical support for the importance of contextual effects, particularly in the case of Canada's Aboriginal population. Despite the null findings, this is not a research avenue that should be closed based upon one study. As with my other work (White, Maxim, and Spence 2004; White, Spence, and Maxim 2005; Spence, White, and Maxim 2007), I drew heavily throughout this dissertation on structuralism, and this work has not convinced me that this

approach is incorrect. Instead, I would argue that it is best to err on the side of caution and conduct more relevant studies before a more definitive case can be made regarding the (null)effects of context in Aboriginal communities.

7.2 Logistic Regression Analysis

The single level logistic regression analysis examined the determinants of Aboriginal health using five blocks of variables. A series of sequential multiple regression analyses were conducted to assess the extent to which blocks of independent variables were predictive of health. As each block of independent variables was entered into the model, it was assigned both unique and overlapping variability left to it at its point of entry. Thus, we were able to assess the contribution of each set of independent variables to the model in terms of what it added to the equation at its point of entry.

Overall, the first block—demographics—accounted for the bulk of explained variance in the model, with 12.0% of the variance in the dependent variable explained by this block alone. Lifestyle factors explained an additional 0.3% of the variance in the dependent variable while formal health services and social support accounted for 1.7% and 0.6% respectively. Culture did not contribute in any significant manner to explaining self-rated health after controlling for blocks one through four.

For the most part, predictor variables had effects on health as hypothesized:

a) **Increases in age were associated with higher odds of reporting poor health.** This coincides with the literature, where the biological decline of the body is a function of the passage of time, accompanied by physical deterioration and increased risk of disease and disability. Moreover, the effects of age can also be seen as a proxy for accumulated social advantage/disadvantage over the life course which is not necessarily captured by variables in the model.

b) **Higher income, as operationalized by equivalized economic family income, was associated with lower odds of reporting poor health.** This supports the neomaterial hypothesis, which underscores health as a reflection of access to differential health promoting exposures and resources in the material world that are a function of absolute deprivation at the individual and community level (Lynch 2000). In other words, cumulative advantages accrue to individuals that possess varying degrees of health producing resources that are available in the market economy. It is these material advantages that determine health as opposed to the ill effects of psychosocial perceptions of relative deprivation, as proposed by the income inequality-psychosocial approach to population health. Community level income, however, did not play a significant role in predicting individual self-rated health, given that no significant contextual variation exists in the data.

c) **High levels of education were associated with reduced odds of reporting poor health.** Those with medium and low levels of education were more likely to report

poor health than those with high levels of education, with the magnitude of difference greater for those with low levels of education than those with medium levels of education. This effect could be described in several ways. Higher education may likely be associated with social class, personal control and/or learned effectiveness. People with greater education often make better lifestyle decisions because they have more opportunity to be effective in the world and, in that sense, may understand they have more to lose by having poor health.

d) **Labor force participation and particularly employment were associated with reduced odds of reporting poor health.** The employed and unemployed were less likely to report poor health than those not in the labor force, albeit the latter less so than the former. This finding coincides with the effects of labor force participation and employment in terms of social class, independence, and personal development as well as psychological wellness. The healthy worker effect is also supported by this finding.

e) The effects of marital status were somewhat unexpected in the model. **Divorced, separated, and widowed respondents as well as married respondents were more likely to report poor health than single respondents.** Those respondents who were divorced, separated, and widowed would be expected to report poorer health outcomes than single individuals given the detrimental effects of no longer enjoying the benefits of a partner. As we note in the literature, partnerships bring economic efficiency, orderliness, the regulation of risky behaviors, and emotional social support.

Surprisingly, married individuals were not healthier than single respondents. Upon further analysis it was found that the coefficient for this variable changed from being non significant (p=0.543) in block 1 (demographic variables) to significant (p=0.026) with the introduction of social support in block 4. Furthermore, the odds ratio also increased from 1.032 to 1.124 over the respective blocks. This evidence is consistent with a suppression effect (Mackinnon et al. 2002). A suppressor variable can be defined as one that increases the predictive validity of another variable when it is included in the regression model (Conger 1974; Mackinnon et al. 2002). This process of removing or suppressing criterion irrelevant variance from the independent predictor, or increasing the power of the independent predictor, through the presence of the suppressor (enhancement variable) characterizes the idea of suppressor effects (Paulhus et al. 2004). Deriving theoretical explanations for suppression results is questionable unless these findings are replicated (Maassen and Baker 2001).[94,95] Moreover, it is recommended that any attempts to test for the presence of a suppression effect should be based on *a priori* assumptions about the theoretical relation between the variables and the role of the suppressor variable (MacKinnon, Krull and Lockwood 2000).

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[94] Wilson and Rosenberg (2002), in their analysis of the determinants of health for First Nations peoples, using the 1996 Aboriginal Peoples Survey, found that marriage reduced the likelihood of poor health. Their model was, however, different in many respects; in particular, they did not have a measure of social support in their model, which appears to be particularly important in terms of the effects of marriage on health.

[95] The idea of suppressor variables and their utility has come under scrutiny by many. Readers are advised to read the discussions on this issue by Wiggins (1973), Cohen and Cohen (1992); Pedhazur (1982); and Maassen and Baker (2001).

