Divergent Disability Rates in Canada: Analysis of the Social
Determinants of Disability

by

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ABSTRACT

Reported disability rates in Canada have varied widely between provinces since 1983. Quebec always reports a disability rate about half the Canadian average while Nova Scotia reports a significantly higher rate than the national average. This pattern has been consistent for many years, across surveys and disability identification questions. This research sheds light on possible factors that may influence the robust nature of these discrepancies in the disability rates of these provinces.

This research uses the social determinants of health approach to explore risk factors that are potentially associated with the onset of disability. Cross-sectional data are used to examine the details of current disability rates and differences that exist between provinces. Longitudinal data and survival analysis modelling are used to evaluate the factors influencing the onset of disability over time. Determining the influence of these factors over time helps understand how disability rates evolved into the current discrepancies.

The findings of this research suggest that Nova Scotia has elevated risks for disability due to a number of factors often related to disability. Nova Scotia has one of the oldest age structures in Canada, low levels of income and education combined with high rates of smoking, obesity and poor health. The combination of these characteristics suggest that the consistently high disability rate in Nova Scotia is logical due to elevated rates for a significant number of risk factors that appear to have a strong influence on the onset of disability.

The results of this research regarding the low disability rates in Quebec are less clear. Several factors suggest Quebec's disability rate should be lower than Nova Scotia, but not at an extremely low level. The age structures of Quebec and Nova Scotia are remarkably similar yet Quebec reports much lower rates of poor health despite a smoking rate and other risk factors for conditions related to disability that are above the national average. However, Quebec also reports significantly lower rates of obesity and a variety of chronic conditions such as arthritis, which combine to produce an environment in Quebec where there are fewer conditions that are often associated with disability.

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LIST OF ACRONYMS

ADL	Activities of Daily Living
AODA	Accessibility for Ontarians with Disabilities Act
BMI	Body Mass Index
CCHS	Canadian Community Health Survey
CLSA	Canadian Longitudinal Study on Aging
CSEP	Canadian Society for Exercise Physiology
CV	Coefficient of Variation
H ₁	Hypothesis 1
H ₂	Hypothesis 2
H ₃	Hypothesis 3
HR	Hazard Ratio
HUI	Health Utility Index
ICF	International Classification of Functioning, Disability and Health
ISQ	Institut de la Statistique du Québec
NOC-S	National Occupation Classification for Statistics
NPHS	National Population Health Survey
OHS	Ontario Health Study
PALS	Participation and Activity Limitation Survey
PH	Proportional Hazard
ROC	Receiver Operating Characteristic
SAS	Statistical Analysis Software
SES	Socio-Economic Status
UCLA	University of California, Los Angeles
UPIAS	Union of Physically Impaired Against Segregation
WHO	World Health Organisation

CHAPTER 1: EXPLORING DISPARITY IN THE DISABILITY RATES IN CANADA

The population of persons with disabilities has a very diverse membership that brings many challenges in producing statistical information about this group. This diversity includes persons with many different types of disabilities with origins ranging from poor design of physical spaces to self-perceptions of aging. Identifying and measuring characteristics of the population of persons with disabilities is a critical endeavor because of significant policy and financial implications yet there are serious discrepancies in existing data sources that have been detected consistently for nearly 30 years. Disability data are used by all levels of government ranging from federal, provincial, territorial, municipal and health regions to plan the funding, availability and selection of programs and services for persons with disabilities. One of the most critical uses of these data is the Canada Health Transfer where billions of dollars are distributed across the provinces to provide health care. Disability data are not the only source of information for this transfer but it is an important component. Without accurate data regarding the population of persons with disability, the programs and services intended to assist this population may not be available where they are needed, may not be appropriate to the specific needs of the population they are intended to serve and the funding may be incorrectly allocated, providing poor value to Canadian taxpayers.

A second reason underlining the importance of understanding the discrepancies in disability rates is the growing use of disability as an outcome variable in disability research and also as a control variable in other research. Instead of conceptualising

disability as an indicator of activity limitations or health status, a growing body of research is using and promoting disability as a demographic variable similar to gender or race (Wisdom et al, 2010; Lollar and Crews, 2003; U.S. Department of Health and Human Services, 2000). Given the powerful effects of disability on significant components of the life course such as labour market status, income and education, ensuring that the measurement and reporting of disability is precise and well understood is critical.

Third, as a world leader in the measurement of social phenomena, it is important that the Canadian statistical system understand the strengths and limitations of its disability measurement tools and how they are functioning. Many developing statistical systems rely upon the best practices of leading statistical organisations to guide them in their development of effective tools for the measurement of social phenomena such as disability. Poorly performing measurement tools that are not well understood could be employed by other countries, perpetuating these weaknesses on an even larger scale.

Finally, this thesis employs a variety of bivariate and multivariate techniques to approach the discrepancies in disability data from a variety of angles. These varied approaches can also be used by social scientists to improve their understanding of other social phenomena that might change over time such as seniors deciding when to move into a supported living setting, the long-term effects of health behaviours and many other topics that involve measurable change over time. This thesis provides step by step instructions for how to calculate bivariate and multivariate results using surveys

with complex designs as well as how to perform one of the more common types of longitudinal analysis (survival analysis).

This chapter begins with a brief summary of the discrepancies observed in the various disability data sources over the past thirty years followed by a brief discussion of plausible explanations that can be quickly dispelled with a brief analysis, indicating that a much more detailed research approach is needed. The overall analytical strategy for this research is explained as well as a summary of the theoretical basis of this research and the methodologies employed. There are two separate results chapters in this thesis so the purpose of these chapters is explained along with the goals of the discussion and conclusion chapters.

SUMMARY OF THE DISABILITY DISCREPANCIES

Statistics Canada first began collecting data on persons with disability in the early 1980s. Since that time, Statistics Canada has consistently found that disability rates are notably lower in Quebec and higher in Nova Scotia compared to the rest of Canada. As an example, Figure 1 shows the age standardised disability rate by province from the 2006 Participation and Activity and Limitations Survey (PALS). Figure 2 further shows the consistency of this finding over a 20 year period spanning three different surveys and three different sets of questions specifically designed to measure disability.

Figure 1: Age Standardised Disability Rates by Province, 2006

1. Error bar represents coefficient of variation for each estimate

Figure 2: Age Standardised Disability Rates by Province, 2006, 1996 & 1986

This discrepancy between Nova Scotia and Quebec is even more puzzling after a closer look at the age composition of the provinces. Nova Scotia had an older

population than Quebec in 2006, with a median age of 41.8 compared to 41.0 in Quebec. The median Canadian age was 39.5 in that year. Given the strong association between age and disability, the relatively low rates of disability reported in Quebec seem paradoxical. Furthermore, previous research shows that the two provinces do not stand out as complete opposites in terms of many health measures and behaviours (Greenberg and Normandin, 2011). While measures of health, health behaviours and life expectancy do not directly cause disability, they are correlated, and as such disability rates in Nova Scotia and Quebec should be more similar than the data reveal. Finally, a cursory analysis of the health measures and behaviours of the Atlantic Provinces suggests that Nova Scotia should indeed possess a high disability rate. As shown on Figures one and two, New Brunswick and Prince Edward Island also have the second and third highest age-standardised rates of disability in Canada yet they have some characteristics where their rates of poor health measures and behaviours trail Nova Scotia. Conversely, while Nova Scotia does not always report the absolute highest rates for all poor health measures and behaviours, this province is consistently near the highest while New Brunswick and Prince Edward Island oscillate between high and low values among the Atlantic Provinces.

Finally, given the presence of Quebec and their large French population it seems logical to examine possible language effects yet this approach does not provide a clear explanation either. For example, Figure 3 shows that Anglophones in Quebec also report very low rates of disability compared to Anglophones outside of Quebec. In 2006, the disability rate for Anglophones in Quebec was 11.6%, significantly lower than

the next lowest Anglophone rate of 14.4% in Newfoundland and Labrador (See Figure 3). The rest of the provinces (except Nova Scotia) report Anglophone disability rates between 15.0% (SASK) and 15.7% (PEI), except for New Brunswick which was higher than usual at 17.8%. Further, Francophones outside of Quebec often report similar rates of disability compared to their Anglophone counterparts. For example, the disability rate in Ontario for Anglophones (15.5%) is not significantly different from the rate for Francophones (15.4%). In fact, there are only two provinces where there are significant differences between the disability rates based on language and the differences are somewhat contradictory. In New Brunswick, the disability rate for Francophones (13.1%) is significantly lower than that of Anglophones (17.8%). The situation is reversed in Saskatchewan where Francophones report a significantly higher disability rate (16.9%) than their Anglophone counterparts (15.0%). Clearly, there are minimal, if any, language effects at play in the discrepancies in the disability rates.

Figure 3: Disability Rates by Province and Language, 2006

The low rate of disability in Quebec has been unofficially dubbed by researchers as “The Quebec Effect,” which has received considerable attention over the past 25 years. On the other hand, there has been little mention of the high rates of disability reported in Nova Scotia. This thesis provides in-depth exploration and description of disability within these two provinces, with the specific aim to increase understanding of why rates of disability vary significantly in Quebec and Nova Scotia compared to Ontario. Ontario is selected as the reference province in this research for three reasons. First, the pattern of Ontario’s disability rate has been relatively stable and near the Canadian average according to most data sources. Second, the population of Ontario is not subject to extreme variations in its age distribution. For example, the very young populations that have moved to Alberta and the territories for work and the elderly population that has moved to British Columbia seeking milder winters can also affect the disability distributions within these provinces. Finally, the large population in

Ontario equates to a large sample size for analysis, providing more detailed analytical possibilities for this research.

THEORETICAL POSITION

The goal of this research is to explore the discrepancies in the disability rates between provinces and better understand the reasons for their existence. At its most basic level this thesis contends that power is exercised to create disability as a socially constructed category. According to Foucault, power is exercised through legitimating discourses – producing knowledge about and attaching meaning to categories of people and behaviour. This is exactly what has happened with disability. Institutions disseminate normative and non-normative constructs or ‘normativities’ through their network of state, legal, economic, political and biomedical instruments and this research argues that it is this discourse that has created and continues to shape the disability category. Goffman’s ‘Stigma’ concept is extremely useful in thinking about this disability category creation process because it is the effects of this stigma that creates the disability category as a binary opposite to the ideal of ‘normal’ functional ability. People with disabilities have been constructed as abnormal in numerous historical periods and these normativities have continued forward in time and blended with new normativities to construct a historical mosaic of the disability category based on ever-evolving constructions of disability. The resultant disability category combined with capitalist society’s emphasis on an individual’s capacity to produce has further devalued the disability category and fosters constructions of helplessness and charity needs.

Nevertheless, evaluating the creation of the disability category and individual conceptions of how they perceive the impact of this process on their decision to report disability is not possible with the quantitative data that currently exists. The second chapter of this thesis lays out the existing theoretical models of disability and explains how this research uses the social determinants of health approach embodied in several Canadian data sources to study the disability discrepancies using a socio-economic rather than individual approach. The hypotheses to be tested by this research are also specified.

ANALYTICAL APPROACH

The stability of the Quebec and Nova Scotia effects over time suggests a very stable research phenomenon yet the people who are maintaining this phenomenon are typically very fluid and always changing, further evidence the population is continuously subject to the disability category creation process. Cross-sectional surveys such as those presented in Figure 2 are effective for producing current estimates but they are less useful for understanding the factors driving the change observed in these estimates over time. Longitudinal data offer a significant advantage in this area because the same people are followed over time, offering the rare opportunity to study their profile and characteristics at the beginning of the survey and monitor the effects through the onset of impairments and possibly disability as time passes. Analysing longitudinal data also offers the opportunity to study the magnitude of factors that affect the onset of impairment and disability during the longitudinal study. Chapter 3 outlines how this

research uses cross-sectional and longitudinal data sources to explore the factors influencing the onset of impairment and disability to better understand the discrepancies in disability rates detected over the past 30 years.

In the Canadian context, Canada is fortunate that their national statistical agency offers a variety of options for studying health and disability. Statistics Canada offers two large health surveys plus a dedicated disability survey. However, none of these surveys are ideal by themselves. Therefore, all three surveys are used in this research including the 2010 Canadian Community Health Survey (CCHS), the 2010 National Population Health Survey (NPHS) and the 2006 Participation and Activity Limitations Survey (PALS). Each survey is described in detail in the methodology chapter so only a brief overview is provided here. The CCHS is a cross-sectional survey with a large sample size to provide detailed analysis at low levels of geography. The NPHS is a longitudinal survey that began in 1994 and followed the same cohort of participants from the beginning. PALS is the final data source for this research and offers a comprehensive view of the population of persons with disabilities. PALS only includes people with disabilities so that it can provide valuable insight into the composition and characteristics of this rare population.

Chapter four is the first of two chapters in this research that provide some results. The presentation of the results begins with a detailed overview of the bivariate results to provide the reader with a solid understanding of the relationships that exist in the population of persons with disability and prepare them for the multivariate results

that are presented in chapter 5. Since the initial bivariate results cannot control for the effects of other variables not included on the table, chapter 5 offers a detailed examination of the strength and direction of the factors that could be influencing the onset of impairment and possibly disability.

Chapter six pulls together all of the bivariate and multivariate results to evaluate each of the hypotheses of this research. The discrepancies that can and cannot be explained are reviewed and possible explanations are provided. The final chapter of this research illustrates some of the limitations to this research that must be considered when interpreting the results and points out areas for future research to consider.

CHAPTER 2: CONFLICTING THEORETICAL APPROACHES TO DISABILITY

This chapter describes the theoretical underpinnings of this thesis and the conceptual model used to explore the discrepancies in the disability rates in Quebec and Nova Scotia. Disability is a growing field of sociology and will likely continue to grow as the world's population ages and a larger proportion begins to experience disability firsthand. The goal of this chapter is to review the existing literature relevant to this research, establish the theoretical position of this research and specify the hypotheses that are examined. To achieve these goals, this chapter begins by describing two major theoretical approaches to disability. This discussion includes an introduction to these approaches, their effects on society and concludes with a summary of the strengths and weaknesses of each approach. This introductory section is followed by a review of key literature for the elements of the social determinants of health included in this research and a discussion of how the social determinants can be applied to the exploration of provincial discrepancies in disability rates. This chapter concludes with a discussion of the hypotheses of this thesis.

THEORETICAL APPROACHES TO DISABILITY

Disability research is a relatively young field of sociology compared to the grand social theories of Marx, Weber, or Durkheim and the lengthy discussions that followed. While there was some work on disability by Parsons in the 1950s with his work on the 'sick role' (Parsons, 1951) and Goffman in the early 1960s with his work on stigma (Goffman, 1963), disability received very little sociological consideration until a

revolutionary paper by Saad Nagi in 1965. Before Nagi's work, concepts of disability primarily revolved around designations of health status and illness. Disability was only considered as an outcome of disease or indicator of malformation or disfigurement. People with disabilities were considered to be diseased or functionally deficient and generally excluded from society (Goodley 2011; Barnes and Mercer, 2010; Oliver, 2009). This approach was termed the 'medical model of disability' and it has dominated social and political thinking about disability for many years.

THE MEDICAL MODEL OF DISABILITY

The term 'medical model of disability' is somewhat misleading because it does not represent an ongoing school of thought proposed by researchers or academics. Instead, this term is used to describe the historical approach or paradigm that has existed for people with disabilities for most of modern history. The medical model of disability is oriented towards clinical diagnosis, treatments, cures and preventions. The origins of the medical model can be traced back to positivism and the rise of medical and scientific knowledge (Snyder and Mitchell, 2006; Stiker, 1999). It should be noted that some theorists refer to the medical model as the 'personal tragedy' model (Oliver, 2009); however, these terms are used interchangeably in this thesis.

The growth of medical knowledge and positivist approaches to persons with disabilities led to dramatic shifts in the treatment of people with disabilities. Kohrman (2003) describes biomedicine as "one of the most significant structures of normalization." By the early 21st century, the power of modern medicine to influence

definitions of normality is virtually unparalleled in modern history (Snyder and Mitchell, 2006). At the same time, Borsay (2002) contends that this rise of medical knowledge has also led to an unparalleled social disabling of society. While current ideologies consider science to have completely neutral values, the effects of the application of scientific methods to people with disabilities have generally been quite negative (Goodley, 2011; Wolbring, 2001). The most obvious example of negative effects of the medical model is the eugenics movement and institutionalisation of people with disabilities.

The development of the eugenics movement and subsequent policies on institutionalisation was a very influential element of the medical model and its discourse had profound effects on the lives of people with disabilities. Wolbring (2001) suggests that 'Eugenics is based on the values of individuals or societies (stated or unstated) as to which characteristics should be part of a society and which should not.' Similar sentiments are also found in the work of Alberti (2006) who claims that all eugenic decisions can be traced back to culture and context. Once medical discourse defined 'normal' versus 'abnormal' through classification, the construction of the 'abnormal' population as undesirable transformed people with disabilities into the targets of eugenics policies. One of the most powerful effects of eugenics and institutionalisation on western culture was the state sanctioned social reinforcement of the negative social constructions of disability spawned by biomedicine and scientific discourse. At the centre of the eugenics movement was the belief that inferior populations could be identified and 'adjusted'. The original intention of eugenics was to 'control social ills'

but history has shown without a doubt that eugenic policies (such as sterilization) were a colossal failure (Snyder and Mitchell, 2006).

The systematic identification and removal of citizens defined as 'abnormal' served as reinforcement of the negative social constructs created by the medical model discourse and eugenic policies. Braddock and Parish (2001) argue that the 'socially sanctioned segregation of disabled people reinforced negative social attitudes toward human difference.' For many years disability researchers and advocates have universally rejected the notion that people with disabilities are abnormal, diseased or inferior yet the medical model has continued its dominance (Barnes and Mercer, 2010; Cheng, 2009; Oliver, 2009). Much of this previous literature is from the United Kingdom and to a lesser extent the United States and other countries. However, there is no evidence to suggest that Canada is any different. In fact, Canada is one of the few developed countries without a national disability rights act, further supporting the notion that the negative constructions of people with disabilities noted previously still shape current thinking about disability for the bulk of the Canadian population. These constructions are carefully considered during the analysis stages of this research.

In summary, the focus of the medical model is very much on the individual and their deficiencies, ailments or inabilities. According to the medical model, the cause of disability is a physiological or psychological condition or injury resulting in a 'damaged' or somehow 'deficient' body that cannot function in a manner considered 'normal' for a human being (Oliver, 1996; Oliver, 1990). The resulting experience of disability is

constructed as a 'personal tragedy' for the person with a disability and society accepts no responsibility for its occurrence. There is no consideration of the broader social context of the individual and their environment, only the medical facts of the individual. Brisenden (1986) explains that "the facts may lead only to distortion and misunderstanding and to a view of disabled people as a category of rejects, as people flawed in some aspect of their humanity." Medical and scientific discourse, sanctioned by government through eugenics and institutionalisation, created the 'disability' category as being something distinctly different from normal, or 'other' as opposed to considering people with disabilities as part of normal human variation. The categorisation of people with disabilities through the medical model approach is a marked contrast from the social model of disability because of its consideration of the broader social context and the environment the person is living in.

THE SOCIAL MODEL OF DISABILITY

In 1965 an Egyptian sociologist named Saad Nagi published a revolutionary article titled "Some Conceptual Issues in Disability and Rehabilitation." Two key elements from Nagi's article changed the conceptual world of disability dramatically. First, Nagi proposed that impairment and disability should be considered separately but are related; arguing that impairments and functional limitations do not always guarantee disability, nor do similar disabilities always root back to similar impairments, but there is always an association between the two (Nagi, 1965; Scotch, 2002). Previously, impairment and disability were synonymous and followed medical model definitions. Second, Nagi suggested that disability was a social construction imposed on

top of an individual's impairment by their environment. A person could have an impairment but not necessarily disability. As noted in the discussion of the medical model, disability had always been thought of as a 'personal tragedy.' Extending the responsibility for disability to society and a person's environment was a radical breakthrough with many social implications. Together, these two new disability concepts spawned an entirely new way of thinking and writing about disability that eventually led to the development of the social model of disability. The development and spread of the social model approach to disability resulted in a dramatic paradigm shift for disability theorists and researchers around the world (Goodley, 2011).

The popularity of Nagi's breakthrough concepts grew rapidly in the academic and disability activist communities through the late 1960s and early 1970s. His argument that disability is a social construct and not a medical construct was subsequently adopted by the Union of Physically Impaired Against Segregation (UPIAS) in their landmark declaration that "Disability is something imposed on top of our impairments by the way we are unnecessarily isolated and excluded from full participation in society" (UPIAS, 1976; cited from Finkelstein, 2001). Finally, in 1983, the British sociologist Mike Oliver coined the term "Social Model" for this approach to thinking about disability (Goodley, 2011).

The social model continued to develop through the 1980s, 1990s and into the 21st century. Several different streams of thought have emerged such as the Minority Rights Model found predominantly in the United States and Canada and the Relational

Model found in the Nordic countries. Comparing and contrasting each of the models would span many pages, in fact entire theses have been written about the intricate details of the various disability models. Since this thesis is intended to explore provincial variations in disability rates and not a strictly theoretical discussion, this thesis must make some generalisations about the social model. For an overview of detailed academic debates surrounding the social model and its various permutations see Goodley, 2011; Barnes and Mercer, 2010; Brownlee and Cureton, 2009; and Shakespeare, 2006. One could argue that many of the recent disability models such as the Minority Rights model and the Relational model could be broadly grouped under the basic constructs of the social model umbrella. The theoretical discussions of all of these models are permeated with the importance of separating impairment and disability, environments that foster social participation, and the notion that disability is the result of discrimination through physical, political, economic, and social dimensions of the environment. Therefore, this thesis uses the broader constructs found under the social model umbrella throughout this thesis to define the theoretical approach used to explore the discrepancies in disability rates. Unfortunately, available data sources are not particularly amenable to applying the social model in this research. These limitations are discussed further in the methods chapter of this thesis (chapter 3).