If we entertain the possibility that this is a true finding, it appears that the effect of marriage in this population is enhanced in the presence of social support. We can only speculate on the negative effect of marriage on health relative to single individuals at this point since the quality of marriages cannot be assessed. There is some evidence that this finding may partly reflect the higher rate of family instability, as measured by the proportion of families headed by a single parent, in the Aboriginal population—a proxy measure for lower marriage quality (Barsh 1994). In his review of the literature, Barsh (1994) found that the proportion of families headed by a single parent (24%) is much higher than the general population (13%). It is suspected that issues related to cohesion and social capital, which tend to be lower in communities characterized by social problems and economic disadvantage, may contribute to poorer marital outcomes although it does not seem to have adversely affected associational social support in this analysis. Future research should examine this suppression relationship further as well as the negative effect of marriage on health.

f) **Males were less likely to report poor health than females.** This was an expected finding given that in the population males have higher levels of mortality but lower rates of morbidity and use of medical services. Further, more women than men live in poverty, which is particularly salient when we consider the issue of single mothers.

g) **Respondents who smoke were more likely to report poor health than non-smokers.** Compared to non-smokers, daily smokers were the most likely to report

poor health followed by occasional smokers. This finding underscores the importance of the well documented evidence of the detrimental effects of smoking on health.

h) Binge drinking habits were significant in the model. The findings were in part as expected. **The only significant difference found between non-drinkers and drinkers was with respect to those who binge drink often, who were more likely to report poor health.** There was some limited[96] evidence that moderate drinkers (i.e., never binge drink) were less likely to report poor health than non-drinkers although this should be investigated further. It should be noted that misclassification may play a role in the findings by including people who had reduced or stopped drinking (associated with aging and ill health) with abstainers.[97] Based on a meta analysis by Fillmore et al. (2006), in the studies that were error free from misclassification, the positive effects of moderate alcohol consumption appear to be non-existent.[98]

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[96] The term "limited" is used because the coefficient was interpreted despite not being significant at an alpha level of 0.05. The rationale was that the p value for the coefficient was very close to the alpha level of 0.05 (i.e., 0.063) and the magnitude of the coefficient was meaningful (i.e., an odds ratio of 0.841).

[97] The survey question asked, "How often in the past 12 months have you had 5 or more drinks on one occasion?" with answers as follows: sometimes; often; never; and do not drink. Thus, abstainers (i.e., do not drink) would include people who had stopped drinking (associated with aging and ill health) resulting in a possible decline in the average health of this group.

[98] Alternate research has found that moderate alcohol consumption can be associated with positive health effects (MacDonald 1999).

i) **Interaction with a family physician or GP in the last year had a negative effect on health.** The odds of reporting poor health were 236% higher than the odds for those who did not report such interaction. Given that reserves tend to be disproportionately isolated communities, access to formal health care services has been a point of concern among many Aboriginal stakeholders (NAHO 2003; RCAP 1996); hence we would expect utilization to have a pronounced effect as people would only seek out interaction with a family physician or GP in cases that are likely quite severe, which is consistent with a "selection effect." This effect also coincides with literature which supports that check-ups and secondary prevention do not have an effect on health and may actually decrease it.[99]

j) **Access to traditional medicines, wellness, and healing practices was not significant in the model.** We examined this variable and retained it because of its theoretical importance (see explanation after "culture" below). It should be noted that this does not necessarily mean that traditional medicines, healing, and wellness practices do not benefit health. The measure I used does not actually assess the utilization of such services; it merely indicates their presence in the community. Interestingly, a recent poll found that 67% of First Nations respondents believe that a return to Aboriginal medicines and healing practices would be one mechanism to improve the health of Aboriginal peoples (NAHO 2003).

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[99] For example, when individuals feel perfectly normal, but are diagnosed, subjected to tests, and treated for diseases which in many cases have no cures, this may actually have a net effect of decreasing the state of health.

k) **Social support had a positive effect on self-rated health**, with more support associated with a lower likelihood of reporting poor health. This finding coincides with the literature that belonging/associating with others has a positive effect on the health of individuals. This is consistent with other studies conducted on the influence of social capital on various social outcomes (White, Spence, and Maxim 2005).

l) **Culture was not a significant explanatory variable in the model.** As with traditional medicine this was retained because of its theoretical importance. A recent poll found that 75% of First Nations respondents believe that the revival of Aboriginal cultures and traditions is an important way to improve Aboriginal health (NAHO 2003). This analysis sought to examine whether culture plays any role in health outcomes for Aboriginal people although it may be argued that the operationalization of the concept was inappropriate. Wilson and Rosenberg (2002) faced a similar issue in their analysis of culture and health among the Aboriginal population with their operationalization of the concept via engagement in traditional activities.

With respect to the non significant findings of access to traditional medicines and healing practices and culture, their retention in the model is strategic. In terms of model building and hypothesis testing, a researcher always includes theoretically relevant variables and trims the model for the sake of parsimony and statistical power based on the statistical significance of predictors (Maxim 1999; Jaccard 2001). The process of dropping variables from the model is generally not recommended unless the researcher can be quite confident that a coefficient for a variable is near zero, the

variable is inconsequential, and misspecification error will not result (Jaccard 2001). Indeed, trimming variables from a model when the sample size is large results in a trivial increase in statistical power by saving degrees of freedom, but this is not balanced by the potentially serious issues that may result from model misspecification (ibid.).

Overall, these determinants of health do not appear to deviate in any important way from those established in the research for the general population (see Chapter 2). In fact, this analysis supports the idea that the differences in health determinants between Aboriginals and non Aboriginals *may be* insignificant. This does mean, however, that the mechanisms and relationships operate in the same manner, which is an issue for future research. Nevertheless, given the evidence of this study we arrive at some relevant policy directions.

7.3 Policy

Providing policy insights from a single study is always a challenge in that a definitive answer to the original research question is almost never fully provided. In fact, the use of findings to guide policy directions must be done in a cautious manner since certainty within the realm of research is a relative term. However, as Rose (1992:111) states, "Certainty is not a prerequisite for action." Indeed, action should not be suspended pending research but proceed concurrently with ongoing research and evaluation with the realization that policy will need to be dynamic to adjust to the new

evidence as it becomes available. Despite the relativistic nature of any research, as situated within the broader context of knowledge, the findings of this study signal some cardinal policy directions:

1) As indicated above, the determinants of health for First Nations people appear to be quite similar to the general population. From a policy perspective, this means that we already have a "jump start" on which interventions may be effective given our experiences with the general population. However, the mechanisms through which these variables and interventions may manifest their effects may not be identical given the intersection of varying historical, cultural, geographical and socioeconomic factors.

2) The empirical results of this study indicate that interventions at the contextual-level should not be a strategic focus for health policy although I have cautioned the reader that further research is warranted before definitive conclusions can be made.

3) From the single level logistic regression model, we can focus policy efforts on a number of factors at the individual-level as outlined below.

Demographic

Targeting specific initiatives for each sex would be useful given the differing social experiences of males and females which contribute to varying health outcomes. This

"gender-based analysis" is an approach that recognizes the differential needs and effects of policy on men and women (Stirbys 2007). First Nation females are particularly likely to be disadvantaged in numerous ways, some of which I have outlined based on an assessment by the Aboriginal Women's Health and Healing Research Group (2007): poverty of subsistence (matrimonial property provisions in the Indian Act); poverty of sexual and reproductive health (adolescent pregnancies, fetal alcohol spectrum disorder, sexual abuse, STDs and cervical cancer); poverty of identity (Bill C-31)[100]; poverty of safety and security (spousal and family violence, diabetes); poverty of mental health (depression, suicide); poverty of participation (discrimination based on gender, chronic health problems); and poverty of power and knowledge (research gaps, capacity deficits, gender inequality). Addressing these issues would be a step in reducing health inequality between males and females.

Initiatives that consider the needs of the separated, divorced, widowed as well as married individuals are needed given their lower health status relative to those who are single. Besides the normal stresses of being separated and divorced, there are additional issues in the context of on-reserve First Nations; for example, there exists a large gap in the laws related to matrimonial real property, where mostly women on a reserve who do not possess a Certificate of Possession are in many cases forced to leave the matrimonial home (Indian and Northern Affairs Canada 2003).[101] Given the

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[100] See White, Cornett, and Anderson (2007).
[101] In fact, the legal framework related to real matrimonial property off-reserve does not apply to people living on-reserve (ibid.).

shortage of housing on-reserve, this usually means that she must leave the reserve, regardless of the custody of the children (ibid.). For separated, divorced, widowed and married individuals, access to institutions offering formal support and counseling may alleviate some of the psychological and mental stresses facing these individuals, which adversely affects their health. Some of these issues may have an economic component while others are likely related to some dimensions of support and interaction/isolation. Developing ways to address the various health promoting needs of various age groups of the population would be useful, realizing that biological processes as well as social processes may be at work. For example, the needs of seniors, who are more likely to experience health problems, may be at risk of poor health as a result of an inability to access health promoting resources in their community. Moreover, reserve communities may be at a disadvantage in terms of being able to offer a variety of health promoting resources in their communities as a result of funding, isolation, and low demand due to the relatively small populations. Given that age is a proxy for accumulated social advantages/disadvantages, a longer term goal is to reduce the disadvantages facing the most vulnerable members of a community, from the womb to infancy to childhood to adolescence to adulthood. Initiatives aimed at various stages of life are useful, but early interventions are likely the most effective.

Socioeconomic Development

Increasing economic development in terms of education, employment, and income would pay dividends. These three attributes of economic development are

interconnected and their influence extends well beyond health outcomes; hence, these issues are far from being strictly within the realm of health policy. Initiatives aimed at socioeconomic development will naturally have intended/unintended consequences for health. Through the process of quantifying the effects of individual socioeconomic characteristics on health, such as labor force participation, income and education, we gain a full appreciation of the magnitude of the effect of these variables. In a recent study by White et al. (2007), findings indicated that there are many best practices emerging that can make a positive impact on Aboriginal labor force participation. Similarly, White, Spence and Maxim (2005) have also found that systematic under achievement in education can be altered by policies aimed at enhancing social capital. White and Beavon (2007) have also developed a policy framework to enhance the effectiveness of Aboriginal run schools. Policy aimed at improving the socio-economic development of First Nations, based on evaluated best practices can be an important pathway to improved health.

Lifestyle

In terms of lifestyle habits, mechanisms to reduce smoking must continue to be emphasized. Recall most respondents—42.5%— reported smoking daily while 16.3% of respondents reported smoking occasionally. With respect to excessive alcohol consumption, excessive binge drinking in particular should continue to be addressed in Aboriginal communities, with 10.8% of respondents reporting binging drinking often. This problem has not gone unnoticed by Aboriginal people as a recent poll found that

82% of First Nations respondents identified decreased use of alcohol and drugs as integral to improving Aboriginal health (NAHO 2003). Tobacco is, however, considered part of a rubric of sacred elements in many Aboriginal cultures as its use is widespread in ceremonies. This makes the suppression of tobacco consumption on health grounds somewhat more difficult. Policy in this sense may best be developed in terms of education on over consumption rather than purely advocated abstinence from any activities related to its use.

Social Relations

Mechanisms to increase social support (belonging/association) in communities would benefit health outcomes. The conditions that foster such support in Aboriginal communities are still not clear; however, social spaces for interaction such as community center and parks, as well as the development of communication infrastructure may foster the development of social networks and the transmission of information flow. This variable was included in the theoretical models developed in the late 1990s at the University of Western Ontario and appears to have some empirical support.[102]

4) Policy driven research in the area of Aboriginal health must be a priority. We are only beginning to scratch the surface in terms of our understandings of the

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[102] These issues relate directly to social capital and social cohesion (see White, Maxim and Beavon 2003).

mechanisms governing Aboriginal health in Canada.[103] Strategic research that targets specific variables of interest is necessary. As indicated in the literature review of Chapter 2, contextual-level research on Aboriginal populations in Canada is a largely unexplored avenue of research, and multilevel analyses are virtually non-existent. From a policy standpoint, multilevel research is useful for a number of reasons: a) we can distinguish effects at various levels of analysis and therefore identify strategic intervention points (e.g., household or community) and quantify the relative impacts of these levels on our social outcomes of interest; b) we can ascertain why communities may have average outcomes of interest that are low or high based on the composition of the residents of those social spaces; and (c) similarly, we can conduct program and policy evaluations on interventions that control for compositional differences. Qualitative research works as a useful addition to multilevel modeling as communities with unexpected outcomes can be investigated through rigorous case studies.