The social model constructs appear to have enjoyed some success as the socially disabling concept of the social model is evident in a growing number of disability policies, programs and laws from international agencies and governments around the world. A good example of one of these applications is the Accessibility for Ontarians

with Disabilities Act, 2005. As noted, Canada does not have a specific disability act similar to the United States (Americans with Disabilities Act (1990), United Kingdom (Disability Discrimination Act, 1995) or Australia (Disability Discrimination Act, 1992) so Ontario decided to create their own disability act. The intent of the act is clearly rooted in the social model because it guarantees accessibility for Ontarians with regards to “goods, services, facilities, accommodation, employment, buildings, structures and premises” (AODA, 2005). Improving accessibility for people with disabilities in all of these areas will be a big step toward full inclusion for people with disabilities. There is much debate concerning how completely the social model approach has been incorporated in these policies, programs and laws (Brownlee and Cureton, 2009; Hurst, 2003). For example, the definition of disability that is used to determine if people qualify as a person with a disability in many of these policies, including the AODA are still based on the medical model. The medical model is very easy to administer from a governmental perspective because only a medical note is required to determine admissibility based on the presence of one or more ‘disabling conditions’ from a specified list. Admittedly, a social model approach would be more difficult to administer but definite progress toward the social model is evident. Even critics can find some elements of the social model that are evident in these areas (Barnes & Mercer 2010).

Perhaps the most prominent and influential application of the social model constructs is the International Classification of Functioning, Disability and Health (ICF) from the World Health Organization. The ICF was the first internationally accepted classification system to consider the social dimensions of disability and the effects of the

environment. The social model's concept of social disablement is clearly codified in the ICF through its approach to disability using four different angles: body functions, body structures, activities/ participation and environment. The ICF diagram from the WHO provides a visual explanation of their conceptualisation of the interactions between the individual, their impairment (health condition) and their environment, with environment comprising physical, social, financial and political dimensions (See Figure 4). A difficulty in any one of these four areas is considered to be a disability according to the ICF. Some authors have named the ICF approach the biopsychosocial model (Barnes and Mercer 2010) because it includes body functions and structures and does not include the more extreme elements of the social model such as deliberate social oppression and dimensions of civil and human rights. Nevertheless, Saad Nagi's separation of impairment and disability is clearly obvious as well as the potential for the environment to influence disability status. The ICF acknowledges medical conditions are usually involved in the background of disability and these conditions may affect body functions and structures but there are more dimensions to consider, namely activity limitations, participation restrictions, environmental and personal factors.

Figure 4: The Conceptual Model of the ICF

World Health Organisation, 2001.

While the ICF is not perfect and an updated version is under development, the imperfections become relatively minor points in comparison to the monumental leap forward that the conceptualisation of disability enjoyed. The publication of an internationally accepted World Health Organization classification system designed to incorporate elements of the environment as disabling factors while separating impairment and disability legitimised the social model as an acceptable approach to thinking about disability outside of academia. ICF concepts are slowly being implemented in survey data collection programs, occupational therapy and psychological/ psychiatric evaluations, and eventually functional performance evaluations by general physicians meaning the social model constructs will continue to spread as well. The next section of this chapter highlights similarities and differences between the medical and social models to help illustrate how these models are different in order to operationalise the constructs properly in this research.

DIFFERENCES BETWEEN MEDICAL AND SOCIAL MODEL PARADIGMS

The medical and social models are very different theoretically, although they do share some common ground. A brief discussion of the differences illustrates how the models are unique and by extension, how to utilise the social model approach properly in this research, given the data were collected in a world still dominated by the medical model. The most striking difference between the medical and social models is the focus of inquiry. The medical model focuses exclusively on the impairments and functional limitations of the individual, ignoring broader social factors, and as a result, the disability category is created by signifying something 'other' that is not normal. Comparisons to normality have existed in virtually all cultures around the world for centuries (Snyder and Mitchell, 2006). In more recent times, when medical and scientific discourse proclaims what is normal and what is not, various cultures have adopted these 'normality' constructs and in the process the disability category has been created, shaped and is perpetually redefined as new forms of 'abnormality' are discovered, such as HIV/AIDS or Attention Deficit Hyperactivity Disorder (ADHD). In contrast, the social model clearly shifts the focus from the individual to society, thereby refusing the medical model's assertion that people are disabled by their impairments. It is important to note that the social model contends that a person can have an impairment but not necessarily disability. Instead, the social model approach argues that people are disabled by the physical, social, political and financial environments around them. The classic example of this contrast is a portrait of a person in a wheelchair at the bottom of a flight of stairs. The medical model contends that the person was disabled by the

medical condition that resulted in the person using the wheelchair. The social model maintains that the person's medical condition is completely irrelevant; the person has been disabled purely because stairs were built instead of a ramp. By choosing to build stairs instead of a ramp, society has also chosen to disable wheelchair users in the process (Oliver, 1996).

A second important difference between the medical and social models is the treatment of impairment. According to the medical model, the impairment is the starting point and sole focus when examining an individual's functional ability. It is the lone causal factor of their disability status, and by extension, their socially constructed normality or abnormality. Conversely, while impairment is also a component of the social model, any similarity with the medical model stops there. The major focus of the social model is the way an impairment interacts with the physical, social, political and financial environments around the individual to produce or negate disability. A person with an impairment only experiences disability in an unsupportive environment. A person with an impairment in a supportive environment does not experience disability. This feature of the social model is what separates it from the medical model and into its own stream of thought about disability.

A final difference between the medical and social models is the universality. The medical model has been the dominant approach in western societies for many years. The effects of the eugenics programs, institutionalisation, and medical and scientific discourse's creation of the 'abnormal' category for people with disabilities have proved

a daunting task for the social model to overcome. Unless a person learns about the social model through personal, scholarly or activist pursuits etc, they are not likely to learn about the social model constructs from general society. The default position for the vast majority of Canadians is the medical model because they don't know of any other options. For this thesis, it means that a social model approach is applied to discrepancies in the data that were reported by people reporting their disability status primarily based on medical model constructions of disability.

The discussion of the social and medical models in this chapter is intended to provide an overview of the ideal theoretical approach to measuring disability. This thesis operationalises disability in this research using a social model approach for two reasons. First, the social model is a better reflection of the situation of the people experiencing disability. People who do not experience limitations should not be counted as part of the population of persons with a disability just because they have a medical condition. This approach can quickly become highly judgemental for situations such as people who require assistive technology including glasses or hearing aids. Medically diagnosable conditions are often underlying the requirements for both glasses and hearing aids yet only hearing aids are typically associated with disability, even though both assistive devices 'correct' medically diagnosable conditions that impair senses. The second reason for choosing the social model is this approach is recommended by the World Health Organisation and it is being adopted by a growing number of statistical agencies around the world. Understanding the complexities of discrepancies in disability reporting while following a social model approach is a

valuable contribution to the literature and will be increasingly relevant in the future as the popularity of the social model continues to expand and its implementation grows. Finally, it should also be acknowledged that the separation of impairment and disability is not possible using the data sources available for this research. This research studies the influence of the social determinants on the prevalence of impairment while also recognising that Canada is not perfectly accessible, meaning that much of these impairments will become disability in unsupportive environments.

The technical details of the operationalisation of this theoretical approach are discussed in the methodology chapter of this thesis so only a brief summary is provided here. Measuring disability purely as the end result of a complex process within the social model framework is not possible with the data available because indicators for elements of the social model are scarce in existing data sources. This limitation applies not only to Canadian data but also data from most countries around the world. Further, the decision about whether to report a disability or not is an individual level decision that is difficult to analyse through survey data. Therefore, compromises must be made to conduct this research. The social determinants of health approach presents a unique opportunity to organise this research along well established dimensions that existing literature has proven to exert significant effects on health. At first glance, this approach may seem to be more closely aligned with the medical model but it is important to note the social model acknowledges that health conditions are often underlying disabilities. Further, the social determinants explore health from the perspective of the environment of the individual in terms of socioeconomic characteristics, social and

physical environments and other factors that are not that dissimilar from the definitions of the environment provided by the social model. While some elements of the social determinants are clearly oriented toward the medical model (chronic conditions, health indicators etc), it is important to understand the effects of these elements on the disparity in disability rates as well. Finally, this research endeavours to examine the elements of the social determinants of health from the social model perspective whenever possible. Therefore, this research is best described as following the social determinants of disability approach. While this research is not the first to follow the social determinants of disability approach, it is an exceptionally rare approach that has little research to build upon (Melo and Valdes, 2011). The focus of the next section is to provide an introduction to the social determinants of health approach and review existing literature that has explored the social determinants and assess their impact on health and disability (where possible) to establish the determinants that should be included in this research.

THE SOCIAL DETERMINANTS OF HEALTH

The social determinants of health are broadly defined as ‘the circumstances in which people live and work’ (Marmot and Wilkinson, 2006). This definition suggests that everything about the environment where people live and work can affect their health. Some of the most common factors associated with the social determinants of health are related to a person’s socioeconomic status such as income, education and occupation. However, the social determinants can be much broader and include

concepts such as the quality of housing a person lives in and whether it has mould or other contaminants, psychological factors such as stress, and health behaviours such as how often people exercise and the quality of the food they eat. The social determinants of health can be thought of as a web of factors that join together to influence the health of individuals through a range of effects (biological and psychological) stemming from their environment. The remainder of this section explores existing literature regarding the various dimensions of the social determinants of health.

EXISTING LITERATURE

Literature on the social determinants of health is well developed and new insights are added regularly. Unlike the scarcity of literature examining regional variation in disability rates or the social determinants of disability, existing literature on the social determinants of health must be organised carefully to avoid confusion due to the volume. Fortunately, the social determinants are conveniently organised into a number of dimensions. This research uses the same dimensions in all chapters to facilitate understanding and comparability between previous literature and this research. It should be noted that this research does not explore all dimensions of the social determinants due to limitations in the available data sources and space in this thesis. The dimensions of the social determinants included throughout this research include demographics, socio-economic status, health indicators, chronic conditions, behavioural risk factors and activities of daily living. Existing literature for each of these dimensions is presented along with an explanation of the various elements that can be found within each dimension.

DEMOGRAPHICS

Demographics are a key component to the social determinants of health and disability because these characteristics are generally difficult or impossible to change (age, gender, race etc.) and there is extensive research regarding the strength of their effects. Not only does the demographic dimension include basic information such as age and gender but this dimension also includes other elements such as living arrangements, geographic area, marital status, aboriginal status, immigrant status, and race.

Age has consistently proven to be among the most significant factors for discussions regarding health and impairment (den Ouden et al, 2012; Melo and Valdes, 2011; Altman and Gulley, 2009; Chen, Chang and Yang, 2008; Dunlop et al, 2007; Brunner and Marmot, 2006; Cockerham, 2004; Rietschlin and MacKenzie, 2004; Berkman and Kawachi, 2000). Some previous research has used age to explore factors associated with health indicators such as self-rated health (Kjellsson, 2013; Shooshtari, Menec and Tate, 2007) while other researchers have used age to explain topics ranging from disability (Melo and Valdes, 2011) and health-related quality of life (Sun et al, 2011) to inequalities in health (Stafford, Duke-Williams and Shelton, 2008), heart attack risk (O'Neill et al, 2012) and mortality (Jylha, 2009; Bardage, Isacson and Pedersen, 2001). The exact biological effects of increasing age are outside the scope of this thesis. The important point to note is that people at older ages are much more likely experience health challenges and conditions than people at younger ages (Marmot and Wilkinson, 2006; Cockerham, 2004). Overall, the wealth of information pointing to age

as a major factor in health and disability suggests that this factor must be included in this research.

Gender is a second demographic characteristic that is widely used in social determinants research. Women typically live about four to five years longer than men (Statistics Canada, 2013) and they also present different health profiles according to previous research (Braveman, Egerter and Williams, 2011; Chen, Chang and Yang, 2008). These health profiles are widely thought to be tied to the very different health behaviours for men and women. Men are more likely to smoke and drink heavily while women are more likely to be inactive (Chen, Chang, and Yang, 2008; Denton and Walters, 1999). Similar to age, gender is typically used as a covariate to explain variation in self-rated health (Kjellsson, 2013; Shooshtari, Menec and Tate, 2007) as well as disability (Melo and Valdes, 2011), health-related quality of life (Sun et al, 2011), inequalities in health (Louie and Ward, 2011; Stafford, Duke-Williams and Shelton, 2008), heart attack risk (O'Neill et al, 2012) and studies of mortality (Jylha, 2009; Bardage, Isacson and Pedersen, 2001). However, unlike age where the correlation between increasing health challenges and age is generally understood and accepted, much research still remains for gender (Chen, Chang and Yang, 2008) and it is not uncommon for gender to be the primary focus of research studying the effects of the social determinants (Chen, Chang and Yang, 2008; Denton, Prus and Walters, 2004; Denton and Walters, 1999; Merrill et al, 1997). Regardless of the work that remains to tease out the precise effects of gender, this element of the demographic dimension has shown clear effects on health and disability and must be included in this research.

Race is another classic element of the demographic dimension in the social determinants of health. There has been a significant amount of research studying race and/or ethnicity as both the primary focus for various health outcomes (Lee, 2011; Louie and Ward, 2011; Warner and Brown, 2011; Dunlop et al, 2007; Andreson and Miller, 2005) and also as a general covariate of health (van Kippersluis et al, 2010; Shooshtari, Menec and Tate, 2007). Previous research that has included race in general includes people of all backgrounds but there are a few studies that have focused primarily on people with Aboriginal ancestry (Reading and Wien, 2010) as well as a slightly different perspective to race that focuses on immigrants and the proposed 'healthy immigrant' effect (Choi, 2012; Ng, 2011; Newbold, 2006). Previous research has linked a number of different approaches to analysing race with significant effects on health outcomes, supporting their inclusion in this research.

There are a number of other demographic factors that previous research has also shown to have significant effects. Another common demographic characteristic that is included in analysis is marital status. This variable has been included in a variety of studies exploring factors that influence health outcomes (O'Neill et al, 2012; Lee, 2011; Melo and Valdes, 2011; Chen, Chang, Yang, 2008; Dunlop et al, 2007) as well as studies of mortality patterns (Bardage, Isacson and Pedersen, 2001) but it does not receive individual attention on the scale of other demographic characteristics such as gender or race. A second demographic variable that receives some attention but on a smaller scale is geography. Marmot and Wilkinson (2006) and Cockerham (2004) both suggest there can be significant effects on health related to geography. Some previous studies

have uncovered geographic variations similar to this research and made these differences a focus of the investigation (Lin et al, 2012; Sun et al, 2011; Shelton, 2009) while others have included indicators of population size, assuming that larger populations in urban areas have better access to health care services (Melo and Valdes, 2011). Finally, some previous research has also used geographic indicators of neighbourhoods, housing conditions and local wealth to study the effects on health (Stafford and McCarthy, 2006). A final demographic variable that is often included in research but is rarely the principal focus of the investigation is living arrangements, specifically people living alone (Kachi et al, 2013; Dunlop et al, 2007; Denton and Walters, 1999). While there are a few other characteristics that could affect health through the social determinants such as religion and sexual orientation, they are rarely included in surveys and other data sources so existing literature is scarce.

SOCIO-ECONOMIC STATUS

Socio-economic status is one of the cornerstones of the social determinants of health approach. The effects of socio-economic status on health outcomes has been well documented by previous research (Nobles, Weintraub and Adler, 2013; Braveman, Egerter, Williams, 2010; van Kippersluis, O'Donnell, van Doorslaer et al, 2010; Marmot and Wilkinson, 2006; Cockerham, 2004; Berkman and Kawachi, 2000; Kristenson et al, 1998; Power and Hertzman, 1997; Bobak and Marmot, 1996). The key concept to consider for this dimension involves the notion that personal and familial wealth exerts significant effects on health through countless dimensions of an individual's life ranging from the quality of their housing and food, ability to get health care when needed,

exposure to environmental contaminants in their work environment and many other effects (Marmot and Wilkinson, 2006). Berkman and Kawachi (2000) suggest there is an urgent need for social determinants of health research to go beyond education and income as indicators of socio-economic status. This research attempts to stretch the definition of socio-economic status as much as possible while working within the constraints of the variables available from the data sources used for this research.

There has been a variety of different approaches to exploring the effects of socio-economic status on health. Some research approaches socio-economic status strictly in terms of occupational class and the environmental factors that workers are exposed to while they are at work, including physical / biological stressors as well as psychological stressors (Kjellsson, 2013). This research found that high class occupations are clearly associated with better health. Continuing with the labour theme, a somewhat related approach has focused on the effects of labour force participation and employment versus unemployment (Kasl et al, 1998; Jin, Shaw and Svoboda, 1995). It could be argued that this approach is somewhat crude because the occupations of people were not considered, just their employment status. Nevertheless, being employed represents fewer health risks than being unemployed (Kasl et al, 1998; Jin, Shaw and Svoboda, 1995). However, regardless of whether the occupational class or employment status is studied, they are both correlated with income, which comprises the majority of the socio-economic research regarding the social determinants of health.

The majority of social determinants research approaches socio-economic status either directly through income, wealth or some other highly correlated proxy for income such as education (Nobles, Weintraub, and Adler, 2013; Semyenov, Lewin-Epstein and Maskileyson, 2013; Kim, 2011; Louie and Ward, 2011; Matthews and Gallo, 2011; Melo and Valdes, 2011; van Kippersluis et al, 2010; Reading and Wien, 2009; Kelaheer, Paul and Lambert, 2008; Ball, Crawford and Mishra, 2006; De Irala-Estévez et al, 2000; Lynch and Kaplan, 2000). It is important to note that a growing body of literature is beginning to point to wealth as a stronger predictor of health outcomes (Semyenov, Lewin-Epstein and Maskileyson, 2013). The results of this research are integrated with the results of this thesis during the discussion chapter (chapter 6). The important point to note is that elements of the socio-economic status dimension of the social determinants of health are critical to this analysis.

HEALTH INDICATORS

Health indicators are also a typical component in social determinants of health because they indicate pre-existing risk factors for poor health and they can also indicate lost economic opportunities due to poor health (Marmot and Wilkinson, 2006). Health indicator variables can range from self-rated health to self-rated mental health and self-rated stress.

Self-perceived health has been repeatedly validated as one of the best predictors of current health status as well as future morbidity and mortality since the 1950s (Idler and Benyamini, 1997; Garrity, Somes, and Marx, 1978; Maddox, 1962; Suchman,

Phillips, and Streib, 1958). The ability of this variable to predict these occurrences with such confidence is remarkable considering it is just one single question. Self-rated health is by far the most common health indicator and it is often used as both an outcome measure for the effects of social determinants of health variables (Kjellsson, 2013; Kim, 2011; Prus, 2011; McDonough, Worts and Sacker, 2010; Shooshtari, Menec and Tate, 2007; Denton, Prus and Walters, 2004) and also as a predictor for other health states such as mortality (Jylha, 2009; Bardage, Isacson and Pedersen, 2001; Idler and Benyamini, 1997). While self-rated health is clearly one of the more popular health indicator variables there are other options in this dimension.

There is a growing body of literature suggesting that stress is also a critical element in long-term health outcomes (Braveman, Egerter and Williams, 2011; Brunner and Marmot, 2006; Cockerham, 2004; Berkman and Kawachi, 2000) but quantitative evidence is still developing (Kristenson, 1998; Denton, Prus and Walters, 2004). Somewhat related to stress is a relatively new field of research that is exploring the effects of mental health on physical health outcomes. For example, O'Neill et al (2012) and Gilmour (2008) were both able to link diagnosed depression to the subsequent onset of cardiovascular disease through longitudinal data. This interconnection between mental health diagnoses and physical health outcomes has been touched upon already, often through measures of stress (Kristenson, 1998; Denton, Prus and Walters, 2004), but these recent studies are providing solid evidence of the psychological-physical connection after controlling for other factors. In general, self-rated mental health is typically used as an outcome variable similar to research exploring factors for

predicting self-rated health (Myer et al, 2008; Mulvaney-Day, Alegria, Sribney, 2007) yet there is some research using self-rated mental health as a control variable for other outcomes (Mock and Arai , 2011). While self-rated mental health has not been as popular as self-rated health in previous research, there appears to be growing interest in this topic.

The final health indicator that has been used by previous research with the social determinants of health is the Health Utility Index (HUI). The HUI has been popular with previous research, particularly in Canada where the HUI was developed and also the United States but it has been used in many countries. The properties of the HUI are well documented (Feeny, 2005), it has been validated numerous times (Horsman et al, 2003; Furlong et al, 2001) and it has proven that it functions well in surveys (Jones et al, 2008; Bowker, Pohar and Johnson, 2006; Maddigan, Feeny and Johnson, 2005; Schultz and Kopec, 2003; Manuel, Schultz and Kopec, 2002; Mittmann et al, 1999). Overall, the HUI is considered to be one of the leading measures of functional health status (Horsman et al, 2003). Previous research typically uses the HUI as a health outcome variable to indicate the effects of the social determinants (Denton, Prus and Walters; 2004; Denton and Walters, 1999). However, the HUI has also been used to indicate decreasing function as a result of chronic conditions (Jones et al, 2008; Bowker, Pohar and Johnson, 2006; Maddigan, Feeny and Johnson, 2005). Finally, the HUI has also received significant attention as an indicator of disability (Feng et al, 2009). Some papers have established cut-points in health scores to indicate the threshold where scores are considered to represent poor health (Kopec et al, 2000; Vozoris and Tarasuk; 2003)

while others such as Feng (2009) have created specific categories for no disability, mild disability, moderate disability and severe disability. In general, the HUI is a very flexible and thoroughly tested indicator of functional health with existing research in place to guide its use. It should also be noted that functional health is the term used with the HUI in the social determinants of health literature. However, in the context of this research focused on disability it could be argued that the term functional health is interchangeable with impairment.