7.4 Shortcomings of the Research

Temporality

One shortcoming of this study is its cross sectional feature, which raises two issues: reverse causation and lag time between cause and effect. In terms of the former, it cannot be ruled out that health status may be affecting the explanatory variables. In

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[103] Although it should be interpreted with caution, there is a large amount of unexplained variance in the model of First Nations health in this study. McFadden's R^2 showed us that about 15% of the variation in the dependent variable has been explained.

addition, a cross sectional design prevents us from exploring the lag time between cause and effect. It is very unlikely that any cause is instantaneous in terms of its effects. One could assume that a cause is stable over time in which case the specification of a lag time may be an unnecessary exercise, but the evidence from previous studies indicates that this is not the case.[104] Given the paucity of data on Aboriginal people (on-reserve First Nations in particular), as well as the problems with under-reporting in the Census and national surveys, any type of temporal analysis is very limited. [105]

It is now recognized that health status is a product of more than simply one's recent activities. The lifecourse approach has been used to address the decontextualization of health outcomes as it has solidified the importance of events across one's entire life as determining one's current status. For example, Barker's (1990; 2003) Early Origins Hypothesis or Fetal Origins Hypothesis exposes the primacy of significant life events during the early critical stages of development, such as malnutrition of the mother, as having a lasting effect in terms of later life risk for variety of diseases. This results from the altered long lasting effects to the baby's physiology which interacts with later influences to produce a variety of health ailments, such as diabetes (Forsen et al. 2000 and Ravelli et al. 1998), stroke and coronary heart disease (Martyn, Barker, and

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[104] For example, Blakely et al. (2000) have demonstrated in their study of the United States that there is, indeed, a lag between income inequality and health status. They found that self-rated health was more strongly associated with income inequality up to fifteen years previously than contemporaneously.
[105] The First Nations Regional Longitudinal Health Survey is the first of its kind that captures detailed information on health and its many determinants of the Inuit and reserve population. In 2002-2003 the first cycle of the survey was completed and the second was slated for 2006 (see NAHO's webpage for more info: http://www.naho.ca/firstnations/english/first_nation_regional.php).

Osmond 1996), and polycystic ovaries (Cresswell et al. 1997). Another popular perspective within the lifecourse approach is related to the idea of accumulated advantage. Put simply: adversity breeds more adversity across the lifecourse, while advantage breeds more advantage across the lifecourse which dictates the degree of disease experienced and polarizes health outcomes in the population with age (Kuh and Ben-Shlomo 1997; Power and Hertzman 1997). There is no doubt that the lifecourse and idea of delayed effects of social exposures are both logical and supported empirically, but this should not underestimate the effects of the immediate milieu. As Marmot and Bobak (2000) explain, the dramatic decline in life expectancy for men of *all ages* in Russia in a mere seven years from 1987 to 1994 illustrates the power of social and economic circumstances in determining health outcomes in a relatively small time frame.[106] Finally, Subramanian and Kawachi (2003) suggest that high quality longitudinal studies of health, function, and illness extending across the life cycle and across generations are necessary to truly study the determinants of health.

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[106] In terms of a variable such as income inequality, Subramanian and Kawachi (2003) comment that researchers do not necessarily believe its effects on health outcomes to be instantaneous. For example, in the case of the United States, there is a striking pattern in the data with states consistently maintaining their relative inequality rank over decades. Thus, one cannot rule out the possibility that cross sectional data is correct, given that it may very well be capturing cumulative disadvantages to health resulting from decades of living in unequal contexts. They also argue that it is imperative to examine the health of subgroups of any large region as averages tend to tell us little about the disadvantaged in the distribution. Ideally time, place and sub group analyses can give us a clear understanding of how income inequality truly works (ibid).

Specific Versus General Measures of Health

This research attempted to model health outcomes as operationalized by self-rated health. Self-rated health is widely used for many reasons as outlined in Chapter 4. There are, however, drawbacks with the use of any single measure, regardless of how valid and reliable it is as an indicator of overall health. Lynch et al. (2004) explain that this simplification fails to understand the specific pathophysiological and behavioral pathways which link specific health outcomes (e.g., cancer, heart disease, diabetes) to specific social factors and differential etiological time lags between any exposure and its outcome. Indeed, general outcomes, such as self-rated health, may be determined by multiple pathways and mechanisms across a variety of dimensions of stratification. Moreover, the manner in which social factors affect less traditional health outcomes such as crime are no doubt possibly quite different than the way they affect chronic disease. There is already some evidence that caution is warranted; for example, the effects of income inequality on infant mortality tend to be more robust than the effects on other outcome variables such as life expectancy and all cause mortality (Lynch et al. 2001). On the other hand, there are patterns that transcend specific measures of health. For example, health has always followed a gradient; that is, health tends to best among those at the top of the socioeconomic ladder and decreases with each step down. In terms of the epidemiological transition, the historical record shows that those higher up the social ladder were most likely to survive infectious diseases, and during the transition diseases of affluence (e.g., heart disease, stroke, lung cancer) eventually become diseases of the poor (Chernomas 1999). This tradeoff between generalizability

and specificity is far from being unique to the research question at hand. We are reminded not to overstate the effects or lack thereof in our work. All we can do is shed light on one piece of a larger puzzle.

7.5 Future Research

Given the results of this study, future research on Aboriginal health should focus on some particular areas of inquiry.

An examination of the effects of other relevant individual-level variables would be a logical way to proceed; for example, the importance of safe water in Aboriginal communities has been an ongoing and pressing issue in Canadian society. Safe water has a distinct effect on health, and this course of research would be a research path worth pursuing.[107] Related to this issue, despite its comprehensiveness, the APS is missing many variables that would be useful for testing comprehensive theories of health. The availability of many confounders and intervening variables allows us to test models in a more comprehensive manner as the causal sequence can be clearly articulated and examined. From a policy standpoint, this enables the identification of relevant strategic intervention points. For example psychosocial processes which mediate the effects of independent variables are not readily available in the dataset.

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[107] In fact, a research grant has already been secured by our research group at the Aboriginal Policy Research Consortium International, at the University of Western Ontario, from the Canadian Institutes of Health Research to pursue this area of inquiry.

The effects of other dimensions of social support on health such as instrumental support or emotional support would be useful, as the links between support and health are well-established in the literature although much less so in the Aboriginal population. Complex relationships between these various dimensions of support and other variables of interest, including cross-level and single level interaction effects, are particularly less well-established.

Analyses comparing the determinants of health for reserve/urban Aboriginals would be useful. It may be the case that the determinants of health vary given the different social exposures in these different areas. Moreover, the magnitude of the effects of variables may be different and the social dynamics governing these relationships may warrant differential models which include more complex modeling terms (e.g., interaction effects).

The primacy of the social context in determining outcomes, including health, is deserving of much more research and attention. Section 7.1 addressed the issue of the insignificant finding of the role of social structure in the health of First Nations reserve residents, underscoring the need for more studies to contribute to the relatively small body of empirical evidence. Even though the effect size of a contextual variable, such as income inequality is not large, given the large segment of the population exposed to the effect, the societal burden in terms of health outcomes is large (Lynch et al. 2004).

Related to this point, other variables with health promoting effects may have significant variability at the contextual-level which, if understood, could be extremely useful for achieving desired outcomes. For example, educational attainment of the individual may be a result of both individual and contextual-level variables. In turn, we know that individual education has a positive effect on health. Thus, by understanding the ecological determinants of variables, such as education, which in turn impact health, we are better able to proceed in improving it.

Drawing out dimensions of stratification within the Aboriginal population is a logical way to proceed. The relational effects of gender and their manifestation as a product of institutional arrangements in society is deserving of strict attention. Most notably, future analyses should examine the intersection of gender with community level effects. For example, we know that the experience of being male and female differs in society, and it may be that the socioeconomic milieu has differential effects on males and females.[108] This cross-level interaction between structure and individual has not been firmly theorized let alone tested within the Aboriginal health literature.

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[108] There are many instances of health differences by male/female in the Aboriginal population. For example, two thirds of all First Nations people diagnosed with diabetes are female, whereas in the general Canadian population males are more likely to be diagnosed with diabetes (Health Canada 2002a). Understanding the foundations for these types of differentials between males and females within these two subpopulations of Canada is a worthy effort.

7.6 Stepping Back: Causes of Inequality

While the relationship between income inequality and a number of social outcomes is well documented, a fundamental question is what causes income inequality? This is a valid point of inquiry if, indeed, income inequality is as profound in its consequences as suggested.[109]

Debates on the proximate causes of inequality, such as demographics, unemployment, inflation, recessions, and other macroeconomic conditions, tend to shy away from the true causes of inequality. These various phenomena which "cause" inequality are created or largely influenced by the social fabric of our society, including our social policies. By ignoring the fundamental approach of governments to developing policy, we miss the root causes of social outcomes.[110] Depoliticizing proximate causes of inequality implies that they are beyond the scope of our political institutions, but most causes of inequality are amendable to social change via political decision making.[111] This point has received much attention in the literature by a number of researchers in the area, such as Coburn (2000; 2004) and Lynch (2000). The discussion has,

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[109] Despite the fact that this work does not support the conclusion that income inequality has a "profound" effect, at least in terms of the self-rated health outcome, we will pursue this engaging line of inquiry further. After all, there may be many social outcomes in First Nations communities that are affected by income inequality, and we know that income inequality tends to be high and varies considerably among the Aboriginal population.

[110] Essentially, there are no causes of income inequality which do not reflect some degree of political intervention, either directly or indirectly.

[111] Even if one believes that a given income inequality distribution has no political origins, if income inequality has a negative effect regardless of its cause, then we are still interested in how we can alter this distribution through social processes, including policy decision making.

however, been absent in the Aboriginal context, where income inequality is particularly large.

A recent contribution by White, Maxim, and Spence (2004) outlined that the legal framework of society frames the context in which social change occurs and dictates the choices of governments in setting the policy agenda as related to Aboriginal people. I do not suggest otherwise; however, income inequality may be one of the best "proxy" variables for the state of the legal system and the political ideology of our times. This may explain some of the differences we observe across Canada as found by Drost and Richards (2003), who showed that the levels of income inequality for Aboriginal people are most pronounced in the West. More work in this area is needed.

7.7 Integrating Perspectives and Developing General Theories

Can the income inequality framework be incorporated into existing work on Aboriginal people or does this framework supplant previous approaches? It appears as though income inequality may enhance our understanding of some current work. Let us look at one largely successful example, the Harvard Project on American Indian Economic Development. For the Harvard Project, headed by Cornell and Kalt (1992; 1998), identifying the prerequisite conditions to produce sustained, self determined American Indian nations has been the primary focus. Their model is supported based on cases of Indian tribes throughout the United States. They identify a triumvirate of key factors: sovereignty, institutions, and culture. The premise behind the importance

of sovereignty is that people should be in charge of their own fate; hence, tribes must exercise control over their resources, governance, and institutions. The second factor refers to the institutional attributes of the tribal governments. They underscore the importance of effective and responsible governance and fair dispute resolution for stability and investment. Lastly, congruence between the institutions of government and tribal cultural ideas of authority is integral to economic development. Thus, socioeconomic development and independence is tied to the exercise of sovereignty coupled with the creation of culturally appropriate institutions of self government, which are characterized by notions of responsibility, reliability, and trust.

An inequality framework should be integrated into these understandings of socioeconomic development. For instance, the preconditions that are conducive to successful sovereignty, including public support for redistributive policies, such as Aboriginal initiatives and social welfare issues more generally, are largely influenced by the degree of inequality in society (Perotti 1996). Similarly, there is no community that exists in complete isolation from the wider society. The socioeconomic conditions of proximate and distant regions as well as their constituents will have an effect of varying magnitudes on the triumvirate of factors. In terms of effective and responsible governance, income inequality has been linked to political instability; for example, capital accumulation can be impeded when governments arbitrarily repudiate contracts and threaten the security of property rights. Thus, ineffective and irresponsible governance results in a cycle of low investment coupled with low growth (Alesina and

Perotti 1996; Thourbecke and Charumilind 2002).[112] Finally, institutions of self government that are culturally appropriate are, indeed, important, but is it possible that there may be a tradeoff between cultural congruence and economic efficiency when the nature of the governance tends to be hierarchical and promote inequality?