CHRONIC CONDITIONS

Chronic conditions do not necessarily fit within the true definition of the social determinants because they are not a central component of the social determinants of health and the notion that health is affected by “where people live and work.” Nevertheless, chronic conditions are often included in social determinants of health research for three reasons. First, similar to health indicators, chronic conditions are also used to indicate risk factors except in the chronic conditions indicate the presence of a health condition itself, rather than the possibility of future health difficulties. Second, the chronic conditions can be used as a possible indicator of lost income opportunities an individual will endure because their ability to work is limited by one or more chronic conditions (Marmot and Wilkinson, 2006). Third, chronic conditions are commonly used as outcome variables to determine the factors that influence the development of this chronic condition. Predicting the risk factors for cardiovascular disease is among the most popular examples of chronic conditions being researched in this manner (O’Neill et al, 2012; Romero-Corral et al, 2010; Gilmour, 2008; Power and Hertzman, 1997). In

spite of this, chronic conditions have also been used in a fourth manner, as controls for other outcomes such as disability (Louie and Ward, 2011) or mortality (Dunlop et al, 2007). Overall, previous research suggests that chronic conditions are an integral component of health and their effects should be controlled when studying health outcomes.

BEHAVIOURAL RISK FACTORS

One of the most influential dimensions of the social determinants of health is behavioural risk factors. There is extensive research providing evidence for the health risks associated with smoking, a lack of physical activity, obesity, alcohol consumption and fruit and vegetable consumption. This section of the literature review highlights existing research for the key behavioural risk factors within this dimension of the social determinants of health. It should be noted that two different types of risk factor are discussed in this research. The first type of risk factor is health indicators and chronic conditions, which may indicate the early stages (health indicators) or presence (chronic conditions) of health problems that could become more serious. This section on behavioural risk factors examines behaviours that previous research suggests will result in future health problems even though there may be no indication of current health problems.

Smoking is widely regarded as a significant risk factor affecting future health status (Marmot and Wilkinson, 2006; Cockerham, 2004, Emmons, 2000) and there is extensive research supporting these assertions (Prus, 2011; Warner and Brown, 2011;

Shelton, 2009; Chen, Chang and Yang, 2008; Denton and Walters, 1999; Power and Hertzman, 1997). Not only has smoking been identified as a risk factor for several forms of cancer but it has also been linked to heart conditions, stroke, chronic respiratory disease and other conditions (Shields, 2005). While some research has not found significant health effects from smoking (Bardage, Isacson and Pedersen, 2001) or weaker impacts than expected (Gilmour, 2008), these examples also had somewhat different goals than directly studying the effects of smoking on health. Virtually all previous research has used smoking status as a control variable for other health outcomes yet some studies have attempted to develop models for predicting smoking status to feed into public health intervention strategies (Chassin et al, 1991).

Body Mass Index (BMI) and particularly obesity is a second key element within the health behaviours dimension with extensive research regarding the long-term health effects. While the BMI is often criticized as a crude measure because it does not consider muscle mass or frame size (Ernsberger, 2012; Lopez-Jimenez, 2009) there is also considerable research suggesting that BMI is a valid measure for providing a general indication of the eating and exercise behaviours of an individual (Ernsberger, 2012; Janssen, 2007; Jee et al, 2006). There is still some debate about whether being overweight (but not obese) brings health risks (Flegal et al, 2013; Orpana et al, 2010; Pierce et al, 2010; Romero-Corral et al, 2010) yet there is extensive research indicating that being severely obese or underweight brings significant health consequences, particularly for children (Reilly et al, 2005; Zamboni et al, 2005). Previous research has used obesity as both an outcome for predictive models as well as a control variable to

study health outcomes in a variety of contexts. For example, some research such as Franko et al (2005) looked at factors from teenage years to predict obesity as young adults. Conversely, a number of researchers have used BMI scores in models to predict health outcomes. One of the more popular health outcomes used with BMI is self-rated health (Kim, 2011; Prus, 2011; Shooshtari, Menec and Tate, 2007; Denton, Prus and Walters, 2004; Denton and Walters, 1999), but research predicting cardiovascular disease (O'Neill et al, 2012; Gilmour, 2008) and mortality (Bardage, Isacson and Pedersen, 2001) are also common.

Physical activity is a third key element in the behavioural risk factor domain that previous research has linked to significant effects on health outcomes. The current Canadian Physical Activity and Sedentary Behaviour Guidelines suggest that Canadians 18-64 perform at least 150 minutes of moderate to vigorous physical activity per week (Canadian Society for Exercise Physiology (CSEP), 2012). According to CSEP (2012), being active for at least 150 minutes per week reduces the risk of heart disease, stroke, high blood pressure, some cancers, type 2 diabetes, osteoporosis, overweight and obesity and there is already evidence supporting this relatively recent assertion (Clarke and Janssen, 2013). Previous research typically uses physical activity as a control variable. This variable has been proven to be a significant predictor of self-rated health (Prus, 2011; Chen, Chang and Yang, 2008) as well as Health Utility Index scores (Denton, Walters and Prus, 2004) mental distress scores (Denton, Walters and Prus, 2004), and heart disease (O'Neill et al, 2012).

Alcohol consumption is an interesting element in the behavioural risk factor domain. The effects of alcohol consumption are not as clearly defined as smoking, obesity or physical activity. As noted, previous research suggests that any amount of smoking results in negative health effects but this is not the case for alcohol consumption where the effects are less clear. Existing literature has established clear health consequences for chronic heavy alcohol consumption (Meyerhoff et al, 2005) while other research has linked moderate alcohol consumption with health benefits. Some of these benefits include lower risk for heart disease (Mukamal et al, 2003), ischemic stroke (Reynolds, 2003), and dementia (Anttila et al, 2004). Alcohol consumption is widely used as a control variable to study the onset of health outcomes but the results are typically mixed and depend on other factors such as gender (Denton, Prus and Walters, 2004) or pre-existing conditions (Bardage, Isacson and Pedersen, 2001).

The final element of the behavioural risk factor dimension is fruit and vegetable consumption. There is growing interest in the effects of eating fruits and vegetables in the broader social determinants of health literature (Marmot and Wilkinson, 2006). This concept is important to include in this research for two reasons. First, there is a slowly growing body of literature suggesting that fruit and vegetable consumption is a good proxy for the overall quality of nutrition being consumed (De Irala-Estévez et al, 2000). Second, there is a separate body of research concerning fruit and vegetable consumption and the possible protection from some types of cancer (Gandini et al, 2000).

ACTIVITIES OF DAILY LIVING

Reporting a need for help with Activities of Daily Living (ADL) has been a popular proxy measure of disability to avoid the stigma of directly asking about disability and the potential response bias (Madans, Loeb and Altman, 2011; Laplante, 2010; World Health Organisation, 2010; Spector and Fleishman, 1998). Previous literature has found good support for these activities being used to identify severe disabilities but milder disabilities are often overlooked (Houle, 2001). The ADL questions are included in this research to indicate how people's activities are being affected by their health and disability. Previous research has used the ADL questions as a predictor of poor health (Nobles, Weintraub, and Adler, 2013) but they could also be used as a dependent variable (Melo and Valdes, 2011).

RESEARCH QUESTIONS AND HYPOTHESES

This research explores the unique disability reporting behaviour in Quebec and Nova Scotia. As noted in chapter 1, there are significant differences between the disability rates reported in Quebec and Nova Scotia, even after age standardisation. This pattern has been stable for almost 30 years using several different sets of questions to identify disability. There is limited previous research on the Quebec Effect (nothing published) and no research on the Nova Scotia Effect. This thesis represents the first serious attempt to examine these problems.

This research approaches disability reporting through the social determinants of health while also considering the social model perspective, meaning that medical

conditions do not automatically equate to disability, a person's activities must also be limited. Given the unique differences between each province and the opposite nature of their discrepancies, the hypotheses are explained separately for each province.

There are three primary hypotheses for this research that involve the social determinants of health and how these determinants may be affecting disability rates over time in Canada. These hypotheses suggest that the long-term influence of these determinants have led to the divergent disability rates in Quebec and Nova Scotia. Specifically, the three hypotheses of this research are as follows:

Hypothesis 1 (H₁): The main hypothesis of this research proposes that the onset of disability involves much more than just the presence or absence of conditions. This hypothesis contends that many dimensions of the social determinants of health are influencing the prevalence of conditions that can result in disability in unsupportive environments. The social determinants lens offers unique insight into the prevalence and distribution of conditions influencing the onset of disability using variables that are readily available from existing data sources. The specific variables used in this research are described in chapter 3 but the important point to note is the social determinants variables are mostly available while there are very few variables suitable to a purely social model approach. There are a couple possible reasons why social model variables are scarce in existing data sources. First, the social model concept is likely not the default position for most Canadians when they think about disability. The dominance of the medical model and scientific discourse in popular media seems to have primed

average citizens to default to the medical model views regarding disability. When statistical agencies attempt to develop survey questions that touch on the impacts of the environment on their daily functioning, people who are not familiar with the social model assume the environment means pollution and acid rain instead of the physical, social, political, and financial elements of their daily lives (Statistics Canada, 2005). A second reason for the absence of social model-based disability data is the funding source and consumers of the data. The federal government is typically the funding source for most national surveys and also the largest single consumer, giving them the loudest voice in the debate about survey content. The government uses disability for a variety of purposes ranging from monitoring employment equity to estimating participation in programs intended for persons with disabilities. The broad spectrum of uses for disability data necessitates a mainstream approach to measuring disability because many government programs have yet to adopt the social model approach to thinking about disability. For example, the eligibility requirements of the Disability Tax Credit include a list of medical conditions but there is no mention of the impact of the environment (Canada Revenue Agency, 2013). While there does seem to be a slow evolution toward the social model of disability such as the new Canadian Survey of Disability, there is still much work to be done before all surveys will include this approach to data.

Nevertheless, while a social model approach would be preferable, the social determinants of health approach is not completely contrary to the social model. The social determinants approach also allows the origins of conditions underlying disability

to be shifted away from their historical location in strictly biological sources in favour of explanations based on demographic factors, socio-economic status, health indicators and risk factors. Chronic conditions are also relevant to the social determinants of health, but it does not play the central role typically portrayed by medical explanations of the onset of disability. Therefore, hypothesis 1 can be stated as the following: the social determinants of health influence the prevalence of conditions associated with disability (impairments), thereby influencing disability rates.

Hypothesis 2 (H₂): This hypothesis focuses on Nova Scotia and builds upon hypothesis 1. H₂ suggests that the high rates of disability detected in Nova Scotia are at least partially due to a higher prevalence of social determinants of health risk factors that result in a higher prevalence of impairments that are resulting in disability. To be more precise, this hypothesis suggests that Nova Scotia may have some combination of elements from various social determinants dimensions that result in a greater prevalence of potentially disabling conditions. An example of this combination could be higher rates of smoking, poverty, obesity, and unemployment combined with lower rates of physical activity, occupational prestige and fruit and vegetable consumption. This scenario is just an example intended to illustrate hypothesis 2 for this research, which states the following: the biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability. The activities of daily living variables are also hypothesized to be indicative of people experiencing a greater prevalence of factors associated with impairment, and by

extension, disability. The actual results and associations for the various elements of the social determinants are presented in detail in chapter 4.

Hypothesis 3 (H_3): This hypothesis focuses exclusively on Quebec and also builds upon H_1 but in the complete opposite direction to H_2 . H_2 suggests that the low rates of disability observed in Quebec are due to fewer risk factors associated with the social determinants of health. Fewer risk factors from the social determinants of health should result in a lower prevalence of conditions associated with the onset of disability. Using the opposite example from H_2 suggests that Quebec may have some combination of elements from various social determinants dimensions such as lower rates of smoking, poverty, obesity, and unemployment combined with higher rates of physical activity, occupational prestige and fruit and vegetable consumption that results in a lower prevalence of potentially disabling conditions. Once again, this scenario is just an example to show that H_3 can be stated as follows: the biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health. Similar to H_2 , the activities of daily living variables are also hypothesized to be indicative of people experiencing a greater prevalence of factors associated with impairment. Bivariate results of the associations between the various social determinants are presented in chapter 4 and the multivariate results are presented in chapter 5.

In summary, this research explores the possibility that the prevalence of conditions associated with disability is different due to unique distributions of the social

determinants of health within each province. By influencing the prevalence of conditions associated with disability, the social determinants of health may also be influencing the reported disability rates. It is important to note that a person can have impairment but not necessarily disability. Unfortunately there are no data sources that would allow these concepts to be analysed separately. The goal of this research is to use the available data to better understand the drivers of the unusual reporting patterns and explore their prevalence in these provinces. The next chapter of this thesis describes the methodology this research employs to test these hypotheses and further understand the discrepancies in disability rates.

CHAPTER 3: METHODS TO UNTANGLE A MULTIDIMENSIONAL PROBLEM

This chapter provides an overview of the data and methodology used to explore disability reporting in Nova Scotia and Quebec compared to Ontario. Using statistical data to untangle the complex web of factors influencing reported rates of disability requires a carefully considered approach. This chapter begins by describing and justifying the overall methodology used for this research and provides a brief overview of the Canadian Community Health Survey (CCHS), National Population Health Survey (NPHS) and Participation and Activity Limitations Survey (PALS; Technical details of the CCHS, NPHS and PALS can be found in Appendix A (see page 240). The introduction of the data sources is followed by a justification for why these data sources are employed in this research. Following this justification, this chapter describes the variables selected from these sources and summarises how the critical variables are prepared for analysis. The summary of the data sources and variables is followed by an explanation of the statistical methods that are used in this research, including a general discussion of the analysis of surveys with complex designs followed by the specific methods used to calculate significance testing, age standardisation, calculating the coefficient of variation, and survival analysis models.

NATIONAL POPULATION HEALTH SURVEY

The National Population Health Survey (NPHS) is a longitudinal health survey that collected information about the same cohort of people from 1994 to 2011. The NPHS is among the largest longitudinal health surveys in the world ever attempted by a

national statistical agency. The NPHS is selected for this research because it has a large sample size (for a longitudinal survey), it is comparable to CCHS, and it collected nine cycles of data over a 16 year period. There are other options for longitudinal health surveys in Canada such as the Canadian Longitudinal Study on Aging (CLSA) or the Ontario Health Study (OHS). However, both of these surveys are still in their infancy and they do not have enough cycles of data collection to be useful in this research. Therefore, the NPHS is the clear choice for this research to study the influence of factors on the onset of impairment or disability.

CANADIAN COMMUNITY HEALTH SURVEY

The Canadian Community Health Survey is Canada's largest health survey and is able to provide estimates at detailed levels of geography thanks to its large sample size. A significant advantage for this research is the CCHS is designed to be similar to NPHS, which offers a more valid comparison between the two sources, particularly for social determinants of health variables because they are key objectives for both surveys. A further advantage is the CCHS sample size is the second largest of all the social surveys at Statistics Canada (approximately 65,000 households participate every year) and since 2007 it is designed to be combined with previous or subsequent years quite easily if additional sample is required for detailed analyses. Statistics Canada regularly produces annual and bi-annual data files to boost sample for researchers. The large sample size of CCHS maximizes the likelihood that there are a sufficient number of cases in Ontario, Quebec and Nova Scotia for more complex analysis both bivariate and multivariate.

The CCHS is very popular with researchers due to its large sample size, annual data files, and rapid release of new data. However, in the context of disability, CCHS is very useful for providing overall disability numbers but disability is such a rare characteristic that even CCHS's large sample cannot produce detailed information. A survey like the Participation and Activity Limitation Survey that has a specific focus on persons with disabilities is required.

PARTICIPATION AND ACTIVITY LIMITATION SURVEY

The Participation and Activity Limitation Survey (PALS) was Canada's national survey for persons with disability and produced remarkably detailed estimates for this rare population. PALS was regarded as a gold standard among disability surveys for the entire world (McColl et al, 2006) but unfortunately this survey program was cancelled in 2010 due to budget limitations and the search for more timely data about disability. PALS is included in this research to provide detailed information about the population with disability to aid in understanding the discrepancies in reported disability rates. However, it should also be noted that while the PALS data provide extensive detail about the lives of persons with disabilities, the PALS data assume disability as a starting point while CCHS and NPHS assume disability is the end point of the social determinants of health. While CCHS and NPHS can estimate the disability rate and provide some information about the severity, they contain little information about the type of disability. The PALS data look at the impact of disability on the rest of the people's lives ranging from help with activities of daily living, education, and labour force etc. all the

way to social activities, transportation methods, and housing requirements. The PALS data provide minimal information about the evolution of the disability itself, hence the limited role in this thesis. Nevertheless, due to the rarity of disability in the general population, NPHS and even CCHS quickly run out of sample when exploring the details about the severity of the disability the person is experiencing. PALS provides detailed information about the type AND severity of the disability at the same time in addition to further covariates, which is why PALS is also included in this research.

JUSTIFYING THE DATA SOURCES

There have been a few informal attempts to explain the Quebec Effect but nothing has ever been published. There has not been any previous research that explored the situation in Nova Scotia. Although none of the previous informal efforts to study the Quebec Effect uncovered an explanation, each attempt contributed to the accumulation of knowledge on this subject. Arguably, one of the key weaknesses of these previous attempts is they have focused on direct comparisons of people reporting disability in one province to people reporting disability in another province or the rest of the country. The profiles for the population of persons with disability in each province often looked fairly similar with only minor differences. The only notable difference was the prevalence rate. The stability of the Quebec and Nova Scotia effects over time, across surveys and between sets of disability identification questions suggest that the factors producing these discrepancies are firmly entrenched in the populations of these provinces. Previous research has used cross-sectional surveys to analyse one-time snap

shots of the disability populations in each province but these snapshots do not provide any information about the factors that influence the onset of this disability.

Longitudinal data offer a significant advantage in this area because the same people are interviewed repeatedly over many years, providing extensive information about the evolution of their health and disabilities. Understanding the factors that influence the onset of impairment and disability in each province also offers the potential to understand the discrepancies in the disability rates between provinces. However, longitudinal data can only produce representative estimates of the entire population with their first cycle of collection unless new participants are added to the longitudinal cohort. The reason for this limitation is the cohort becomes less representative over time as births and new immigrants enter the target population but they are not represented in the cohort. In the context of a health survey (and many other topics), adding participants to the cohort after the first cycle of collection is problematic for two reasons. First, participants that are added after the initial cycle are more difficult to use in the analysis because longitudinal analysis with health topics often includes first cycle as the baseline reference point. Studies focusing on the long-term effects of health decisions focus on the health characteristics of participants at the baseline to maximize the number of years for an affect to appear. The oldest cycle would not include the new participants so their utility in the analysis is significantly diminished and creates major challenges for researchers regarding how to treat these cases. Second, the methods for creating the survey weights become infinitely more complicated when new participants are added after the initial cycle, which also makes

the final data file more difficult for researchers to use (Fitzmaurice, Laird, and Ware, 2004). Fortunately, producing representative estimates is a key strength of cross-sectional surveys. Canada is fortunate to have a large annual cross-sectional health survey (CCHS) designed to complement a longitudinal health survey (NPHS) that collected data from 1994 to 2011. While the cross-sectional survey does update to current best practices in survey content on a regular basis, significant effort is made to ensure that the cross-sectional and longitudinal data are complementary when possible.

The complementary nature of these two data sources is ideal for research projects such as this one because it offers the opportunity to take advantage of both of their strengths. Therefore, in this research the CCHS data are used to provide a detailed bivariate understanding of the various factors and indicators potentially related to the development of impairment and disability in Quebec, Nova Scotia and Ontario. These factors are then compared and contrasted between the provinces to establish a general understanding of the prevalence and distribution of these factors and illustrate any significant differences between the provinces to set the stage for the multivariate analysis. The NPHS data are also used for the bivariate results to establish the similarities and differences between estimates from the CCHS and NPHS to illustrate the comparability of the two sources. The primary purpose of the NPHS data in this research is for the multivariate models. The details of the multivariate techniques are discussed later in this chapter. The key point to note is the longitudinal data from the NPHS are used in survival analysis models to examine the strength of the effects from the various factors potentially related to the onset of impairment and disability during

the follow-up period of NPHS. While the NPHS and CCHS are very complementary their sample sizes are not large enough to provide detailed information on the population of persons with disability in terms of the type and severity of disability. To fill this data gap, data from the 2006 Participation and Activity Limitations Survey (PALS) are used to provide a better understanding of exactly what types of disability are being experienced, how they are distributed within the population of persons with disability by severity, and any differences that exist between the provinces.

In summary, the complementary nature of the CCHS and NPHS make them ideal for a research project requiring detailed cross-sectional estimates as well as longitudinal analysis of factors over time. While the demise of NPHS in 2010 is unfortunate, this year lines up well with CCHS because the required variables for this research rotate in and out of CCHS on a 4 year basis. Fortunately the required variables are included in the 2010 CCHS data. The one limitation to this pair of surveys is the rarity of disability and the need for details on the population of persons with disabilities. Fortunately Canada also has the PALS and its detailed information about people with disabilities to fill this data gap. The remainder of this chapter focuses on the methods used to analyse these data sources and the pitfalls to avoid to ensure the results are valid.