What this example demonstrates is that income inequality may require a rethinking or "tweaking" of existing perspectives seeking to explain social outcomes of Aboriginal people. The ability to incorporate this evidently important explanatory variable, given the large amount of empirical evidence, within a causal framework will pay great dividends.

7.8 Key Contributions

Having outlined some of the shortcomings of this work and future directions for research, I will now provide a brief overview of the main contributions of this dissertation. The contributions are broken down into three distinct categories: theoretical, substantive, and policy.

Theoretical

- The development of a comprehensive model of the determinants of Aboriginal health, including variables at all relevant levels of analysis.

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[112] There are also other processes at play, such as social capital (social organization, networks of associations, interpersonal trust, norms of reciprocity), which can facilitate collective action for mutual benefit. Social capital is integral for economic growth as well as effective government and is directly related to income inequality.

- A focus on the socioeconomic determinants of health, particularly elaborating our understanding of the income inequality hypothesis.
- Exploration/application of the psychosocial determinants of health, including the idea of relative deprivation in the First Nation population.
- Increased understanding of the contingent relationships between structure and individual variables, that is, the potentially different effects of social support by context.
- Revealing some unique relationships between the intersection of race, ethnicity, and income inequality.
- Underscoring the importance of the relative distribution of resources in addition to the absolute distribution of resources.

Substantive

- The application of multilevel modeling to a fundamentally important Aboriginal issue, health, and the estimation of a statistically appropriate model to truly capture the various effects of the determinants of health at different levels, including income inequality. Income inequality studies in Canada have generally been single level (ecological) – multilevel evidence is much more reliable.
- Decomposing the variation in health by its component parts, that is, individual and contextual

- Measuring the effects of the social determinants of health for the First Nations reserve population
- Capturing Intra Aboriginal differences

Policy

- The identification of strategic areas of focus for improving the determinants of health for Canada's First Nations reserve population

7.9 Conclusions

This research project has demonstrated the importance of examining new ways of approaching our understanding of Aboriginal health processes from both a theoretical and methodological perspective. Theoretically, the material focus on the social context and its interactions with individual-level causes discerns new mechanisms that may generate the outcomes we observe. Not only are new ways of theorizing about the issues at hand pivotal for generating new insights and hypotheses, but they demand unique methodologies and underscore the gravity of comprehensive data.

In closing, the state of Aboriginal health is perhaps the most urgent Aboriginal policy issue in society. In a political climate where finite societal resources must be allocated in the most strategic and efficient manner possible to maximize health policy, our understanding of the major determinants of health for Aboriginal Canadians is of

principal importance. Developing new paths of inquiry and scrutinizing existing agendas must be at the forefront of research and policy alike.

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Appendix A: Original Survey Questions, Answers, and Recodes

	Variable	Question	Answer	Recodes
Dependent Variable	Self-rated health (E01HLTH)	In general, would you say your health is...	. Missing 01 Excellent 02 Very good 03 Good 04 Fair 05 Poor 00 Not stated or Invalid	. & 00 = Missing and then imputed 01 = Good Health (01-03) 02 = Not good health (04-05)
Independent Variable (Individual-level)	Age (AGEU)	Age in years as of Census day	-9 Not stated or Invalid 15-119	-9 = Missing and then imputed
	Sex (IDQ06SEX)	Sex of respondent	01 Male 02 Female	
	Marital Status (MARST)	Marital status of respondent	-8 Missing 01 Divorced 02 Legally married (and not separated) 03 Separated but still legally married 04 Never married (single) 05 Widowed	-8 = Imputed 01 = Divorced, Separated, Widowed (01+03+05) 02 = Married (02) 03 = Single (04)
	Income (EFINC)	Economic family total income	-999998 Missing	-999998 = Imputed

	Variable	Question	Answer	Recodes
	Equivalized economic family income (EQECFAINC)	Equivalized economic family income		Derived from Income (EFINC) and Number of persons in household (UNITS) EFINC/ UNITS$^{1/2}$ $\frac{EconomicFamilyTotalIncome}{\#ofpeopleinhousehold^{1/2}}$
	Labor Force Status (LFSTATUS)	Labor Force Activity	. Missing 01 Employed 02 Unemployed 03 Not in the labor force 99 Not stated or Invalid	. & 99= Missing and then imputed
	Education (HLOS)	Highest level of schooling	. Missing 01 No schooling 02 Less than high school diploma 03 High school diploma 04 Some trade school 05 Some other non university institution 06 Some university 07 Diploma or certificate from trade school 08 Diploma or certificate from other non university institution 09 University certificate or diploma below bachelor's level 10 Bachelor's level 11 University certificate or	. & 99 = Missing and then imputed 01 = Low education (01-02) 02 = Medium education (03-05) 03 = High education (06-14)

	Variable	Question	Answer	Recodes
			diploma above bachelor's level 12 Master's degree 13 Degree in medicine, dentistry, veterinary medicine or optometry 14 Earned doctorate 99 Not stated	
	Number of persons in household (UNITS)	Number of persons in household	-8 Missing 001-025	-8 = Imputed
	Smoking (E24SMK)	At the present time do you smoke cigarettes daily, occasionally or not at all?	. Missing 01 Daily 02 Occasionally 03 Not at all 04 Refused 99 Not stated or Invalid	., 4 & 99 = Missing and then imputed 01 = Daily 02 = Occasionally 03 = Not at all
	Drinking (E33ALC)	During the past 12 months, have you had a drink of beer, wine, liquor or any other alcoholic beverage?	. Missing 01 Yes 02 No 03 Refused 99 Not stated or Invalid	., 03 & 99 = Missing and then imputed 01 Yes 02 No
	Binge Drinking (E36DRNK)	How often in the past 12 months have you had 5 or more drinks on one occasion?	. Missing 01 Less than once a month 02 Once a month 03 2 to 3 times a month 04 Once a week 05 2 to 3 times a week 06 4 to 6 times a week 07 Every day 08 Never 09 Don't know 10 Refused 99 Not stated or Invalid	.,9, 10 & 99 = Missing and then imputed Derived from Drinking (E33ALC) and Binge Drinking (E36DRNK) 01 = Sometimes(01-03) 02 = Often (04-07) 03 = Never (08) 04 = Do not drink

	Variable	Question	Answer	Recodes
	Family Medicine (E02DOCT)	In the past 12 months, have you seen or talked on the telephone with the following health professionals about your physical, emotional or mental health: Family doctor or general practitioner?	. Missing 01 Yes 02 No 99 Not stated or Invalid	. & 99 = Missing and then imputed 01 = Yes 02 = No
	Traditional Medicines/healing/wellness practices (E03TRAD)	Are First Nations, Métis or Inuit traditional medicines, healing or wellness practices available in the city, town or community where you live?	. Missing 01 Yes 02 No 03 Don't know 04 Refused 99 Not stated or Invalid	., 04 & 99 = Missing and then imputed 01 = Yes 02 = No
	Culture (B01ABLG)	Do you understand or speak an Aboriginal language?	. Missing 01 Yes 02 No	. = Imputed 01 = Yes 02 = No
	Social Support	People sometimes look to others for companionship, assistance, guidance or other types of support. Could you tell me how often each of the following kinds of support is available to you when you need it:		
	(E37LOVE)	a) Someone who shows you love and affection	. Missing 16 All of the time 17 Most of the time 18 Some of the time 19 Almost none of the time 20 Refused 99 Not stated or Invalid	., 20 & 99 = Missing and then imputed 04 = All of the time 03 = Most of the time 02 = Some of the time 01 = Almost none of the time

	Variable	Question	Answer	Recodes
	(E37GTIME)	b) Someone to have a good time with	. Missing 21 All of the time 22 Most of the time 23 Some of the time 24 Almost none of the time 25 Refused 99 Not stated or Invalid	., 25 & 99 = Missing and then imputed 04 = All of the time 03 = Most of the time 02 = Some of the time 01 = Almost none of the time
	(E37TOGTH)	c) Someone to get together with for relaxation	. Missing 31 All of the time 32 Most of the time 33 Some of the time 34 Almost none of the time 35 Refused 99 Not stated or Invalid	., 35 & 99 = Missing and then imputed 04 = All of the time 03 = Most of the time 02 = Some of the time 01 = Almost none of the time
	(E37ENJOY)	d) Someone to do something enjoyable with	. Missing 36 All of the time 37 Most of the time 38 Some of the time 39 Almost none of the time 40 Refused 99 Not stated or Invalid	., 40 & 99 = Missing and then imputed 04 = All of the time 03 = Most of the time 02 = Some of the time 01 = Almost none of the time
	Social Support Scale			Social Support (a) + Social Support (b) + Social Support (c) + Social Support (d)

	Variable	Question	Answer	Recodes
Independent Variables (Contextual-level)	Income Inequality: Gini Coefficient			Created using equivalized economic family income variable. See Chapter 5 for more details.
	Income Inequality: Theil Coefficient			
	Income Inequality: Coefficient of Variation			
	Community Median Income			

Appendix B: Average Levels of Health in APS Reserves

Community Name	Proportion with Good Health	Proportion with Poor Health
Ahtahkakoop No. 104	.76	.24
Alert Bay	.76	.24
Alexis No. 133	.76	.24
Alkali Lake No. 1	.79	.21
Assiniboine No. 76	.81	.19
Big River No. 118	.79	.21
Blood No. 148	.91	.09
Buffalo River Dene Nation No. 193 (Peter Pond Lake No. 193)	.80	.20
Burnt Church No. 14	.76	.24
Campbell River No. 11	.75	.25
Canoe Lake No. 165	.91	.09
Capilano No. 5	.89	.11
Chehalis No. 5	.78	.22
Chemainus No. 13	.69	.31
Chemawawin No. 2	.83	.17
Chicken	.84	.16
Chisasibi	.93	.07
Christian Island	.82	.18
Clearwater River	.83	.17
Cole Bay No. 3	.81	.19
Cote No. 64	.77	.23
Couchiching No. 16A	.77	.23
Cowessess No. 73	.86	.14
Cowichan No. 1	.73	.27
Cross Lake	.83	.17
Curve Lake First Nation No. 35	.81	.19
Deer Lake	.80	.20
Deline	.89	.11
Deschambault Lake	.82	.18
Devon No. 30	.92	.08
East Moberly Lake No. 169	.71	.29
Ebb and Flow No. 52	.91	.09
English River No. 21	.80	.20
Eskasoni No. 3	.83	.17
Fairford No. 50	.79	.21
Fisher River	.79	.21
Flying Dust First Nation No. 105 (Meadow Lake No. 105)	.83	.17

Community Name	Proportion with Good Health	Proportion with Poor Health
Fort Good Hope	.77	.23
Fort Hope No. 64	.77	.23
Fort Liard	.95	.05
Fort MacKay - DPL	.66	.34
Fort McPherson	.82	.18
Fort Nelson No. 2	.73	.27
Fort Providence	.89	.11
Fort Resolution	.84	.16
Fort William No. 52	.69	.31
Garden River No. 14	.91	.09
Gitanmaax No. 1	.80	.20
Gitsegukla No. 1	.69	.31
Gitwangak No. 1	.93	.07
Gordon No. 86	.85	.15
Grand Council of the Crees / Grand conseil des Cris	.86	.14
Hagwilget No. 1	.78	.22
Hay River Dene No. 1	.89	.11
Indian Brook No. 14	.69	.31
James Smith No. 100	.84	.16
John d'Or Prairie No. 215	.86	.14
Kamloops No. 1	.78	.22
Kettle Point No. 44	.76	.24
Kitamaat No. 2	.74	.26
Kitsakie No. 156B	.75	.25
La Loche	.90	.10
Lac La Ronge No. 156	.80	.20
Lac Seul No. 28	.85	.15
Lennox Island No. 1	.75	.25
Little Pine No. 116	.77	.23
Louis Bull No. 138B	.85	.15
Makaoo(Part) No. 120	.82	.18
Makwa Lake	.88	.12
Millbrook No. 27	.81	.19
Ministikwan	.70	.30
Mission No. 1	.80	.20
Mississagi River No. 8	.82	.18