ESTIMATION PROCEDURES

Each of the surveys used in this research brings their own objectives which result in their own unique approaches. However, when it comes to analysis all three of these surveys have a lot in common. They all use complex survey designs that must be

considered during variance estimation to ensure reliable and valid results. CCHS is used as the example to simplify the discussion but the approach is the same for NPHS and PALS. Estimating characteristics from complex surveys such as NPHS, CCHS or PALS requires considerable understanding of the mechanics behind such a survey. Please refer to Appendix A on page 240 for a technical discussion of the three surveys.

The most basic principle of estimation in a probability sample such as CCHS is that each participant represents many other people in addition to himself or herself. For example, if a population of interest had 1,000 people and a 2% sample was drawn at random (a total of 20 people), each person in the sample would represent 50 people in the population being studied ($20 * 50 = 1,000$). The weight of each person in the sample is 50 because they are representing herself/ himself plus 49 other people. In reality, the survey design and weighting process is far more problematic because of complex survey designs, stratification to ensure the representativity of desired categories, clustering to minimise the cost of surveying, plus numerous corrections for non-response, out-of-scope, calibration to known population estimates, and Winsorization (adjusts extremely large weights) to name just a few.

A top priority for all surveys is the quality measure of an estimate derived from that survey. In order to calculate a quality measure such as a coefficient of variation (CV), the variance must also be calculated. The CCHS and most other large surveys use a complex stratified multi-stage design where the variance cannot be calculated using the standard formula. In a simple random sample design, variance is simply the sum of

squared deviations from the mean divided by N . A stratified multi-stage design violates the most basic principle of a simple random sample because not all units have an equal chance of being selected. Therefore, when using data from a complex survey such as CCHS, NPHS or PALS, the variance estimation must take into account the design and stratification.

Many of Statistics Canada's surveys use the 'bootstrap' method to estimate the variance for complex survey designs. The bootstrap method involves drawing many simple random samples (with replacement) from the full survey data file. Each simple random sample is called a 'replicate'. A replicate contains units that can also be part of many other replicates because the sampling is done with replacement (i.e. each unit is put back into the sample and is available for the next selection). Since each replicate is a simple random sample, the simple variance equation can be used to calculate the variance of an estimate within each replicate and the survey weight for each unit within the replicate is recalculated and often referred to as a 'bootstrap weight'. More bootstrap weights inevitably mean more precision but it is a delicate balance with computational complexity and the computing time required to perform the calculations. Most surveys use five hundred (CCHS) or one thousand (PALS) bootstrap weights but some older surveys use as little as two hundred and fifty (NPHS) or even one hundred. The standard deviation of a point estimate for each bootstrap weight is the estimator of the bootstrap variance. Fortunately for users of Statistics Canada data, the creation of the bootstrap weights is done by survey methodologists and the complex computations that calculate the variance from a complex survey design can be done by statistical

analysis software such as SAS, SPSS, STATA or SUDAAN using the variance estimation formula for bootstrap weights, which is already programmed into the software.

The purpose of the first section of this chapter is to provide a solid understanding of the data sources and why they are selected for this research. The next section of this chapter explores the variables that are selected from CCHS, NPHS and PALS and describes the creation of unique and important variables.

VARIABLES

All three of the surveys selected for this research provide a very rich source of information for this research, offering hundreds of variables each. The purpose of this section is to describe the variables that are selected to represent the concepts proposed by existing literature and theory as described in chapter 2. This discussion presents the independent and dependent variables selected from each survey separately and describes how they are used in this analysis. This section also notes any major modifications to the variables beyond basic data management. Since the CCHS and NPHS are designed to be complementary many of the variables are quite similar. Therefore, this overview of the variables proceeds by the dimensions of the social determinants of health and highlights the differences in the variables between CCHS and NPHS. The PALS data contribute very specialised variables to this research so they are discussed separately.

The Canadian Community Health Survey data are used to provide a detailed portrait of health characteristics for each province to set the stage for the longitudinal

analysis of the National Population Health Survey. The CCHS and NPHS offer an extensive selection of variables but this research focuses specifically on those related to the social determinants of health and disability discussed in chapter 2.

DEMOGRAPHIC

There are a number of demographic variables suggested by previous research. Age and gender are common to most research projects yet there are also some less common variables suggested by the literature that are also available from the CCHS. As discussed in chapter 2 (see page 28), race and immigrant status have been popular as both predictor and outcome variables so they are also included in this research. To address these topics, several variables are selected from the CCHS and NPHS including racial origin, which is grouped into the broad categories Asian, Black and White due to small samples (except for White) as well as Aboriginal status and immigrant status. Previous research also suggests that marital status and living alone have significant effects on health so an indicator for living alone is created as well as three marital status dummy variables to indicate whether a person is married/ common law, never married, or separated/ divorced/ widowed. The final demographic variable included in this research is the size of the urban area the respondent lives in to derive the urban-rural indicator.

SOCIO-ECONOMIC STATUS

Socio-economic status (SES) is a cornerstone of the social determinants of health. As noted in chapter 2 (see pages 31-33), previous research has proven the

effects of SES on health using a number of different ways to measure it for an individual or household. This research also attempts to measure socio-economic status using several different approaches noted in the literature. One of the most common measures of SES is income. CCHS and NPHS both offer a few different options. To study income, this research examines the level of personal and household income as well as indicators of relative poverty by examining household income adequacy in comparison to other people in their health region. The smaller sample size of NPHS results in extensive suppression on the bivariate results presented in chapter 4 but these variables are all included in the multivariate models presented in chapter 5.

A second approach to measuring socio-economic status is through the highest level of education completed. CCHS and NPHS offer detailed education information in this regard so the highest level of education is organised into four groups: less than high school, high school complete, some post-secondary education, and post-secondary education complete.

There is a growing body of literature related to the health effects of various occupations as noted during the discussion in chapter 2. The CCHS and NPHS provide extensive detail on the occupation of the participant using the National Occupation Classification for Statistics system (NOC-S). The NOC-S provides 521 possible occupation categories offering data-users the opportunity to group the categories to suit their research needs. As noted in previous research, the prestige of an occupation is believed to have an impact on health outcomes so a scale is needed to rank the 521 occupation

categories in terms of prestige. This research uses the NOC-S occupation scale developed by Boyd (2008) because it provides a scale for ordering the NOC-S occupation codes based on prestige scores and it is compatible with the CCHS and NPHS data. This approach scores the amount of prestige of an occupation by assigning scores ranging from zero to one hundred. The method used to create the occupation prestige scale variable should also be explained.

There are 2 steps to creating the occupation prestige derived variable. First, the values for the prestige score are entered into a database where each record represents one of the NOC-S codes. For example, the NOC-S code D011 “Specialist Physician” receives a score scale value of 100 because it has very high prestige. Once the database with all the scores for each occupation code is created this database is then merged with the CCHS and NPHS databases by NOC-S code to match the occupation codes of the respondents with the corresponding scores from the Boyd (2008) prestige scale. Derived variables are also created due to the large number of values contained in the prestige score. This derived variable has four categories based on the quartile distribution of the prestige score variable. Finally, it should also be noted that NOC-S codes and scores are only available for people who worked in the previous 12 months before the survey. The previous occupation of people who worked before that time is not available. This limitation is discussed further in chapter 7.

Another important SES variable included in this research is labour force status. There are important differences between the labour force status variables of CCHS and

NPHS. The CCHS determines whether people had a job and worked in the past week, had a job but did not work in the past week (due to holidays, illness and other reasons), did not have a job last week, or they are permanently unable to work. It is important to note that the CCHS data do not separate the category “did not have a job last week” into people that are unemployed (actively searching for work) versus those that are not in the labour force (not searching for work, i.e. students, homemakers) or people that have retired. For people with disabilities, the not in labour force group can also include people who have given up looking for work because of their disability. In the case of CCHS, many of these people are likely identified in the “permanently unable to work” category, however, people may feel they are able to work if given the right environment.

The NPHS uses a slightly different labour force status variable that partially addresses the lack of clarity regarding people that did not have a job but not completely. The NPHS labour force status variable does separate people who are unemployed from those who are not in the labour force but it does not separate people who are not in the labour force from those who have retired. Within this population, the NPHS offers a flag for people who are not working due to illness or disability.

HEALTH INDICATORS

Health surveys offer a wide variety of health indicators depending on the type of analysis that is desired. According to the previous research discussed in chapter 2 (see pages 33-36), the most relevant health indicators for this research are self-reported

health, self-perceived mental health, self-perceived stress and the Health Utility Index. The CCHS uses more detailed and up to date methods for measuring mental health and distress than NPHS so the numbers should not be compared. Closely related to mental health is life satisfaction, which is offered by the CCHS only.

There are two variables in the health indicators group that require extensive modification for this research. The first variable to be modified is the life satisfaction variable. In the CCHS data, the life satisfaction scale runs from zero to ten, with zero being completely dissatisfied and ten being completely satisfied. For this research there are two problems with this arrangement. First, the SUDAAN statistical analysis software requires that the zero value be available when producing bivariate results (Research Triangle Institute, 2011). Therefore, all values for the life satisfaction variable are increased by one to ensure the zero value is available for SUDAAN. Second, eleven categories is a lot for a concept where many people tend to load at the extremes or right in the middle. Some categories have only a handful of responses while others have a significant number (Statistics Canada, 2011b). To adjust this disparity, the satisfaction with life variable is grouped into five groups for analysis on the bivariate tables. The multivariate analysis tests both the 11 category and 5 category versions of this variable. The groups and values are as follows: very dissatisfied (1, 2, 3), dissatisfied (4, 5), neutral (6), satisfied (7, 8), very satisfied (9, 10, 11).

The second variable requiring modification is the Health Utility Index (HUI). The sub-components of the HUI are used in the bivariate analysis to understand the

composition of the population while a derived variable based on HUI is used as a severity variable throughout this research. The overall HUI score is grouped into four categories to indicate the severity of disability based on the validation work of Feng et al (2009). There are four categories in the derived HUI variable. The severe disability category includes people with an HUI score of less than 0.70. A moderate disability is someone with a HUI score of 0.70 to less than 0.89. The mild disability category represents people with HUI scores between 0.89 and less than 1. People with no disability have HUI scores equal to 1. It should also be noted that the HUI algorithm has been slightly modified in this research to better represent the social model of disability. The premise of the HUI scale is everyone begins at 1 and points are deducted for each element of less than perfect health that is detected by the HUI questions. Most HUI calculations are not contrary to the social model but there are three examples that could be improved. All three of these examples involve the use of assistive technology. As noted in chapter 2, the basic ideal of the social model contends that disability only occurs when a person with an impairment is in an unsupportive environment. When a person is wearing glasses, using hearing aids, or taking medication for pain they are adapting their environment to the point that they do not have a disability. Normally, the HUI scale deducts points immediately for people who wear glasses, use hearing aids, or take medication for pain regardless of how their daily activities are affected. The impact of this deduction is people who wear glasses, use hearing aids or take medication are mathematically prevented from being in the perfect health category even if they have no other conditions and their activities are not limited. Therefore, for

this research, the macro that calculates the HUI scores is re-written so that points are only deducted if a person experiences a limitation in their daily activities. There is no deduction just because people wear glasses, use hearing aids, or take medication for pain.

CHRONIC CONDITIONS

The chronic conditions variables are very similar between CCHS and NPHS. The larger sample of CCHS results in much greater detail available for the bivariate tables but both sources provide virtually the same list of conditions to use in the multivariate analysis. The chronic conditions included in this research are selected very carefully and consistent with the previous research discussed in chapter 2 (see pages 36-37). The only modification to these variables is the creation of a derived variable to indicate the number of conditions the participant reported. CCHS and NPHS both provide counters for the number of chronic condition for each person. However, these counters include all chronic conditions. This research creates new counters that only include the conditions that are used in this research.

BEHAVIOURAL RISK FACTORS

The behavioural risk factors included in NPHS and CCHS are very similar because both surveys have specific objectives to study the social determinants of health and risk factors. There are two variables available from CCHS that are not available from NPHS. These variables are fruit and vegetable consumption and daily energy expenditure. When NPHS was designed in the early 1990s, the importance of fruit and vegetable

consumption was just beginning to be recognised and it was not included in NPHS until later cycles. The daily energy expenditure variable from CCHS is an attempt to include physical activity that people do as part of their regular activities, separate from sports or exercising. For example, some occupations such as restaurant servers and bicycle couriers are very active in their work so this activity can be captured through the daily energy expenditure variable. The physical activity variable targets activity that is specifically intended to be exercise (Statistics Canada 2011b). As noted in chapter 2, (see pages 37-40), smoking, Body Mass Index and physical activity have all been proven to play a role in long-term health and there are mixed results for alcohol consumption. The measurement tools are slightly different between NPHS and CCHS but the overall concepts are reasonably comparable but caution must be used interpreting results.

There are three variables that are manipulated from their original states and should be explained. The first variable is Body Mass Index (BMI). A new derived variable for BMI is created because the three categories of obesity have very few cases, (especially for NPHS). In order to have some sample in a useable obesity category, all three classes of obesity are grouped together into one category. The second and third variables to be manipulated are the physical activity and daily energy expenditure variables. These variables are both continuous and must be grouped for the bivariate analyses so they are split into four categories based on their quartiles. It should be noted that these variables are tested as both continuous and categorical variables in the multivariate analysis.

ACTIVITIES OF DAILY LIVING

The Activities of Daily Living (ADL) variables provide a useful indicator of how a person's activities are being affected by their health or disability as well as an indication of the type of help they need. The CCHS and NPHS both offer ADL variables but they are slightly different. The ADL activities began as the following on NPHS in 1994: preparing meals, shopping, regular housework, heavy household chores, personal care, and moving inside the house. The CCHS data adds getting to appointments or running errands and finances but removes shopping and heavy household chores. The lone data modification required for this research involves the rarity of needing help with daily activities. When NPHS began with its comparatively small sample size there were few people who reported needing help with activities of daily living, resulting in heavy suppression in the 1994 data. To address this problem for the bivariate results, people who reported needing help with their daily activities in 1994 are grouped together to represent people who needed help with at least one activity of daily living.

INTERACTION TERMS

Interaction terms are also created to study the combined effects of several indicators. These interaction terms are created using all possible pairings of gender, smoking status, drinking status, obesity, education, grouped occupation, industry and employment status. The results of these interaction terms are presented in chapter 5 on multivariate results.

PARTICIPATION AND ACTIVITY LIMITATION SURVEY

The Participation and Activity Limitation Survey (PALS) has a very different purpose in this research. The sole intention for PALS is to provide detailed information about the population of persons with disabilities that is not available from NPHS or CCHS. For this research, the key variables from PALS are the severity variable and the variables to indicate the type of disability. A person can have more than one disability so the ten types of disability available from PALS are constructed as a series of dummy variables to indicate which disabilities are present. The most important point to discuss concerning the PALS variables is the different severity scale that must be used with this data. The HUI was included in the 2006 PALS but there are clear respondent evasion techniques in the data. In PALS 2006, the HUI is placed after another series of questions about activities where positive responses (“Yes”) can lead to additional loops of questions. When the respondents arrived at the HUI questions they had clearly decided that “no” is a much better answer than “yes” because it meant fewer questions (Veilleux, 2009). To address this problem, a different severity scale based on World Health Organisation (2001) definitions of disability is used instead. This severity scale separates the population of people with disabilities in PALS into four categories: mild, moderate, severe and very severe disability.

The overview of the variables used in this research is intended to provide a background understanding to prepare for the description of the methodological procedures applied to the data. This discussion includes description of the technical

details of the analytical procedures, the assumptions that are made and the different software that is used.

METHODOLOGICAL PROCEDURES: BIVARIATE ANALYSIS

There are several different quantitative analysis procedures applied to the data in this research that require explanation because of the complex designs of the surveys. The principles are the same for all three surveys so this discussion proceeds by analytical technique rather than by survey or social determinant of health as has been done in previous sections. The analytical techniques that are applied to the data in this research include significance testing, calculating the coefficient of variation (CV), age standardisation, and the multivariate analysis. It should be noted that SAS and SUDAAN are used throughout this research. SAS is version 9.2 (Network version) while SUDAAN is the SAS-callable SUDAAN version 10.1 (Network version). SAS-callable SUDAAN is chosen over the stand alone SUDAAN because it can be executed from within the SAS programming window to facilitate data manipulation with SAS followed immediately by procedures requiring complex survey variance estimation with SUDAAN without having to export data files.

The critical starting point to this research is the bivariate analysis. The bivariate results are used to provide a detailed portrait of the CCHS, NPHS and PALS populations to establish existing relationships and illustrate potential significant relationships in the multivariate analysis. All bivariate analysis in the research is performed using SAS-callable SUDAAN version 10.1 (Network Version) because of its ability to correctly

estimate the variance of estimates derived from surveys with complex designs. The PROC DESCRIPT procedure is used to produce all the bivariate tables. As these tables are produced SUDAAN is also able to calculate other critical information depending on which options are selected. For this research, SUDAAN's built-in options for significance testing, coefficient of variation calculation and age standardisation are used. The methods for using each of these options are described below.

SIGNIFICANCE TESTING

Significance testing is a critical step for the bivariate results presented in this research to ensure that any observed differences are actually different and meaningful. This research assumes the standard 0.05 alpha level but notes any differences that approach significance by indicating the P value in brackets when it is greater than 0.05 but less than or equal to 0.10. The significance testing in this research is conducted using SAS-callable SUDAAN version 10.1 (Network Version). The procedure PROC DESCRIPT is used with the option DIFFVAR to specify each pair of differences for significance testing. Using this approach provides an output for each pair of categories and the significance of the difference (Research Triangle Institute, 2011). The most common significant testing is between the provinces so the significant test is run with Ontario versus Nova Scotia, Ontario versus Quebec, and finally Nova Scotia versus Quebec. The large sample of CCHS and the large effective sample size of PALS result in many significant differences. The smaller sample size of NPHS still results in important significant differences but there are several instances where it appears that a slightly

larger sample would provide more significant results. The full results of the bivariate significance testing are presented in chapter 4.

AGE STANDARDISATION

Age standardisation is a critical step for this research to ensure that valid comparisons are being made between the provinces. Nova Scotia and Quebec present some of the oldest age structures in Canada so it is important to ensure the validity of the comparisons. This research uses the age distribution for all of Canada as the standard distribution for the age standardisation. The CCHS, NPHS, and PALS data are all standardised to the full Canadian population contained within each survey. While it is not difficult to standardise all surveys to the same age distribution, their very different nature suggests that this is not a valid approach. The longitudinal nature of NPHS means it represents a very unique population after 9 cycles and the population of persons with disabilities also tends to be approximately 20 years older than the general population. Since the data are never directly compared between the surveys it is not necessary to standardise to the exact same age distribution.

There are four steps to the age standardisation method used in this research and the approach is the same for all three surveys. First, an age group variable is created in SAS (Version 9.2; Network Version) that indicates the number and size of the age groups to be used in the age standardisation. All three surveys use 5 year age groups beginning at 15 years of age and capping at 85+. The NPHS and CCHS analyses include youth 12-14 so they are their own age group. Second, a frequency of this age group is requested in

SAS using the PROC FREQ procedure and it is output as a data file. The next step is to read the data file and create a proportion variable for each age group using PROC SQL in SAS. The first three steps are preparatory steps for the actual age standardisation that is performed using SUDAAN. The procedure PROC DESCRIPT is used with a few options. The STDVAR option must be specified and indicates the age group variable created in step 1. The option STDWGT is also used and each age group proportion variable created in step 3 must be specified. The last option is the OUTPUT= which specifies the name of the output data file from the age standardisation. The final result is an Excel data file that provides the age standardised values for each bivariate category that is specified (Research Triangle Institute, 2011). All estimates provided in this thesis are age standardised using this method.

COEFFICIENT OF VARIATION

A coefficient of variation (CV) is a popular indicator for the quality of an estimate derived from survey data. The CV is expressed as a percent and indicates the amount of variation inherent in the estimate (Statistics Canada, 2011b). To simplify, a CV can be thought of as the maximum percentage error. For example, an estimate of 50 with a CV of 20% means the “true” value lies within the boundaries of 50 plus or minus 20%. A major advantage of using the CV as a quality indicator in this research is the CV can be compared across all three data sources because the unit is expressed as a percent. Obviously smaller CV’s are preferable and the acceptable limits depend on the application. Statistics Canada provides recommended CV boundaries with most data sources. Generally, a CV between 0-16.5% is considered to be good quality. A CV

greater than 16.5 and less than or equal to 33.3% should be flagged with the indicator “Use with Caution” and marked with a superscript E. A CV greater than 33.3% is considered “Too Unreliable to be Published” meaning the estimate is suppressed and replaced by an F (Statistics Canada, 2011b). This research uses Statistics Canada’s recommended CV boundaries. The coefficient of variation is calculated by dividing the standard error of the estimate by the estimate itself and multiplying by 100. This research calculates CV’s by requesting the SEPERCENT option and an output data file when creating tables with PROC DESCRIPT in SUDAAN. Once the output data file is created, SAS is programmed to calculate the CV as a new variable by dividing the standard error of the estimate by the estimate itself and multiplying by 100. The variable ‘CV’ is added as a new variable on the requested output. A CV is calculated for all estimates provided in this research to ensure they are of acceptable quality to be published.

METHODOLOGICAL PROCEDURES: MULTIVARIATE ANALYSIS

The purpose of the multivariate techniques employed in this research is to measure the strength of the effects from each factor suspected to be influencing the onset of disability. When longitudinal data are available such as NPHS, an ideal technique to utilise is survival analysis because it can indicate the strength of the factors associated with the onset of an event. There is a variety of different types of survival analysis that can be used so this section begins by justifying the type of survival analysis

selected for this research. The remainder of this section discusses the technical details regarding how this technique is performed.