Community Name	Proportion with Good Health	Proportion with Poor Health
Mnjikaning First Nation No. 32 (Rama First Nation No. 32)	.81	.19
Montana No. 139	.94	.06
Montreal Lake	.83	.17
Moosomin No. 112B	.97	.03
Mosquito No. 109	.81	.19
Musqueam No. 2	.74	.26
Nanaimo Town No. 1	.74	.26
Nelson House No. 170	.81	.19
Nisga'a Nation / La nation Nisga'a	.84	.16
Norway House No. 17	.81	.19
Okanagan No. 1	.79	.21
Old Crow	.78	.22
Opaskwayak Cree Nation	.79	.21
Oxford House No. 24	.83	.17
Peepeekisis No. 81	.77	.23
Peguis No. 1B	.83	.17
Peigan No. 147	.88	.12
Pelly Crossing	.68	.32
Piapot No. 75	.79	.21
Pikwakanagan (Golden Lake No. 39)	.79	.21
Pinehouse	.93	.07
Poundmaker No. 114	.78	.22
Rae-Edzo	.89	.11
Ross River	.80	.20
Sagamok	.79	.21
Samiajij Miawpukek	.84	.16
Samson No. 137	.87	.13
Sandy Bay	.66	.34
Sandy Bay No. 5	.86	.14
Sandy Lake No. 88	.74	.26
Seabird Island	.73	.27
Sechelt (Part)	.77	.23
Seekaskootch No. 119	.82	.18
Siksika No. 146	.84	.16
Sioux Valley No. 58	.82	.18
South Saanich No. 1	.70	.30
Split Lake No. 171	.79	.21
St. Theresa Point	.74	.26

Community Name	Proportion with Good Health	Proportion with Poor Health
Standing Buffalo No. 78	.85	.15
Stoney No. 142, 143, 144	.85	.15
Stony Creek No. 1	.85	.15
Stony Plain No. 135	.75	.25
Sturgeon Lake No. 101	.74	.26
Tache No. 1	.89	.11
Tsahaheh No. 1	.78	.22
Tsinstikeptum No. 9	.84	.16
Tsulquate No. 4	.73	.27
Tsuu Tina Nation No. 145 (Sarcee 145)	.81	.19
Tulita	.80	.20
Utikoomak Lake	.79	.21
Wabamun No. 133A	.79	.21
Wabasca No. 166, 166A, 166B,166C,166D	.84	.16
Wapachewunak No. 192D	.81	.19
Waterhen No. 130	.91	.09
Waywayseecappo First Nation	.84	.16
WhaTi	.90	.10
White Bear No. 70	.80	.20
White Fish Lake No. 128	.69	.31
Wikwemikong Unceded No. 26	.78	.22
Wiliiams Lake No. 1	.86	.14
Woyenne No. 27	.71	.29
Minimum **Maximum** **Mean (unweighted)**	.66 .97 .81	.03 .34 .19

Appendix C: A Comparison of Cases with Expected Residuals and Outliers (Studentized Residuals > 2.5) by Variables in the Model

	Expected Residuals (N=18823)	Outliers (N=67)
Self-rated health (%)		
Good Health (Excellent/Very good/Good)	82.4	0
Poor Health (Fair/Poor)	17.6	100
Age, years (Mean)	36.45	20.94
Sex (%)		
Male	49.8	73.1
Female	50.2	26.9
Marital Status (%)		
Divorced, Separated, Widowed	12.5	3.7
Married	31.7	14.8
Single	55.8	81.5
Equivalized Economic Family Income (Mean $)	12740.33	15825.33
Ln Equivalized Economic Family Income (Mean $)	9.452528	9.669367
Labor Force Status (%)		
Employed	39.9	61.1
Unemployed	12.8	17.1
Not in labor force	47.3	21.8
Education (%)		
Low education	56.4	67.4
Medium education	22.0	18.7
High education	21.6	13.9
Smoking (%)		
Daily	42.4	47.1

	Expected Residuals (N=18823)	Outliers (N=67)
Occasionally	16.3	18.6
Not at all	41.3	34.3
	95% Sample (N=18	**Residual**
Binge Drinking (%)		
Sometimes	39.8	49.0
Often	10.7	9.9
Never	6.2	5.3
Do not drink	43.4	35.8
Seen GP in last Year (%)		
Yes	62.7	0.0
No	37.3	100
Traditional Medicine/Wellness/Healing Practics (%)		
Yes	72.6	87.2
No	27.4	12.8
Culture (%)		
Yes	79.8	86.8
No	20.2	13.2
Social Support (Mean)	13.32	14.6811

Curriculum Vitae

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Education

PhD, Sociology, University of Western Ontario, 2002-Ongoing
BA (Honors), Sociology, University of Western Ontario, 2001

Selected Honors and Awards

Social Sciences & Humanities Research Council of Canada Doctoral Fellowship, 2004-2006
Graduate Student Teaching Award, 2003
Ontario Graduate Scholarship, 2002-2004
Dean's Honor List, 1999-2001

Research

Relevant Research Experience

Research Officer
Strategic Research and Analysis Directorate, Indian Affairs Canada 2005-ongoing

Research Assistant/Associate
The University of Western Ontario 2001-ongoing

Selected Refereed Contributions

Spence, Nicholas D., White, Jerry P., and Paul S. Maxim. (Forthcoming). "Modeling Community Determinants of Canada's First Nation's Educational Outcomes." *Canadian Ethnic Studies.*

White, Jerry P., **Nicholas D. Spence**. (2005). "Impacts of Social Capital on Educational Attainment in Aboriginal Communities: Lessons from Australia, Canada, and New Zealand." Policy Research Initiative.

White, Jerry P., Paul S. Maxim and **Nicholas D. Spence**. (2004). "An Examination of Educational Success." In *Aboriginal Policy Research: Selected Proceedings of the Aboriginal Policy Research Conference 2002, Volume 1*, edited by White et al. Toronto: Thompson Educational Publishing.

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