Survival analysis is an ideal technique to study factors associated with the onset of impairment and disability through longitudinal data. Survival analysis is also known as “time to event” analysis because it models the factors influencing the time to the occurrence of an event. This research uses the onset of disability during the longitudinal follow-up as an event so that the strength of the factors influencing the onset of impairment and disability can be studied. Not all survival analysis techniques provide the strength of the factors (e.g. accelerated failure time models; Hosmer and Lemeshow, 2008). For the purposes of this research, the Cox proportional hazard (PH) family of models is most appropriate because it provides the coefficients of all the factors. Within this family, the discrete PH model should be used with the NPHS data because the follow-up periods have a fixed interval (every 2 years). Longitudinal surveys with fixed intervals such as NPHS detect new characteristics that arrive sometime during the two year interval between follow-up interviews but the exact date is unknown. This occurrence is known as interval censoring. The discrete PH model addresses interval censoring by using a separate record for the same respondent to indicate each interval of follow-up. This adjustment for interval censoring makes the discrete PH model the most appropriate model for the NPHS data and this research. Further, the discrete proportional hazards model provides adjusted proportional hazard ratios that indicate the amount of hazard associated with one factor while controlling for all other factors in the model.

A hazard ratio is an expression of the change in the amount of risk for a specific outcome relative to people that do not have this characteristic (Hosmer and Lemeshow, 2008). For example, in the context of this research studying the risk for the onset of a severe disability, a hazard ratio of 2.0 for people who have arthritis indicates that the risk for the onset of a severe disability is twice as high for people with arthritis as it is for people without arthritis, controlling for all other variables in the analysis. More generally, hazard ratios indicate the strength of each factor and their influence on the onset of disability.

In order to use the discrete PH model and compute the hazard ratios there are two steps required to prepare the data and conduct the analysis. First, the dataset must be expanded such that one record is created for the baseline year plus one additional record for each follow-up period until the onset of the event being studied. For example, if a case developed disability in 2000, they would only have separate records for the baseline year in 1994, plus a record for 1996, 1998 and 2000. A case that did not develop a disability at all during the follow-up period would have records for 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008 and 2010. The second step to preparing for the discrete PH models is a dichotomous event variable must be created to indicate the follow-up period where the transition to disability occurred. This variable becomes the dependent variable in all of the discrete PH models.

There are a number of different possible transitions that can be modelled as events using the discrete PH model approach because people can move between the

four different severities of disability described on page 62. Typically, the severity of a disability increases as time passes but there are exceptions such as accidents and illnesses. Unfortunately for this research, there are a limited number of transitions between the four categories of severity during the follow-up period of NPHS. Combined with the relatively small sample size of NPHS, the limited number of transitions also limits the options available for modelling the onset of disability. In fact, the only transition that had adequate sample to be studied separately (without being grouped) is the transition from no disability to mild disability. Nevertheless, the bivariate analysis reveals that the mild disability group is often most similar to the no disability group and very dissimilar from the severe disability group. The key research group of interest is people who developed severe disability over time because they are the most unique. Understanding the progression of this extreme group will also shed light on the dynamics of the transitions of other groups. Therefore, the key transition that is modelled using the discrete PH models is anyone who began the NPHS follow-up with no disability, a mild or moderate disability and transitioned to a severe disability. However, it should be noted that people with severe disabilities are not necessarily unhealthy. They are only experiencing enough difficulty with the activities included in the HUI to warrant a low score on functional health, which best equates to impairment.

Consistent with the bivariate section, the multivariate analysis is also organised using the validated disability categories established by Feng et al (2009). To represent a transition into the severe disability category, the onset of disability is defined as transitioning from an HUI greater than or equal to 0.70 in 1994 to an HUI of less than

0.70 (severe disability) in a subsequent NPHS follow-up between 1996 and 2010. The transition to an HUI score below the 0.70 threshold for severe disability is the event that is modelled using discrete proportional hazard models.

The methods for computing the discrete PH models are relatively straightforward with most statistical software yet this research must account for the complex survey design of NPHS. Accordingly, there are a few steps to ensure the variance is estimated correctly. This research uses the procedure PROC SURVEYLOGISTIC in SAS (V9.3; Network version) and the complimentary log-log link option to estimate the discrete PH models and their hazard ratios. The PROC SURVEYLOGISTIC option is new to SAS with version 9.2 and has the ability to correctly estimate the variance for estimates from complex surveys (SAS Institute, 2008). This procedure offers a few options for variance estimation including Taylor Linearization, Jackknife and Balanced Repeated Replication (Bootstrap). Since Statistics Canada provides bootstrap weights with the NPHS database the bootstrap method is used for all discrete PH models in this research. To use the bootstrap variance estimation method with PROC SURVEYLOGISTIC the option VARMETHOD=BRR must be specified together with the WEIGHT option to indicate the survey weight variable and the REPWEIGHT option to indicate the name of the bootstrap weight variables. The output of this procedure provides the hazard ratios for each model. The output also provides some basic diagnostics. A complete discussion of the diagnostics for the models in this research is provided in chapter 5 following the discussion of the models themselves (see pages 148-160).

Finally, it should be noted that categorical variables are entered into the models as class variables. If a class variable is significant, it is retained in the model and the significance of each category is indicated on the output. The categorical variables are constructed so that the first category is the desired reference category and the remaining categories provide the hazard ratio compared to the reference category. Categorical variables that are not significant are converted to dummy variables so that key categories (i.e. smoker, drinker, obese etc.) can also be tested in the models.

The purpose of this chapter is to provide an explanation of the data and methods that are used to explore the discrepancies in the disability rates in Quebec and Nova Scotia compared to Ontario. This research uses three different sources of data to provide cross-sectional, longitudinal and detailed disability information. The methods of this research are designed to correctly estimate variance for complex surveys while providing bivariate and multivariate results. The next chapter of this thesis presents the results of the bivariate analysis in order to begin understanding the various relationships between the social determinants of health and disability across the three provinces.

CHAPTER 4: DESCRIBING HEALTH AND DISABILITY IN CANADA

The bivariate results present the general characteristics of the provincial populations in terms of the various factors and indicators potentially related to the onset of disability. This overview is provided to establish a general understanding of the prevalence and distribution of these factors to provide a foundation to assist in understanding the prevalence and distribution of various characteristics in order to prepare for the multivariate analysis in chapter 5 while also beginning to build evidence for the hypotheses of this thesis. This chapter builds a basic understanding of these relationships by illustrating any significant differences between the provinces and examining the evolution of these factors over time. The hypotheses of this thesis contend that the social determinants of health play a significant role not only in health and mortality but are also significant factors in the development of impairment and disability. As noted in chapter two, health and disability are correlated but there are important differences with regards to participation in daily life. Therefore, the exploration of factors associated with the development of impairment and disability is organised by the elements of the social determinants of health. Specifically, the categories of factors related to the development of disability presented in this chapter include: demographics, income, socio-economic status, general health, chronic conditions, behavioural risk factors, and functioning in the community.

BIVARIATE RESULTS

The bivariate presentation uses cross-sectional data from the Canadian Community Health Survey (CCHS) to establish a current profile of the factors potentially associated with the onset of disability in as much detail as possible. Once the current profile is established, longitudinal data from the National Population Health Survey are added to examine the evolution of these factors over time and establish whether there is consistency between the distributions recorded in NPHS and CCHS. This consistency will provide support for the use of the NPHS data as a proxy to study the evolution of these factors over time and the development of impairment and disability. Understanding the evolution of these factors over time will help understand the current prevalence of disability found in the CCHS data. However, as noted in chapter 3, the estimates from CCHS and NPHS data should never be directly compared. The 2010 CCHS values represent estimates of the true values in 2010. The 2010 NPHS data reflect the characteristics of the longitudinal panel from the data collected in 2010. The CCHS and NPHS estimates are both provided to illustrate similarities and differences between the actual 2010 estimates from CCHS and characteristics of the longitudinal NPHS panel in 2010. Please refer to chapter 3 for more details about the difference between longitudinal and cross-sectional data sources.

The analysis of the NPHS data over time is also included to explore initial bivariate evidence for the hypotheses of this thesis in preparation for the multivariate results presented in chapter 5. It should be mentioned that not all factors included in

this research are explored in the text that follows; only factors with noteworthy results are mentioned. Please refer to the tables to find complete results for all factors examined by this research. The focus of this exploration is significant differences that exist between the three provinces and any significant evidence of factors influencing impairment and disability. This baseline of social determinants will aid subsequent discussions of the differences that are observed in the multivariate analyses of the factors related to the development of disability.

Finally, it should also be noted that all bivariate analyses presented in this thesis are age standardised (except age distributions) to facilitate valid comparisons between provinces. Please refer to chapter 3 for detailed information about how the age standardisation is done. The CCHS uses the complete Canadian population aged 12 years of age and older in 2010 while the NPHS represents the complete Canadian population 12 years of age and older in 1994. The PALS data are age standardised to the complete 2006 Canadian population 15 years of age and older because that is the youngest possible age for the PALS adult survey.

DEMOGRAPHIC CHARACTERISTICS

As noted in chapter 2 (see pages 28-31), demographic information is often very relevant to discussions of factors related to disability because of the strong association with age and other factors such as gender and race. The demographic information available from the CCHS and NPHS provide a detailed portrait of the characteristics of each province in order to begin the analysis. The NPHS data are used minimally to

explore shifts in demographic characteristics over time because gender rarely changes and everyone aged 16 years during the 16 year follow-up period. The NPHS data are included in this section to provide an indication of the differences between the actual 2010 estimates and characteristics of the NPHS longitudinal panel in 2010.

The age distribution of the CCHS data lines up very much as expected in terms of the severity of disability. People with the most severe disabilities tend to be older and people without disabilities tend to be younger. There is also a gradual shift toward an over-representation of females as severity increases. The population without disabilities displays almost a perfect 50/50 balance between males and females and this balance slowly shifts toward women, averaging 56.0% for people with severe disabilities in the three provinces.

The most noteworthy difference between the three provinces is the distribution of their age structure. Table 1 clearly demonstrates that there is a significantly younger population in Ontario compared to Quebec. There are a number of age and severity categories with significant differences indicating that the population of Ontario is much younger than that of Quebec. This finding is also confirmed by the average ages where Ontario is approximately 2 years younger for three of the four severity groups. While not all differences are statistically significant, there are very few comparisons suggesting that the Quebec population is younger than Ontario and none of them are significant. In contrast, the age structure of the Nova Scotia population appears to be somewhat in between Ontario and Quebec, but slightly closer to Quebec. While Nova Scotia is

significantly younger than Quebec for people age 12-29 with a moderate disability, there are also a number of instances where the two provinces are very similar or the differences balance out across a number of categories. This result is also confirmed by the average age where Nova Scotia typically reports a slightly younger age structure except for people with severe disabilities (See Table 1).

A second important demographic characteristic to mention is the percentage of people living alone. Living alone suggests there may not be anyone that is regularly available to provide assistance if needed, which may also result in a disability through an unsupportive environment. However, living alone may also indicate that regular assistance is not required. Nevertheless, Quebec consistently reported significantly higher rates of living alone compared to Ontario and Nova Scotia. While the prevalence of living alone may be tied to Quebec's consistently higher rate of divorce and to a lesser extent, being single, the consistently low rates of marriage or common-law status also point to less availability of assistance when needed.

The most significant demographic difference among the provinces is the geographic distribution of the population between urban and rural areas. Living in a rural area typically results in less availability of healthcare and other services. According to the CCHS data, every province and every category of disability is significantly different from each other. On average, about 1 in 6 Ontarians live in a rural area compared to 1 in 5 Quebecers and slightly less than half of all Nova Scotians. Interestingly, there was

minimal variation between the categories of severity and no visible shift toward urban areas and increased availability of healthcare and other services.

The final noteworthy demographic difference between the provinces involves the racial composition of the population. Once again every province and category of disability is significantly different from each other. Ontario's large immigrant population is clearly visible in the demographic statistics where about one third of the entire population of Ontario is an immigrant to Canada. Quebec also displays a sizeable immigrant population with one sixth immigrating to Canada while Nova Scotia has attracted less than ten percent of their population from the international community. As a result of the large immigrant population in Ontario, the percentage of people reporting their race as Asian is typically five times higher or more compared to either Quebec or Nova Scotia.

Table 1: Demographic Characteristics of CCHS by Province and Severity

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Demographic Characteristics</i>	%			%			%			%		
Gender												
Male	50.1	46.8	48.4	51.8	51.3	53.1	45.8	47.6	47.8	43.6	41.4	46.9
Female	49.9	53.2	51.6	48.2	48.7	46.9	54.2	52.4	52.2	56.4	58.6	53.1
Age Group												
12-29	30.1 ^{*†}	26.3	27.7	32.4 [†]	32.2	28.9	27.8 [†]	29.4 ^φ	21.5 ^φ	12.2	10.4 ^E	13.1
30-44	27.0 [†]	25.5	23.8	25.3	22.9	24.9	22.5	17.2 ^E	24.8	15.2	14.7 ^E	14.9
45-64	31.8 ^{*†}	35.5	34.7	30.1	30.1	32.1	31.0	36.3	34.4	43.8	43.1	40.8
65+	11.1 ^{*†}	12.8	13.9	12.3	14.9	14.0	18.7	17.1	19.3	28.8	31.8	31.1
Average Age	41.5	43.2	43.5	41.1	42.2	42.8	44.9	44.7	46.8	54.0	55.2	53.9
Living Arrangement												
Lives alone	10.8 [†]	11.0 ^φ	16.1 ^φ	13.2 [†]	16.8	18.8	15.5 [†]	14.9 ^{Eφ}	20.1 ^φ	15.1 [†]	16.4 ^{Eφ}	23.4 ^φ
Geographic area												
Urban	84.4 ^{*†}	55.3 ^φ	80.7 ^φ	84.3 ^{*†}	57.9 ^φ	81.5 ^φ	86.1 ^{*†}	58.4 ^φ	81.7 ^φ	85.9 ^{*†}	56.9 ^φ	77.0 ^φ
Rural	15.6 ^{*†}	44.7 ^φ	19.3 ^φ	15.7 ^{*†}	42.1 ^φ	18.5 ^φ	13.9 ^{*†}	41.6 ^φ	18.3 ^φ	14.1 ^{*†}	43.1 ^φ	23.0 ^φ
Immigration Status												
Immigrant	33.1 ^{*†}	6.9 ^{Eφ}	13.3 ^φ	32.9 ^{*†}	4.6 ^{Eφ}	14.5 ^φ	32.3 ^{*†}	8.4 ^{Eφ}	17.0 ^φ	27.8 ^{*†}	F ^φ	13.4 ^{Eφ}
Aboriginal Status												
Aboriginal	2.1 [†]	2.7 ^{Eφ}	0.9 ^{Eφ}	2.0 ^{*†}	6.4 ^{Eφ}	1.1 ^{Eφ}	2.4	F	1.7 ^E	3.5	F	F
Ethnic Origin												
Asian	14.4 ^{*†}	2.0 ^E	2.0	16.6 ^{*†}	F ^φ	3.9 ^{Eφ}	15.1 ^{*†}	F	3.0 ^E	12.2 ^{*†}	F	F
Black	3.8 ^{*†}	1.2 ^{Eφ}	2.6 ^φ	4.1 [*]	F ^φ	2.8 ^{Eφ}	3.0 ^E	F	6.3 ^E	6.9 ^{E*}	F ^φ	F ^φ
White	74.3 ^{*†}	93.9 ^φ	90.0 ^φ	72.1 ^{*†}	93.1	88.6	71.6 ^{*†}	93.1 ^φ	85.3 ^φ	75.2 ^{*†}	94.9 ^φ	84.4 ^φ
Marital Status												
Married or common-law	63.2 ^{*†}	66.0 ^φ	58.1 ^φ	59.1	56.9	55.0	53.6	53.1	52.5	53.2 [†]	51.3 ^φ	43.3 ^φ
Divorced, separated, widow	9.3 [†]	9.8	11.7	11.5	13.5	12.6	16.4	12.8 ^E	14.0	14.9 [†]	14.2 ^φ	19.9 ^φ
Single	27.5 [*]	24.2 ^φ	30.2 ^φ	29.4	29.6	32.4	30.0	34.0	33.5	31.9 [†]	34.5 ^φ	36.7 ^φ
First official language												
English	80.1 [†]	93.3 ^φ	7.2 ^{Eφ}	72.5 [†]	96.3 ^φ	F ^φ	70.3 [†]	91.1 ^φ	F ^φ	74.8 [†]	93.8 ^φ	8.5 ^{Eφ}
French	3.8 ^{E†}	F ^φ	81.3 ^φ	6.5 ^{E†}	F ^φ	86.8 ^φ	F	F ^φ	86.3 ^φ	12.5 ^{E†}	F ^φ	82.1 ^φ

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older (except age groups)

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[†] Difference between Ontario and Quebec is significant at 0.05 level

^φ Difference between Nova Scotia and Quebec is significant at 0.05 level

The demographic characteristics from the NPHS data illustrate a number of the same relationships seen in the CCHS data but there are also a few important differences to note. Consistent with the CCHS, the NPHS data also exhibits a notable trend where increasing age is also associated with increased severity of disability. Looking at the provinces, the most important similarity to note between the two sources is the observed age structures, although the differences are less extreme than CCHS. According to the average age of people remaining in the NPHS panel in 2010, people in

Quebec without a disability or a mild disability have the youngest average age. At the same time, people in Quebec with a moderate or severe disability have the oldest average age. Nova Scotia is also an interesting case because the CCHS indicate that this province also has an older age structure but the NPHS panel is often closer to the younger end of the spectrum. Additional consistencies between NPHS & CCHS include the much higher percentage of people living in rural areas of Nova Scotia, the marital status profile and the expected linguistic differences.

The most important difference between the two data sources is the over-representation of women in Ontario in the severe category of disability. While this trend is also evident in CCHS, the magnitude is much larger in the NPHS data. As the severity of disability increases, the over-representation also increases. This trend is present for all provinces yet Table 2 clearly shows that Ontario's percentage of women in the severe disability category (65.4%) is sharply higher than either Nova Scotia (55.9%) or Quebec (54.3%), although the difference is only significant with Quebec.

Overall, the NPHS and CCHS data appear quite consistent with similar trends and relationships present. While the demographic structures are not exactly consistent they are reasonably similar. The principal concern with using the NPHS data to understand the current distribution of disability is the inconsistency of the overrepresentation of women in Ontario with severe disabilities. This inconsistency will be considered when examining the multivariate analyses and during the discussion in chapter 6. The overall consistency of CCHS and NPHS in terms of demographic results provides initial support

for using the NPHS panel as a proxy to explore factors affecting the development of impairment and disability to understand current disability statistics from CCHS.

Table 2: Demographic Characteristics of NPHS by Province and Severity

Variable	Severity ¹											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Demographic Characteristics (2010)</i>	%			%			%			%		
Gender												
Male	54.3 *	38.9 [♢]	44.8 [♢]	47.3	40.6	45.1	44.2	45.5	42.6	34.6 [†]	44.1	45.7
Female	45.7 *	61.1 [♢]	55.2 [♢]	52.7	59.4	54.9	55.8	54.5	57.4	65.4 [†]	55.9	54.3
Age Group												
12-29	F	F	4.5 ^E	F	F	F	F	F	F	F	F	F
30-44	24.1	27.4 ^E	28.0	25.9 ^E	30.3 ^E	22.4 ^E	24.7 ^E	F	21.8 ^E	11.6 ^E	F	F
45-64	53.7 ^{††}	45.0	46.8	43.9	32.3 ^{E♢}	52.4 [♢]	43.9	39.2 ^E	43.6	44.8 ^E	35.7 ^E	36.8 ^E
65+	20.0	21.9	20.7	26.1 ^E	30.9	21.4	28.1 ^E	30.0 ^E	31.5	42.3 ^E	44.8 ^E	47.9
Average Age												
1994	37.0	36.3	36.0	37.8	38.2	37.3	39.2	38.6	40.1	46.8	45.9	47.4
2010	52.9	52.2	52.0	53.7	54.1	53.3	55.2	54.5	56.1	62.8	61.7	63.4
Geographic area												
Urban	82.8 *	64.2 [♢]	79.8 [♢]	83.2 *	71.8 [♢]	80.6 [♢]	85.2 *	70.8 [♢]	75.5 [♢]	88.3	66.2 [♢]	81.2 [♢]
Rural	17.2 *	35.8 [♢]	20.2 [♢]	16.8 ^{E*}	28.2	19.4 ^E	14.8 ^{E*}	29.2 ^{E♢}	24.5 ^{E♢}	11.7 ^{E*}	33.8 [♢]	18.8 ^{E♢}
Marital Status												
Married or common-law	80.4	80.9	79.5	80.1	68.1	69.0	75.3	66.4	73.8	78.2	68.1	61.9
Divorced, separated, widow	16.1	14.2	18.1	18.3	28.7	27.5	22.0	25.5	22.5	17.8	31.9	32.4
Single	3.6 ^E	F	F	F	F	F	F	F	F	F	F	F
Immigrant Status												
Immigrant	24.9 ^{††}	8.1 ^{E♢}	8.6 ^{E♢}	27.9 ^{††}	F	10.1 ^E	28.4 ^{††}	F	F	28.1 ^{††}	F [♢]	6.7 ^{E♢}
First official language												
English	80.1 [†]	93.3 [♢]	7.2 ^{E♢}	72.5 [†]	96.3 [♢]	F [♢]	70.3 [†]	91.1 [♢]	F [♢]	74.8 [†]	93.8 [♢]	8.5 ^{E♢}
French	3.8 ^{ET}	F [♢]	81.3 [♢]	6.5 ^{ET}	F [♢]	86.8 [♢]	F [†]	F [♢]	86.3 [♢]	12.5 ^{ET}	F [♢]	82.1 [♢]

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

All results are standardised to the age distribution of all Canadians 12 years of age and older in 1994

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[†] Difference between Ontario and Quebec is significant at 0.05 level

[♢] Difference between Nova Scotia and Quebec is significant at 0.05 level

¹ Severity refers to HUI score in 2010

SOCIO-ECONOMIC STATUS

The impact of socio-economic status on health outcomes has been well documented by the previous research presented in chapter 2. Recall that within the social determinants of health framework, socio-economic status can include a wide variety of concepts ranging from the classic factors such as income and education to other factors that are less often associated with health such as housing conditions or

unsanitary or stressful occupations. More details about the socio-economic variables included in this analysis can be found in the description of variables in chapter 3.

LABOUR FORCE STATUS

The socio-economic status characteristics reveal a number of noteworthy results and perhaps the most interesting involves labour force status. According to existing research discussed previously, labour force status is one of the most important determinants of health because it can have wide ranging effects on many other areas of life such as income, life satisfaction, and general health, with unemployment considered particularly costly to health. As noted in chapter 3, the CCHS does not specify whether people did not have a job because they were unemployed or not looking for work (student, homemaker, retired etc.). This information is available from NPHS and discussed later in this section. Nevertheless, the employment profiles from CCHS for the three provinces are quite unique although there is considerable suppression in the data so the focus must be on people who had a job. As shown in Figure 5, the rates of people who had a job line up as expected within each province, where people with severe disabilities are least likely to have a job and people without disabilities are the most likely. The most striking result is the variation in these rates between provinces. Ontario residents consistently report higher rates of having a job compared to Quebec and these differences are statistically significant for people without a disability or a mild disability where the sample is largest. Moreover, residents of Quebec consistently report higher rates of not having a job and significant differences exist with either Ontario or Nova Scotia for every category of disability except for moderate disabilities.

However, as noted above, the category “did not have a job” includes more than just people who were unemployed. Finally, the labour force characteristics of Ontario and Nova Scotia are remarkably similar yet there is one interesting result that should also be mentioned. Within the most severe category of disability, Nova Scotia reports a much higher rate of having a job than Ontario (55.7% vs. 44.2%), although this result just misses significance, ($P=0.08$; See Figure 5).

Figure 5: People Who Had a Job by Province and Severity

Source: Canadian Community Health Survey, 2010

The labour force characteristics of the NPHS panel reveal a number of longitudinal results that add useful context to this exploration of factors associated with impairment and disability. The most obvious trend on Figure 6 is the decreasing employment for people with severe disabilities, which is expected and consistent with CCHS. However, the declining employment figures over time may not be expected given the stronger job market in 2010 compared to 1994 (Statistics Canada, 2012c). However,

the NPHS panel is aging and transitioning from employment to retirement. The key trend to note is the faster rate of transition away from employment noted for Ontario and Nova Scotia compared to Quebec, which is unexpected given that Quebec's age structure seems older though is not significantly different. Further, Ontario's pronounced shift out of the labour force reduces Ontario's employment figures from significantly higher than Quebec in 1994 to not significantly different in 2010.

Figure 6: Employment for the NPHS Panel by Province and Severity

Source: National Population Health Survey, 2010

HIGHEST LEVEL OF EDUCATION

A second socio-economic characteristic that demonstrates some interesting significant differences between the provinces is the highest level of education. As one of the classic indicators of socio-economic status, educational attainment can have pronounced effects on the health of individuals because it directly determines many other characteristics such as income and occupation. One of the more interesting

differences found in the CCHS data on Table 3 is the apparent polarisation of educational attainment in Quebec, and to a lesser extent Nova Scotia, when compared to Ontario. Nova Scotia and Quebec consistently report higher rates of people without a high school diploma compared to Ontario and these differences are significant for Quebecers with a severe disability and both Quebec and Nova Scotia for people without a disability. At the same time, Quebec also reports higher rates of completed post-secondary education for all categories of disability except for severe and two of the three differences are significant. Related to this finding are the significantly higher rates of high school completion in Ontario compared to Quebec and Nova Scotia for all categories of disability. The lone exception is for people without a disability where Ontario reports the highest rate of high school completion but the difference is only significant for Quebec, not Nova Scotia (See Table 3).

Table 3: Socio-Economic Status Characteristics by Province and Severity

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Socio-economic status</i>	%			%			%			%		
Labour force status												
Had a job- worked last week	66.2 [‡]	66.4	62.8	65.3 [‡]	64.3	56.6	58.6	58.8	55.4	44.2	55.7	41.6
Had a job- absent last week	4.2 ^{*‡}	6.7	6.5	4.5 [‡]	5.3 [‡]	6.8	4.2 [‡]	F	6.2	4.1 [‡]	F	F
Did not have a job last week	28.9 [‡]	25.6 [‡]	30.3 [‡]	28.9 [‡]	29.2	35.0	32.8	33.1	36.5	37.6	28.5 [‡]	37.7 [‡]
Permanently unable to work	0.8 [‡]	1.2 [‡]	0.5 [‡]	F	F	F	4.4 [‡]	F	1.8 [‡]	14.1	11.8 [‡]	11.1
Highest level of education												
Less than secondary school	16.6 ^{*‡}	22.6	19.4	20.2	22.5	21.8	22.1	24.8	24.4	25.6 [‡]	25.7	30.4
Secondary school only	15.9 [‡]	14.6	12.2	19.3 ^{*‡}	12.9	12.4	20.2 ^{*‡}	11.1 [‡]	12.6	18.7 ^{*‡}	10.4 [‡]	10.0
Some post-secondary education	7.5 [*]	4.2 [‡]	7.0 [‡]	7.8	9.6 [‡]	8.3	7.2	5.9 [‡]	8.8	7.9	10.7 [‡]	15.1
Completed post-secondary education	60.0	58.5	61.4	52.7 [‡]	55.0	57.5	50.5 [‡]	58.2	54.2	47.9	53.2	44.5
Occupational prestige score												
First quartile	28.2	30.3	26.5	20.9	17.7	22.1	18.8	17.0 [‡]	19.0	22.0	19.3 [‡]	14.0 [‡]
Second quartile	20.2 [*]	15.1	17.1	20.5	14.5 [‡]	17.1	17.0 [*]	12.0 [‡]	12.9	16.8	15.7 [‡]	15.1 [‡]
Third quartile	20.6	23.9	21.9	20.1	23.9	19.8	20.5	29.2	19.9	21.6	20.9 [‡]	22.2
Fourth quartile	30.9	30.7	34.5	38.5	43.9	41.0	43.7	41.9	48.1	39.5 [‡]	44.2	48.7

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older

[‡] Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[‡] Difference between Ontario and Quebec is significant at 0.05 level

[‡] Difference between Nova Scotia and Quebec is significant at 0.05 level

Using the NPHS data to follow the SES indicators through time reveals some interesting changes but perhaps the most notable involves the highest level of education. The profile of the highest level of education between the provinces changes considerably between 1994 and 2010 as people complete higher levels of education and this increase is visible for all severities of disability. The largest increase involves those who had completed post-secondary education. All three provinces report dramatic increases yet not all provinces increased at the same pace. Ontario and Quebec increase at a similar pace while Nova Scotia lags behind. In fact, in 2010 the post-secondary completion rate for Ontario becomes significantly higher than Nova Scotia for three out of the four severity groups compared to just one in 1994. In terms of the consistency in the relationships, the CCHS data shows that Quebec, and to a lesser extent Ontario, report significantly higher rates of post-secondary completion than Nova Scotia. The NPHS data on Figure 7 suggest that this gap may be widening over time such that the social determinant effects of low education in Nova Scotia may not have been as strong in 1994 as they are in 2010 (See Figure 7). The multivariate analysis will shed more light on this issue but the key point to note is the consistency in the relationships between CCHS and NPHS.

Figure 7: Post-Secondary Education Complete by Province and Severity, 1994-2010

Source: National Population Health Survey, 2010

HOUSEHOLD INCOME

A final dimension of socio-economic status that demonstrates some noteworthy differences between the provinces is household income. Household income is a much better indicator of the financial reality that the individual is enduring because of the opportunity for co-residents to pool resources and share costs. The most important difference shown on Table 4 is the frequent over-representation of Quebec in the lowest categories of income, regardless of the severity of disability. While these differences are only consistently significant with Ontario, Nova Scotia only has a higher rate of people in the lowest household income category for people with severe disabilities. At the other end of the spectrum, Ontario reported the highest levels of household income for all categories of disability except moderate where Nova Scotia is highest but the difference is not significant. Ontario has significantly higher rates of household income for people without a disability or a mild disability compared to

Quebec and Nova Scotia and is also higher than Quebec for people with moderate disabilities. Finally, it should also be noted that once the household income is recalculated to indicate income adequacy using the number of household members, nearly all of the significant differences disappear (See Table 4).

Table 4: Income Characteristics by Province and Severity, 2010

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Income</i>	%			%			%			%		
Personal income category												
No income - \$19,999	28.0	27.0	30.5	30.9	35.4	35.8	36.5	35.2	39.4	48.7	39.6	51.1
\$20,000 - \$39,999	24.6 ^{*F}	29.6	28.5	28.6	30.0	29.8	28.0	32.7	31.2	24.9 [*]	42.0	27.3
\$40,000 - \$59,999	18.6	19.0	20.5	18.2	15.7	18.0	17.4	15.8 ^E	14.8	12.1	7.2 ^E	12.4
\$60,000 or more	28.8 ^{*F}	24.4	20.5	22.3 ^F	18.9	16.4	18.1	16.3	14.6	14.3	11.3	9.2
Household income category												
No income - \$39,999	18.3 ^{*F}	24.1	25.2	22.6 ^F	28.4	32.4	28.8 ^F	33.4	36.6	42.2 ^F	49.3	43.0
\$40,000 - \$69,999	25.2 ^F	24.7	28.3	28.6	34.1	28.1	27.1	25.1	32.6	24.2	23.1 ^E	29.4
\$70,000 - \$99,999	19.8	21.6	20.2	17.9	13.8	18.3	20.7 ^F	16.5 ^E	15.2	14.5 ^F	12.9 ^E	11.0 ^E
\$100,000 or more	36.7 ^{*F}	29.6	26.3	30.9 ^{*F}	23.7	21.3	23.3 ^F	25.1 ^{EΦ}	15.5 ^Φ	19.1	14.7 ^E	16.6 ^E
Ratio of household income adequacy												
Lowest	25.8	24.9	26.3	32.9	29.4	33.1	36.2	35.3	36.4	48.8	50.8	49.8
Lower middle	20.1	19.9	19.9	18.8	23.8	20.7	23.7	17.1 ^E	23.5	17.6	19.0 ^E	15.4
Upper middle	20.9	22.9	21.6	20.4	20.2	18.6	17.9	21.5	19.4	19.3 [*]	10.6 ^E	16.8
Highest	33.1	32.4	32.2	27.9	26.6	27.6	22.2	26.1	20.7	14.3	19.6 ^E	18.0
Income source												
Welfare / social assistance	2.5 [*]	1.3 ^{EΦ}	3.4 ^Φ	4.3	F	6.4 ^E	6.9	F	5.9	18.1 ^{*F}	10.4 ^E	12.6
Worker's compensation	2.1 ^F	2.8 ^E	3.3	1.9	2.9 ^E	2.7	2.5	10.7 ^E	4.7 ^E	6.3 [*]	9.3 ^E	10.0 ^E

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older

^E Use with caution

^F Too unreliable to be published

^{*} Difference between Ontario and Nova Scotia is significant at 0.05 level

^F Difference between Ontario and Quebec is significant at 0.05 level

^Φ Difference between Nova Scotia and Quebec is significant at 0.05 level

The evolution of household income over time also reveals some critical relationships and brings some challenges as well. The changing values of household income over time result in either inconsistent categories or significant suppression for the first or last cycle due to small cell counts from shifting dollar amounts. As seen in CCHS, household income adequacy is also useful for examining income because even though the dollar values change in NPHS, accounting for the number of household

residents is a key adjustment according to the social determinants of health (Hacker, Ormandy, Ambrose, 2010; Reading and Wien, 2009). While LICO indicators would have been preferred, there are technical problems with the LICO values in the first two cycles of NPHS. Therefore, household income adequacy is the most useful variable that is available.

The most obvious trend on Table 5 is the growth in the top two categories, particularly the highest income category. In 1994, Ontario's reputation as the economic engine of Canada is clearly evident through significantly higher levels of income adequacy for many of the comparisons. Moving forward to 2010 reveals that Ontario's income adequacy increased dramatically and at a faster pace than Quebec or Nova Scotia, resulting in even more significant differences for the highest level of income (See Table 5). This finding is consistent with the relationships uncovered in the 2010 CCHS data, suggesting that the social determinants as seen through NPHS income data are a reasonable proxy to study the factors affecting CCHS disability statistics.

Table 5: Household Income Adequacy by Province and Severity, 1994-2010

Variable	Severity ¹											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Socio-economic status</i>	%			%			%			%		
Ratio of household income adequacy 1994												
Lowest	6.6 ^{E*†}	15.5 ^E	20.3	F ^{*†}	F	17.0 ^E	12.6 ^E	F	20.6 ^E	19.4 ^{E*†}	30.3 ^E	24.3 ^E
Lower middle	20.9 ^{*†}	38.8	29.0	30.8	32.9	33.0	21.8 ^{E*}	49.0 [‡]	32.4 ^{E‡}	28.3 ^{E†}	38.6 ^E	34.5 ^E
Upper middle	43.1	33.3	36.6	40.3	37.6	32.6	47.2	31.6 ^E	36.1 ^E	35.2	25.9 ^E	30.7
Highest	29.4 ^{*†}	12.4 ^E	14.0	22.4 ^{E*}	F [‡]	17.4 ^{E‡}	18.4 ^{E*†}	F [‡]	11.0 ^{E‡}	17.2 ^E	F	10.4 ^E
Ratio of household income adequacy 2010												
Lowest	F ^{*†}	7.5 ^E	3.6 ^E	F	F	4.6 ^E	F	F	F	12.0 [‡]	17.9 ^E	17.1 ^E
Lower middle	6.1 ^{*†}	13.2 ^E	19.7	15.9 ^E	22.4 ^E	19.6	16.6 ^{E*†}	25.6 ^E	25.1	23.6	32.9 ^E	25.3 ^E
Upper middle	21.8 [‡]	33.8	28.9	29.9	23.9 ^E	35.2	28.9	29.8 ^E	30.6	32.4	33.1 ^E	32.1
Highest	71.1 ^{*†}	45.5	47.8	50.3	42.0	40.5	50.5 [‡]	35.7 ^E	37.9	32.0 ^{*†}	16.0 ^E	25.6 ^E

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

All results are standardised to the age distribution of all Canadians 12 years of age and older in 1994

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

† Difference between Ontario and Quebec is significant at 0.05 level

‡ Difference between Nova Scotia and Quebec is significant at 0.05 level

¹ Severity refers to HUI score in 2010

Overall, the relationships found in the CCHS and NPHS data are quite consistent for the socio-economic status indicators. Ontario's labour force characteristics are strong according to both sources, although the NPHS panel experienced somewhat of a weakening in Ontario. Nova Scotia shows consistently lower levels of education while Ontario enjoys the highest levels of income adequacy. Therefore, the socio-economic indicators of NPHS appear to be a valid proxy to study the association of these factors with the onset of impairment and disability.

HEALTH INDICATORS

There are a number of health indicators that the previous research noted in chapter 2 (see pages 33-36) has proven to be strong indicators of current overall health status and future mortality. These health indicators include elements of physical as well as mental health. In this research, there are three indicators that show noteworthy

variations between the provinces including: self-perceived health, self-perceived mental health and self-perceived stress.

SELF-PERCEIVED HEALTH

Self-perceived health has proven to be very useful in previous research and this pattern continues in the results of this thesis. The 2010 CCHS data show that the frequency of reporting excellent and poor health is distributed as expected between the categories of severity, where people with severe disabilities were more likely to report poorer health and people without disabilities reported the highest levels of excellent health. Overall, Ontario reports the highest rates of excellent health although the results are not always significant. Figure 8 below presents the prevalence of excellent or very good health and clearly shows that Ontario consistently reports high levels of excellent or very good health. However, it should be noted that important information is also masked in the bivariate results by the combination of excellent and very good health to avoid suppression due to poor data quality. Ontario and Quebec report similar rates of excellent health for all categories of disability with no significant differences. At the same time, Ontario reports higher rates of excellent health compared to Nova Scotia and these differences are significant for all severities except for mild disabilities (See Figure 8).

Figure 8: Excellent or Very Good Self-Perceived Health by Province and Severity

The story over time seen through the NPHS data reveals the expected shift toward lower levels of health as the population ages but also a remarkable similarity to the relationships seen in the 2010 CCHS results. When the NPHS panel began in 1994, Ontario and Quebec also reported the highest levels of excellent health while Nova Scotia reported the highest rates of fair or poor health. This pattern is consistent across all categories of severity to the point that people in Ontario and Quebec with moderate to severe disabilities reported rates of excellent health that matched or exceeded people in Nova Scotia with mild disabilities. As shown on Table 6, not only did this trend remain evident through 2010, but the number of statistically significant differences for Nova Scotia when compared to Ontario or Quebec increased, even after age standardisation. The impact over time for this expanding poor health in Nova Scotia is explored further in the multivariate results chapter of this thesis.

Table 6: Health Indicators by Province and Severity, 1994-2010

Variable	Severity ¹											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Health Indicators</i>	%			%			%			%		
Health Utilities Index (HUI)												
1994 HUI score categories	46.7 *	44.3 ^φ	51.5 ^φ	23.6	23.3	23.7	16.5	13.1	15.2	13.2 *	19.3 ^φ	9.6 ^φ
2010 HUI score categories	46.8	49.3	53.3	20.0	18.8	17.7	15.0	12.7 ^E	13.3	18.2	19.2 ^φ	15.6 ^φ
Self-rated general health 1994												
Excellent	34.8	28.2	32.8	26.9	16.8 ^E	31.1	21.2 ^E	F	26.4	16.1 ^E	15.9 ^E	15.3 ^E
Very Good	40.1	48.2 ^φ	41.6 ^φ	40.0	48.3	39.2	36.3	44.6 ^E	36.3	37.5 *	16.3 ^E	30.4
Good	21.2 *	17.3 ^{Eφ}	22.0 ^φ	28.0	28.3 ^E	23.4 ^E	37.4	24.6 ^E	33.1	33.4 ^E	32.3 ^E	34.4 ^E
Fair or poor	F	F	F	5.2 ^E	6.6 ^E	6.4 ^E	5.1 ^E	16.8	4.2 ^E	13.0 *	35.5	19.9
Self-rated general health 2010												
Excellent	22.3 *	14.2 ^{Eφ}	23.2 ^φ	14.5 ^E	11.3 ^E	15.8 ^E	F	F	F	F	F	8.1 ^E
Very Good	49.3	45.4	41.4	32.2	31.1	38.5	31.8 ^E	38.0 ^E	35.1	17.6 ^E	12.1 ^E	7.6 ^E
Good	25.5	34.1	32.2	47.0	45.7	40.0	45.1 ^E	47.0 ^E	48.4	34.6 *	21.3	34.5
Fair or poor	F	6.3 ^E	F	6.3 ^E	11.9 ^E	5.6 ^E	14.7 ^E	7.8 ^E	13.5 ^E	45.5 *	63.5	49.8
Mental distress score												
Increased since 1994	19.6 [‡]	16.0 ^{Eφ}	31.6 ^φ	27.8 [‡]	36.1	40.8	33.8	40.5	43.0	37.2	20.4 ^φ	43.4 ^φ
Perceived stress score												
High perceived stress 1994	11.4	12.3 ^E	16.5	17.6 ^E	13.5 ^E	12.3 ^E	11.7 ^E	24.8 ^E	17.6 ^E	21.4 ^E	24.6	22.8
High perceived stress 2010	F	F	4.4 ^E	13.3 ^E	15.9 ^E	10.5 ^E	19.1 ^E	F	17.5 ^E	25.1 ^E	12.5 ^E	23.9 ^E

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

All results are standardised to the age distribution of all Canadians 12 years of age and older in 1994

^E Use with caution

F Too unreliable to be published

-- Not applicable

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[‡] Difference between Ontario and Quebec is significant at 0.05 level

^φ Difference between Nova Scotia and Quebec is significant at 0.05 level

¹ Severity refers to HUI score in 2010

SELF-PERCEIVED MENTAL HEALTH

Mental health is also quickly becoming recognized as a key contributor to overall health through physical effects on the mind and body. The 2010 CCHS data indicate that the severity of disability also lines up as expected with self-perceived mental health where poor self-perceived mental health is associated with higher rates of disability. Table 7 shows that once again the interesting story is found between the provinces. Unfortunately, there is heavy suppression for people reporting low levels of self-perceived mental health at all levels of severity so the focus must be on those who report excellent mental health. The most important difference to note is that Nova Scotia consistently reports the lowest rates of excellent mental health. Although this

difference is only significant in two instances, there appears to be a clear trend of poorer perceived mental health in Nova Scotia. For people without disabilities, Ontario reports significantly higher rates of excellent self-reported mental health (51.8%) compared to Quebec (48.7%) or Nova Scotia (47.3%). However, the situation reverses in Ontario for people with any disability where Ontario is lowest or mid-pack. For people with disabilities, Quebec reports the highest rates of excellent mental health, although the difference is only significant for people with moderate disabilities (See Table 7). Overall, Quebec consistently reports high levels of perceived mental health that equal or exceed Ontario and Nova Scotia.

Table 7: Health Characteristics by Province and Severity

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Global health measures</i>	%			%			%			%		
Self-perceived health												
Excellent	32.0 *	26.1 ^φ	32.1 ^φ	19.3	14.7 ^E	17.7	10.9 *	F ^φ	11.3 ^φ	6.7 *	F	3.3 ^E
Very good	42.2 *	47.3 ^φ	39.8 ^φ	42.9 [†]	47.7 ^φ	37.0 ^φ	34.3 [†]	39.5 ^φ	29.0 ^φ	19.1	20.8 ^E	21.1
Good	21.7 [†]	22.8	24.4	29.1 [†]	30.1	36.2	39.0	37.5	43.0	33.0 [†]	39.0 ^φ	42.0 ^φ
Fair	3.5	3.3 ^E	3.1	7.7	6.8 ^E	8.3	13.5	16.6	14.8	28.4	24.2	23.2
Poor	0.5 ^E	F	F	F	F	F	2.2 ^E	F	1.8 ^E	12.8	13.0 ^E	10.4
Self-perceived health - compared to one year ago												
Much better	8.2	9.5	7.5	6.1	7.8 ^E	6.4	6.4 [†]	6.9 ^E	10.2	5.4	8.0 ^E	10.1 ^E
Somewhat better	11.6	12.8	10.3	13.2	11.3 ^E	14.4	14.2	15.5 ^E	15.4	13.8	10.5 ^E	13.0
About the same	74.8	72.9	75.9	71.3	75.1	68.5	61.7	67.6 ^φ	55.8 ^φ	51.3	51.5	49.1
Somewhat worse	5.2	4.6 ^E	5.8	8.8 *	5.5 ^{Eφ}	9.7 ^φ	16.4 *	8.9 ^{Eφ}	16.8 ^φ	22.9	24.1	19.6
Much worse	0.3 ^E	F	0.5 ^E	F	F	F	1.3 ^E	F	1.7 ^E	6.5 ^E	5.9 ^E	8.2 ^E
Satisfaction with life												
Very unsatisfied	0.2 ^E	F	F	0.2 ^{E†}	F	F	0.9 ^{E†}	F	F	4.4	6.5 ^E	4.4 ^E
Somewhat unsatisfied	0.3 ^E	F	F	1.9 ^{E†}	F	F	4.2 ^E	F	3.0 ^E	8.1	F	5.6 ^E
Neither satisfied nor unsatisfied	2.0	1.8 ^E	1.7	6.1 *	F ^φ	4.1 ^φ	10.2	9.5 ^E	8.9	14.8	18.4 ^E	11.1
Satisfied	14.7 [†]	10.4 ^φ	12.2 ^φ	26.6	28.6	27.8	34.6 *	33.2	30.4	31.1	21.8	29.3
Very satisfied	82.9 ^{*†}	87.3	85.7	65.2	67.8	67.1	50.1 *	56.3	56.5	41.5	47.8	49.7
Self-perceived mental health												
Excellent	51.8 ^{*†}	47.3	48.7	27.9	27.9	30.1	18.7 [†]	16.1 ^φ	23.8 ^φ	19.1	14.0 ^E	19.8
Very good	34.3 ^{*†}	40.3	37.0	43.8	40.5	39.7	38.8	38.7	34.4	26.3	35.5	28.8
Good	12.7	11.9	13.0	24.1	27.6	26.7	30.8	30.2	32.3	32.7	26.8	32.5
Fair	1.1 ^{E*}	F ^φ	1.2 ^{Eφ}	4.1	3.8 ^E	3.4 ^E	10.1	13.9 ^E	8.0 ^E	15.1	18.5 ^E	14.5
Poor	F *	F	F	F	F	F	1.6 ^E	F	F	6.8	F	4.4 ^E
Perceived life stress												
Not at all stressful	16.4	16.8	15.4	9.8 [†]	10.0 ^{Eφ}	13.5 ^φ	6.2 [†]	6.1 ^E	8.4	5.3 [†]	6.9 ^E	11.3
Not very stressful	26.0 ^{*†}	31.5 ^φ	22.2 ^φ	20.3	23.5	17.8	18.5	21.9	18.5	16.4	12.6 ^E	19.3
A bit stressful	41.3 [†]	38.0	38.1	45.8	48.6 ^φ	42.2 ^φ	44.8	47.7	42.6	38.1 ^{*†}	47.6 ^φ	32.4 ^φ
Quite a bit stressful	14.2 [†]	12.8 ^φ	21.2 ^φ	21.3 *	17.2 ^φ	23.5 ^φ	25.2	20.6 ^E	25.3	29.4 *	24.8	23.4
Extremely stressful	2.1 *	F ^φ	3.1 ^φ	2.9 *	F ^φ	2.9 ^{Eφ}	5.3	F	5.2	10.7	8.1 ^{Eφ}	13.5 ^φ

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[†] Difference between Ontario and Quebec is significant at 0.05 level

^φ Difference between Nova Scotia and Quebec is significant at 0.05 level

As noted in the methodology chapter, the NPHS measures self-perceived mental health using a very different approach than CCHS which includes a detailed module on mental health to compute a distress score. Unfortunately not everyone receives a distress score, which results in heavy suppression. Nevertheless, it is possible to calculate the change in the distress score using the NPHS data. Figure 9 below indicates the percentage of people in the NPHS panel that increased their mental distress score

between 1994 and 2010. The most noticeable result is the high rate of increase in mental distress for Quebecers, which often yields significant differences between Ontario and Nova Scotia. The oddest result is the very low rate of increase in Nova Scotia for people with severe disabilities. Fortunately the severe disability category is one of the few areas where the mental distress scores are not suppressed so this odd result can be further analysed. The reason for the small increase in stress for Nova Scotia between 1994 and 2010 is that the high distress rate is already quite high (32.2%^E) compared to Ontario (19.4%^E) and Quebec (12.2%^E) so there is less room for any additional increases. The large increases in Quebec are at least in part the result of having the lowest rates of high distress in 1994.

Figure 9: Increase in Mental Distress Score by Province and Severity, 1994-2010

Source: National Population Health Survey, 2010

SELF-PERCEIVED STRESS

The final health indicator explored in this section is self-perceived stress. The CCHS data indicate that few people report their days are “extremely stressful” so this analysis combines this group with the second most stressful category “very stressful” and is referred to as “High Stress.” Figure 10 reveals two interesting phenomena in the relationships between the severity categories, high stress and the provinces. First, there is a strong positive association between the severity of disability and high perceived stress. For people without disabilities, the average rate of high stress is slightly less than half (18.1%) that of people with severe disabilities (36.6%). This result is somewhat unexpected because people with severe disabilities are less likely to be in the labour force and tend to be older as well. The second noteworthy finding is the much lower rate of high stress in Nova Scotia for all categories of disability. There are significant differences between Nova Scotia versus Ontario and/or Quebec for every category of disability except moderate. Ontario and Quebec are statistically similar for every category with the exception of people without disability where the rate of high stress in Ontario (16.3%) is significantly lower than Quebec (24.3%; See Figure 10).

Figure 10: High Self-Perceived Stress by Province and Severity

Self-perceived stress is also measured differently by NPHS compared to CCHS. NPHS uses a perceived stress module to calculate an overall perceived stress score. Consistent with CCHS, the stress scores also seem to increase with the severity of disability. However, as the panel ages, the stress scores are generally declining over time but there are a few exceptions. There are no significant differences between the provinces but there is some evidence of the low rates of stress in Nova Scotia that are detected in CCHS. However, the CCHS relationship is more pronounced and significantly different.

Overall, the health indicators suggest much similarity exists in the relationships detected in the CCHS and NPHS data, suggesting that NPHS is a suitable proxy for studying the evolution of factors related to disability over time. General health is consistently higher in Ontario and Quebec but lower in Nova Scotia according to both sources; Nova Scotia has the lowest rates of excellent mental health in the CCHS data

and the highest rates of mental distress in the NPHS data. Finally, while the self-perceived stress indicator is not perfectly comparable there is limited evidence that Nova Scotia reports lower rates of stress in NPHS while this relationship is much stronger in CCHS. These differences are considered during the multivariate results.

CHRONIC CONDITIONS

The CCHS and NPHS data provide a variety of indicators to indicate the presence of chronic conditions. Chronic conditions can often indicate the presence of impairments that may result in a disability given the correlation between health and disability. While chronic conditions are not always an immediate indicator of disability, as the condition progresses or worsens (i.e. arthritis etc.) the likelihood of experiencing disability can increase without a supportive environment.

Using the CCHS data to provide population estimates shows that the prevalence of the various chronic conditions lines up as expected such that people without disabilities consistently have the lowest rates of chronic conditions, people with severe disabilities have the highest rates and there is a steady gradient in between. There are few significant differences between the provinces but a couple important results stand out. The most noteworthy observation involves the rates of arthritis between categories of severity and the three provinces. Figure 11 below clearly shows that every estimate of the arthritis rate in each province and severity group is significantly different. In fact, arthritis demonstrates some of the strongest significant differences between provinces and severity groups. The relationships between the rates of arthritis

are also surprisingly consistent between the categories of severity. Nova Scotia always has significantly higher rates of arthritis, Quebec always has significantly lower rates of arthritis, and Ontario is always in the middle, slightly closer to Quebec. As noted previously, all results are age standardised so this pattern is surprising not only because Nova Scotia's older age structure is consistently visible compared to Ontario, but also because Quebec's very low arthritis rates are contrary to their older age structure, which is older than Nova Scotia (See Figure 11).

Figure 11: Arthritis Rate by Province and Severity

A second interesting result from the analysis of the chronic conditions involves the rates of anxiety. Nova Scotia reports the highest rates of anxiety for three out of the four categories of severity. While only one of these differences is significant due to small cell counts (as seen by data quality flags on Table 8), logically speaking, the high rates of anxiety are unexpected given the low rates of stress noted in the previous health indicators section. Another notable discovery is Ontario's low rates of anxiety.

Ontario consistently reports the lowest rate of anxiety and although the difference is not significant with Nova Scotia due to small cell counts, Ontario's anxiety rate is significantly lower than that of Quebec for three of the four severity categories.

Table 8: Prevalence of Chronic Conditions by Province and Severity

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Diagnosed chronic conditions</i>		%			%			%			%	
Asthma	6.5	5.9 ^E	7.7	7.6 [*]	12.6 ^Φ	8.9 ^Φ	9.2	9.2 ^E	10.1	15.6	16.3 ^E	14.0
Arthritis	10.3 ^{*F}	14.7 ^Φ	7.0 ^Φ	12.7 ^{*F}	20.0 ^Φ	8.7 ^Φ	22.1 ^{*F}	33.7 ^Φ	14.9 ^Φ	34.8 ^{*F}	47.5 ^Φ	25.5 ^Φ
Back problems	12.1	12.4	11.2	15.0	16.0	16.1	26.3	30.8	24.6	45.5	47.4	47.6
Migraines	7.6	7.1 ^E	6.7	9.3	11.9 ^E	7.6	14.7	16.2 ^E	12.9	22.9	27.5	21.5
COPD	1.5	1.8 ^E	1.8	1.9	2.4 ^E	2.0 ^E	3.9	3.9 ^E	3.7	6.2	7.0 ^E	7.8
Diabetes	5.9 ^F	5.5	4.2	6.3	6.7 ^E	4.0	7.6	8.8 ^E	5.9	11.3	12.7 ^E	9.8
Heart disease	3.3 ^F	4.1	3.9	4.5	3.7 ^E	5.6 ^E	5.2	F	6.2	8.3	11.0 ^E	9.3
Cancer	1.2 [*]	2.6 ^E	1.5	1.9	F	1.6 ^E	2.5 ^E	F	2.5 ^E	3.1 [*]	8.7 ^{EΦ}	2.3 ^{EΦ}
Stroke effects	0.3 ^{EF}	F	0.5 ^E	0.5 ^E	F	F	1.1 ^E	F	1.2 ^E	2.2 ^F	F	1.4 ^E
Mood disorder	2.1	F	1.6	6.1 [*]	12.5 ^{EΦ}	4.6 ^{EΦ}	12.2	12.1 ^E	10.8	23.0	24.2	23.9
Anxiety	1.8 ^F	3.3 ^E	2.8	3.7 ^F	7.1	6.4	8.2	14.5 ^{EΦ}	9.1 ^Φ	16.5 ^F	18.1 ^E	18.8
Number of chronic conditions												
Zero	63.8 [*]	60.2 ^Φ	64.8 ^Φ	55.3 [*]	39.6 ^Φ	56.0 ^Φ	38.9	32.9	42.6	19.8 [*]	15.7 ^{EΦ}	21.7 ^Φ
One	24.3	25.5	24.8	28.1 [*]	37.4 ^Φ	28.6 ^Φ	29.0	25.7	28.4	26.8	21.8	26.2
Two	8.5	9.9	7.9	11.1	15.1	10.8	18.7	23.3	18.1	23.5	21.7	23.4
Three or more	3.4	4.4 ^{EΦ}	2.5 ^Φ	5.5	7.9 ^{EΦ}	4.5 ^{EΦ}	13.4	18.1	10.9	29.9 [*]	40.8 ^Φ	28.7 ^Φ

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older

^E Use with caution

^F Too unreliable to be published

^{*} Difference between Ontario and Nova Scotia is significant at 0.05 level

^F Difference between Ontario and Quebec is significant at 0.05 level

^Φ Difference between Nova Scotia and Quebec is significant at 0.05 level

A final noteworthy observation from the chronic conditions analysis is the overall effect of chronic conditions measured by the number of chronic conditions that each person reported. This summary measure is divided into four groups: no chronic condition, one chronic condition, two chronic conditions and three or more chronic conditions. The most striking observation for this variable is the much higher volume of chronic conditions in Nova Scotia seen on Figure 12. Nova Scotia consistently has the smallest proportion of people with no chronic conditions and the largest proportion with three conditions or more. Many of these results are significantly different from Quebec and Ontario, which present a very similar profile of chronic condition

prevalence. While Quebec's overall rate of chronic conditions appears consistently lower than those of Ontario not a single difference is statistically significant.

Figure 12: Number of Conditions by Province, Severity

Source: Canadian Community Health Survey, 2010

The much smaller sample size of NPHS limits the estimates for chronic conditions that can be produced. Nevertheless, examining the useable NPHS data on chronic conditions reveals a strong similarity to the 2010 CCHS results and suggests one possible reason for the current trend. Consistent with CCHS, the 1994 rates of arthritis from NPHS are highest in Nova Scotia. The difference is only significant for people without disabilities but approaches significance for Quebec with all three categories of severity ($P=0.15$ to 0.16). This relationship is not as strong as the CCHS data but the trend is very similar. In terms of the number of chronic conditions, Nova Scotia is again least likely to report zero chronic conditions regardless of severity. This difference is significant for people with mild disabilities and just misses significance for severe disabilities ($P=0.06$), meaning that during the 16 year follow-up, Nova Scotians are most likely to have at

least one or more chronic conditions affecting their health. Unlike the CCHS data where Ontario and Quebec are quite similar, Quebec begins the longitudinal panel with the lowest rates of chronic conditions and the difference is significant for mild disabilities. Ontario seems to have a lower overall rate of chronic conditions compared to Nova Scotia but more than Quebec. Following the NPHS panel to 2010 reveals the expected aging effects through increased chronic conditions with remarkable consistency in the distribution. Nova Scotia continues to have the highest rates of chronic conditions in three of the four severity groups. Once again only one of the differences is significant but the severe category just misses once again ($P=0.07$). The final detail to note from Table 9 is the sizeable increase in chronic conditions in Quebec relative to Ontario and Nova Scotia. Quebec's significant advantage in chronic conditions in 1994 decreases to the point that there are no significant differences with Ontario in 2010 (See Table 9).

Table 9: Prevalence of Chronic Condition by Province and Severity, 1994-2010

Variable	Severity ¹											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Diagnosed chronic conditions</i>	%			%			%			%		
Arthritis												
1994 rate	7.5 [‡]	16.9 [♢]	5.1 [♢]	7.2 ^E	12.5 ^E	F	13.8 ^E	24.6 ^E	10.3 ^E	24.0	32.3	15.6
2010 rate	22.5 [‡]	33.7 [♢]	16.5 [♢]	25.5 [‡]	23.8 ^E	14.7 ^E	38.1	38.4 ^E	34.1 ^E	59.2	56.1	50.2
Back problems												
1994 rate	10.7 ^E	10.1 ^E	9.3 ^E	12.0 ^{EF}	10.7 ^{E♢}	F [♢]	12.0 ^E	F [♢]	12.2 ^{E♢}	18.1	25.5	18.7
2010 rate	14.0 ^E	12.8 ^E	10.2	19.2 ^E	F	F	23.9 ^E	32.8 ^E	26.8 ^E	40.5 ^E	39.8 ^E	32.0 ^E
High blood pressure												
1994 rate	F	7.8 ^E	5.9 ^E	7.5 ^E	F	F	11.7 ^E	19.1 ^E	F	11.0 ^E	13.1 ^E	12.8 ^E
2010 rate	26.6	29.3	23.4	25.6	31.1 ^E	22.9	34.1	36.6 ^E	F	33.3	36.9 ^E	35.9
Total- All chronic conditions²												
1994 rate	49.0	55.5	42.9	52.2 [‡]	53.8 [♢]	38.3 [♢]	53.6 [‡]	71.8 [♢]	50.1 [♢]	67.4	79.8	53.6
2010 rate	77.4	83.4	76.7	80.2	85.0 [♢]	72.6 [♢]	83.9	100.0	90.2	87.3	92.0	81.9
Number of chronic conditions- 1994												
Zero	51.0	43.9	56.7	47.8 [‡]	46.2 [♢]	61.7 [♢]	46.4	28.2 ^E	49.9	32.6	20.2 ^E	46.4
One	27.2	31.4	27.5	31.7	22.3 ^E	26.4	28.9	F	24.2 ^E	29.1 ^E	30.9 ^E	18.7 ^E
Two	11.2	16.4	10.2	13.1 ^E	17.9 ^E	F	12.8 ^E	34.0 ^E	16.3 ^E	11.6 ^E	24.9 ^E	12.2 ^E
Three or more	10.7 ^E	8.2 ^E	5.6 ^E	7.3 ^E	13.6 ^E	5.6 ^E	11.9 ^E	19.2 ^E	9.6 ^E	26.7	23.9	22.7
Number of chronic conditions- 2010												
Zero	22.5	16.6 ^E	23.0	20.5 ^E	15.3 ^E	27.2	F [*]	F [♢]	F [♢]	F	F	F
One	28.1	22.8 ^E	29.1	28.6	32.1	26.5 ^E	19.6 ^E	25.5 ^E	19.4 ^E	17.8 ^E	F	F
Two	20.5	20.7 ^E	23.4	18.6	27.7	22.6 ^E	19.4 ^E	F	22.7	F	18.9 ^E	16.0 ^E
Three or more	28.9 [*]	39.9 [♢]	24.5 [♢]	32.3	24.9	23.6	45.4	55.7 ^E	49.0	62.9	75.1	64.9

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

All results are standardised to the age distribution of all Canadians 12 years of age and older in 1994

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[‡] Difference between Ontario and Quebec is significant at 0.05 level

[♢] Difference between Nova Scotia and Quebec is significant at 0.05 level

¹ Severity refers to HUI score in 2010

² Total of chronic conditions includes all chronic conditions available from NPHS: Asthma, Arthritis, Back problems, High blood Pressure, Migraines, Bronchitis, Diabetes, Epilepsy, Heart disease, Cancer, Ulcers, Stroke effects, Alzheimers, Cataracts and Glaucoma.

In general, the chronic disease patterns are very similar between NPHS and CCHS across the provinces and severity groups. While much more detail is possible with CCHS, the NPHS data clearly show the familiar pattern in Nova Scotia with much higher arthritis and chronic conditions in general. While the Quebec's shift toward increasing levels of chronic conditions is logical given their age structure, they should also have been at a higher level from the beginning of NPHS. Nevertheless, the consistency with CCHS in 2010 suggests once again that the NPHS is a good proxy for studying the onset of disability over time to aid in understanding the 2010 CCHS disability rates.

BEHAVIOURAL RISK FACTORS

The choices people make in their daily lives regarding their health can have both short and long term costs and benefits as noted in chapter 2 (see pages 37-40). There are four health behaviours from the CCHS data that demonstrate interesting relationships between the three provinces, including: smoking, drinking, fruit and vegetable consumption, and BMI.

SMOKING

The health consequences of smoking have been well established for many years (Marmot and Wilkinson, 2006; Denton and Walters, 1999). One of the strongest relationships in the health behaviour section is found with smoking. Interestingly, while not suspected to be a direct cause of disability, the CCHS data in Figure 13 clearly show that this exposure to smoking increases consistently with the severity of disability. This finding may be due to the higher rates of smoking associated with the older ages typically found in the more severe categories. In terms of provincial differences, Ontario consistently reports significantly lower rates of smoking compared to either Quebec or Nova Scotia. Quebec reports the highest smoking rates for three of the four severity groups but none of the differences are significant.

Figure 13: Smoking Rate by Province and Severity

Source: Canadian Community Health Survey, 2010

The longitudinal data from NPHS for smoking are somewhat incomplete. The smoking questions changed several times during the lifetime of NPHS so the data are not comparable between 1994 and 2010. Therefore, these NPHS results focus on the 1994 smoking rates as an indicator of future health problems. Consistent with the CCHS data, the 1994 NPHS data indicate that Ontario also has much lower rates of smoking in all categories of severity and many of these differences are significant. Once again, Nova Scotia and Quebec are very similar.

The NPHS data also offer information about whether anyone in the household smokes inside the house, exposing all household members to cigarette smoke. This additional indicator of cigarette smoke exposure is not provided by CCHS but paints a very similar portrait of smoking, only with higher rates of smoke exposure across the board. Figure 14 below clearly shows the significantly lower rates of exposure to cigarette smoke inside the house in Ontario compared to Nova Scotia and Quebec. The

most startling statistic is 60.5% of Nova Scotians with a severe disability are exposed to cigarette smoke inside their own home at significantly higher rates compared to 37.6% in Ontario. Quebec (52.8%) is also significantly higher than Ontario but not significantly different from Nova Scotia. The multivariate results provide additional information about the long-term effects of smoking on disability.

Figure 14: Cigarette Smoke inside the House by Province and Severity, 1994

Source: National Population Health Survey, 2010

ALCOHOL CONSUMPTION

Drinking alcohol regularly is a second health behaviour that can have negative health effects if abused although as noted in chapter 2 (see page 40) some protective effects have been detected as well. The CCHS data show some significant differences in terms of alcohol consumption between the provinces and severities. As shown on Table 10, there is a slight gradient where people without a disability are most likely to drink regularly and people with severe disabilities are least likely but only the two extremes

are significantly different. In terms of provinces, Quebec reports significantly higher rates of regular drinking compared to both Ontario and Nova Scotia. The rate of regular drinkers in Quebec hovers around 70% for people with mild, moderate or no disability while Ontario and Nova Scotia are much closer to 60% or less. The difference between Quebec and Ontario is significant for almost every category of severity. Nevertheless, the difference between Quebec and Nova Scotia is only significant for people with no disability or a moderate disability.

Table 10: Behavioural Risk Factors by Province and Severity

Variable	Severity											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Behavioural Risk Factors</i>	%			%			%			%		
Fruit and vegetable consumption												
Less than five servings per day	53.5 ^{*†}	60.3 [‡]	46.3 [‡]	58.9 ^{*†}	69.0 [‡]	53.7 [‡]	61.8 [‡]	68.6 [‡]	50.8 [‡]	63.9	66.8	59.6
Five to ten servings per day	41.9 [‡]	37.8 [‡]	46.7 [‡]	38.1 [*]	28.3 [‡]	41.1 [‡]	35.7 ^{*†}	27.8 [‡]	43.2 [‡]	31.5	26.1	36.0
More than 10 servings per day	4.6 ^{*†}	1.9 ^{E‡}	7.0 [‡]	3.0 ^{E†}	2.7 [‡]	5.2 [‡]	2.5 ^{E†}	F	6.0	4.5 ^E	F	4.4 ^E
Smoking Status												
Current or former smoker	37.3 ^{*†}	44.6	46.8	44.6 ^{*†}	52.8	53.1	40.3 [‡]	49.3	52.8	51.5 ^{*†}	63.4	61.4
Alcohol use - past 12 months												
Regular drinker	60.8 [‡]	56.7 [‡]	71.3 [‡]	60.0 [‡]	63.5	70.2	54.8 [‡]	57.4 [‡]	67.8 [‡]	47.1 [‡]	51.6	58.1
Occasional drinker	14.3	17.9 [‡]	13.7 [‡]	15.9 [*]	22.2 [‡]	13.1 [‡]	19.2 [‡]	22.9 [‡]	14.8 [‡]	23.1	22.5	18.0
Did not drink in past 12 months	24.8 [‡]	25.4 [‡]	15.0 [‡]	24.1 ^{*†}	14.3	16.6	26.0 [‡]	19.7	17.3	29.9 [‡]	26.0	23.9
Body Mass Index Category												
Underweight	3.3 ^{E*}	F [‡]	2.7 ^{E‡}	2.7 ^E	F	2.3 ^E	2.3 ^E	F	4.3 ^E	3.7 ^E	F	F
Normal weight	46.6 [*]	41.5 [‡]	49.8 [‡]	48.3 [*]	39.2	45.8	43.9	42.2	43.8	39.0 [*]	31.8	36.3
Overweight	34.1	35.0	33.6	32.3 [‡]	34.6	36.9	33.7	31.4	35.0	30.0	31.2	37.2
Obese (Class 1, 2 & 3)	16.0 ^{*†}	22.7 [‡]	13.9 [‡]	16.7	22.9	15.0	20.1 [‡]	26.2 [‡]	16.8 [‡]	27.3	28.3	22.9
Frequency of activity- 15 minutes +												
0 - 7 per month	22.4	19.3	22.3	28.3	26.4	28.9	31.1	26.1	32.7	42.6	37.5	43.2
8 - 21 per month	24.8 [‡]	25.1	29.3	25.5	22.6	26.3	24.3	31.1	28.1	23.2 [*]	19.0	22.5
22 - 38 per month	26.3	24.7	25.8	22.4 [‡]	27.1	27.2	24.4	20.6	23.4	18.5	19.3 ^E	19.9
38 or more per month	26.5 [‡]	30.8 [‡]	22.7 [‡]	23.7 [‡]	23.8	17.5	20.2 [‡]	22.3	15.9	15.6	24.2 [‡]	14.4 [‡]
Daily energy expenditure- grouped												
Minimal energy expenditure	22.6	20.2	20.7	27.8	25.9	28.4	30.5	26.7	30.5	40.9	35.1	43.0
Some energy expenditure	23.4 [‡]	22.8	26.3	25.3	21.5	25.6	28.3	25.8	26.6	26.7 ^{*†}	23.3	21.5
Moderate energy expenditure	25.6 [‡]	23.9 [‡]	28.4 [‡]	22.2	26.1	25.6	22.2	27.1	26.2	17.9	24.3	18.1
High energy expenditure	28.4 [‡]	33.0 [‡]	24.6 [‡]	24.7 [‡]	26.5	20.4	18.9	20.3	16.7	14.5	17.4 ^E	17.4

Source: Statistics Canada, Canadian Community Health Survey 2010.

All results are standardised to the age distribution of all Canadians 12 years of age and older

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

[‡] Difference between Ontario and Quebec is significant at 0.05 level

[‡] Difference between Nova Scotia and Quebec is significant at 0.05 level

The questions about alcohol consumption are consistent over time in NPHS and display some interesting results over time, by severity and by province. One of the most notable patterns is the completely opposite relationship between drinking and severity compared to smoking from CCHS and NPHS. Recall that the smoking rates increased with severity while the regular drinker rates decrease with severity. Also contrary to the smoking pattern, Nova Scotia reports lower rates of regular drinkers than either Quebec or Ontario and this difference is often significant. The high rates of regular drinking detected by 2010 CCHS in Quebec are somewhat evident in the NPHS data but not as clearly. The Quebec drinking rates are higher than Ontario for mild, moderate and severe disabilities although only the mild disability category is significantly different.

FRUIT AND VEGETABLE CONSUMPTION

As noted earlier, the CCHS is the only data source for fruit and vegetable consumption. According to the CCHS data, people with disabilities tend to eat more fruits and vegetables than people without disabilities. However, the interesting story is between the provinces. Similar to arthritis, almost every estimate is significantly different from all the other provinces with a few exceptions, mostly for people with severe disabilities as the sample thins out. As shown in Figure 15, Nova Scotia residents eat fewer fruits and vegetables in every category and the difference is often significant. Moreover, Quebec eats the most fruits and vegetables and this difference is often significant as well. Ontario is found almost exactly in the middle between Nova Scotia and Quebec but still significantly different in many cases.

Figure 15: Fruit and Vegetable Consumption by Province and Severity

BODY MASS INDEX

The final behavioural risk factor with noteworthy results is Body Mass Index (BMI). The BMI can be used both as a general barometer of current health and also provide an indication of future trajectories. The CCHS data reveal what are likely the consequences of the poor nutrition in Nova Scotia as seen through low fruit and vegetable consumption in the previous section. Figure 16 clearly demonstrates that Nova Scotia has much higher rates of obesity for all categories of severity except the most severe and these differences are often significant. Quebec's good nutrition is also evident through their consistently low rates of obesity which are also frequently significant. Ontario always has a lower obesity rate than Nova Scotia as well and is often much closer to Quebec, although the difference is only significant for people without disabilities.

Figure 16: Body Mass Index by Province and Severity

Source: Canadian Community Health Survey, 2010

Aging brings many expected effects for the NPHS panel such as increased rates of arthritis or lower rates of excellent health. However, the sharp increase of obesity in the NPHS panel is arguably more of a reflection of the obesity pandemic facing many industrialised countries, rather than an anticipated effect of aging during the follow-up period. The longitudinal data from NPHS shown on Figure 17 suggest that the obesity problem in Nova Scotia has been around for some time and seems to be getting worse. At the same time, with the exception of moderate disabilities, Quebec appears to be maintaining the low obesity rates from 1994 and is consistent with the pattern detected in CCHS.

Figure 17: Obesity Rate by Province and Severity, 1994-2010

Source: National Population Health Survey, 2010

Overall, the behavioural risk factor variables demonstrate remarkable consistency between the two data sources. The significantly lower smoking rates in Ontario are clearly visible, as are the higher drinking rates in Quebec and lower drinking rates in Nova Scotia. Unfortunately there is no indication of fruit and vegetable intake on NPHS but the BMI and obesity relationships are very consistent with CCHS in suggesting that Nova Scotia is notably more obese than Quebec and even Ontario. Overall, the behavioural risk factor variables indicate exceptional consistency between the CCHS and NPHS while also illustrating the patterns in behavioural risk factors.

ACTIVITIES OF DAILY LIVING

According to the 2010 CCHS data, requiring help with daily activities is only common for people with severe disabilities, suggesting that milder disabilities would also be overlooked in CCHS data if this approach was used to detect disability.

Therefore, this exploration of help with activities of daily living focuses on just the severe category of disability.

The most surprising result is Ontario's much higher rate of needing help for many activities compared to Nova Scotia. This result is the opposite of what would be expected given Nova Scotia's older age structure and higher disability rate. In fact, Figure 18 clearly demonstrates that Ontario reports significantly higher rates of needing help for five of the six activities included in the CCHS. The lone exception is help with moving inside the house where Ontario (6.4%) and Nova Scotia (6.5%) are essentially the same and Quebec's rate (3.2%) is significantly lower. The final noteworthy difference involves personal care. Ontario's rate of 10.0% is nearly double the rate for Quebec (5.3%) and still significantly higher than Nova Scotia (7.6%).

Figure 18: Help with Activities of Daily Living with a Severe Disability by Province

Source: Canadian Community Health Survey, 2010

The NPHS sample is too small to study the evolution of needs for help with activities of daily living because almost every estimate is suppressed in 1994. Nevertheless, one of the few estimates available for 1994 and 2010 is an indicator of needing help with at least one of the six ADLs covered by NPHS. The effects of aging on the NPHS panel are clearly visible through significant increases in the rates of needing help. Contrary to the CCHS data that detected the greatest need for help in Ontario, the NPHS panel cites Nova Scotia as having the highest rate of need in both 1994 and 2010, which is expected given their older age structure. In fact, Ontario reports a lower rate of need for help with any activities of daily living in 1994 and 2010 as well as five of the six ADL's in 2010. However, none of the differences are statistically significant. Quebec tends to fall in the middle according to the NPHS data although it recorded the largest percentage point increase in needing help with ADL's between 1994 and 2010, which according to Table 11 brings Quebec almost to the same rate of need as Nova Scotia.

Table 11: Help with Activities of Daily Living by Province and Severity, 1994-2010

Variable	Severity ¹											
	No Disability			Mild Disability			Moderate Disability			Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Activities of Daily Living</i>	%			%			%			%		
Total- Needs help with a daily activity												
1994 rate	F	F	3.2 ^E	F	F	F	5.7 ^E	15.9 ^E	F	15.0 ^E	24.2 ^E	16.7 ^E
2010 rate	12.9	13.6	10.2	12.0 ^E	19.9	10.7 ^E	27.2	31.7 ^E	32.1	57.0	64.9	62.4
Help with everyday activities - 2010												
Preparing meals	F	F	F	F	F	F	F	F	F	12.5 ^E	29.3 ^E	18.1 ^E
Shopping	F	F	F	F	F	F	F	F	F	23.4 ^E	29.4 ^E	33.6 ^E
Regular housework	F	F	F	F	F	F	F	F	7.9 ^E	28.5 ^E	30.4 ^E	40.8 ^E
Heavy chores	12.7 ^E	13.6 ^E	10.1 ^E	11.2 ^E	19.9	10.1 ^E	22.9 ^E	31.7 ^E	30.4	49.0	60.5	54.2
Personal care	F	F	F	F	F	F	F	F	F	14.0 ^E	14.0 ^E	14.7 ^E
Moving inside house	F	F	F	F	F	F	F	F	F	9.9 ^E	8.7 ^E	10.5 ^E

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

All results are standardised to the age distribution of all Canadians 12 years of age and older in 1994

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

† Difference between Ontario and Quebec is significant at 0.05 level

‡ Difference between Nova Scotia and Quebec is significant at 0.05 level

¹ Severity refers to HUI score in 2010

Overall, the bivariate data from the CCHS and NPHS demonstrate a number of unique differences between the provinces in terms of their demographic characteristics, socio-economic status, health indicators, chronic conditions, health behaviours, and help with activities of daily living. Nevertheless, there is one key piece of information that can aid in understanding factors associated with the onset of impairment and disability. The missing piece of information is detail on the different types of disability that are experienced in the different categories of severity. Unfortunately the samples in the NPHS and even the CCHS are much too small to provide this level of detail. To fill this data gap, data from the 2006 Participation and Activity Limitations Survey (PALS) are utilised in order to provide a better understanding of exactly what types of disability are being experienced, how they are distributed across severities, and any differences that exist between the provinces.

PARTICIPATION AND ACTIVITY LIMITATIONS SURVEY

The detailed disability information available from PALS reveals some useful patterns about the composition of the various types of disabilities. The most important point to note is that regardless of the province, by far the most common types of disability are related to mobility, agility and pain as shown in Figure 19. There is a sharp gradient ranging from mild disabilities where slightly less than half of all people have at least one of these disabilities all the way up to very severe disabilities where between 89.1% and 97.1% of people have at least one of these three types of disability. There is also significant overlap between these three disability types to the point that more than five out of six people with very severe disabilities report the trio of mobility, agility and

pain disabilities together, in addition to other types of disability. A final noteworthy result is Quebec's significantly lower rates of pain disabilities. Quebec reports the lowest rate of pain disabilities for every category of disability and these differences are often significant, especially for Ontario, which often reports the highest rates of pain disabilities. In fact, Ontario's rate of pain disabilities is significantly higher than Quebec for three of the four severity categories. Ontario also reports higher rates of pain disabilities than Nova Scotia but the only significant difference is mild disabilities.

Figure 19: Rates of Mobility, Agility and Pain Disabilities by Province and Severity

Source: Participation and Activity Limitations Survey, 2006

As noted in the previous discussion there are steep gradients with increasing severity for most of the disability types but some are considerably steeper than others. The steepest gradients can be found for communication, learning, memory and emotional/psychological disabilities which are extremely rare for people with mild

disabilities and grow to slightly less than half of all people with very severe disabilities. The gradient for developmental disabilities is surprisingly flat, likely owing to the rarity and typically shorter life expectancy of people with this type of disability because it includes conditions such as Down's syndrome. The gradient for hearing disabilities is also noteworthy. For people with mild disabilities, hearing disabilities are the second most common type behind the mobility / agility / pain trio. Most other forms of disability increase dramatically as severity increases while hearing disabilities increase much more gradually between the mild and very severe categories.

There are also interesting provincial relationships for people with hearing disabilities. Nova Scotia consistently reports the highest rates of hearing disability for each category of severity and many of these differences are significant. Most notably, there is a large significant spike in the hearing disability rate for people in Nova Scotia with very severe disabilities (53.9%) compared to Ontario (37.8%) and Quebec (34.6%). A second interesting similarity between the PALS and CCHS data is the low rates of cognitive disabilities in Quebec. According to the PALS data on Table 12, the rate of cognitive disabilities in Quebec was significantly lower than Nova Scotia for people with very severe disabilities (35.7% vs. 47.8%) and significantly lower than Ontario for people with moderate disabilities (12.8% vs. 17.6%).

Table 12: Type of Disability for Province and Severity, 2006

Variable	Severity											
	Mild Disability			Moderate Disability			Severe Disability			Very Severe Disability		
	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec	Ontario	N.S.	Quebec
<i>Disability Type</i>	%			%			%			%		
Hearing Disability	21.2	21.8	20.6	30.9	32.0 [♢]	24.8 [♢]	29.2	32.1	26.8	37.8 [*]	53.9 [♢]	34.6 [♢]
Seeing Disability	4.7	5.8	6.8	19.5	16.6	17.8	27.7 ^{†*}	21.5	21.1	44.1	42.4	38.3
Communication Disability	1.0 ^{E†}	1.4 ^E	2.7 ^E	7.1 ^{E*}	3.8 ^{E♢}	6.9 [♢]	17.5	19.5	17.2	41.7	42.9	38.2
Mobility Disability	45.3	42.5	45.3	69.8	72.5	70.7	88.5	89.2	87.7	95.8	95.6	96.0
Agility Disability	40.8	38.3	39.1	69.9	68.8	70.7	85.5	88.5	85.7	95.7	97.1	95.6
Pain Disability	50.9 ^{†*}	44.1 [♢]	34.5 [♢]	79.0 [†]	79.1 [♢]	70.2 [♢]	85.9	85.3	83.4	93.8 [†]	90.3	89.1
Learning Disability	5.9	6.0	7.2	12.1	13.7	11.3	23.0	20.3	21.7	37.5	43.2	49.4
Memory / Cognitive Disability	F	F	F	7.1 ^E	5.0 ^E	3.7 ^E	17.6 [†]	17.3	12.8	44.4	47.8 [♢]	35.7 [♢]
Developmental Disability	F [*]	1.8	1.0	2.7	2.3	3.2	4.7	5.2	7.9	10.7	12.0	13.2
Emotional / Psychological Disability	2.6 ^E	2.9 ^E	2.6 ^E	11.7	11.0	11.5	21.1	22.2	17.6	44.5	41.7	41.7

Source: Statistics Canada, Participation and Activity Limitations Survey, 2006.

All results are standardised to the age distribution of all Canadians 15 years of age and older

^E Use with caution

F Too unreliable to be published

* Difference between Ontario and Nova Scotia is significant at 0.05 level

† Difference between Ontario and Quebec is significant at 0.05 level

♢ Difference between Nova Scotia and Quebec is significant at 0.05 level

In summary, the key point to note from the PALS data is the dominance of the mobility / agility / pain trio for all categories of severity. The flat gradient of hearing disabilities as severity increases is also relevant, as are the higher rates of hearing and cognitive disabilities in Nova Scotia while the rates of cognitive disabilities in Quebec are lower. Finally, the relative rarity of communication, learning, memory, developmental and emotional/psychological disabilities in the milder severity groups should be noted because these types will only become common in the more severe categories of the CCHS and NPHS data.

SUMMARY OF BIVARIATE RESULTS

The bivariate results presented thus far are intended to establish a solid foundation for exploring the multivariate results presented in the next section. A number of significant differences between the provinces are noted and expected to be evident in the multivariate results. The most critical demographic results to recall

include the older age structures of Nova Scotia and Quebec, higher rates of people living in rural parts of Nova Scotia, and lower rates of employment and income in Quebec. Within the social determinants of health model these demographic characteristics mesh with results from more obvious measures of health such as lower rates of excellent health and less stress in Nova Scotia, high rates of arthritis and other chronic conditions in Nova Scotia. There are also notable differences in the behavioural risk factors as seen by the low rates of smoking in Ontario, high rates of drinking in Quebec, low rates of fruit and vegetable consumption and high rates of obesity in Nova Scotia. Finally, the higher rates in Ontario for needing help with activities of daily living are also considered during the multivariate results.

In general, the higher disability rates in Nova Scotia seem logical given that the data for Nova Scotia point to poorer overall health in Nova Scotia compared to Ontario and Quebec. The overall results for Quebec are less logical given their long history of very low disability rates. Quebec presents a fairly similar portrait of health compared to Ontario and while there are differences, they tend to balance out. Many of these differences are significant and there are many other relationships that approach significance. Knowing which characteristics have the strongest effects requires more sophisticated methods than the bivariate results can provide. Therefore, the actual effects of these characteristics and relationships over time are examined in the next chapter using multivariate techniques applied to the longitudinal data from NPHS.

CHAPTER 5: MULTIVARIATE FACTORS AND THE ONSET OF DISABILITY

This multivariate chapter presents the results of the survival analysis models developed using the NPHS longitudinal data. The bivariate results of chapter 4 are useful to gain a general understanding of the relationships between the various factors potentially related to impairment and disability. However, only multivariate models can control for the effects of other factors during the analysis to ensure the results are not spurious. Therefore, the purpose of this chapter is to present the results of the multivariate models to determine the strength and influence of each factor on the onset of impairment and disability.

The survival analysis models are used to calculate hazard ratios for each of the factors related to the development of disability during the 16 year follow-up period of the data. A number of models are constructed that follow the social determinants of health as a guide. Models for each province are developed for each dimension of social determinants included in this research. A final model for each province is then developed based on all of the social determinants of health that are significant in the first group of models. The results from all of the models are presented to set the stage for the discussion in chapter 6.

As noted in chapter 3, there are a number of different possible transitions that can be modelled as people move between the four different severities of disability during the NPHS follow-up period. Due to limitations in the number of transitions available for analysis, this research focuses on all transitions into the severe disability

category (HUI less than 0.70), regardless of whether they began NPHS without a disability or a mild or moderate disability.

Initial Discrete Proportional Hazard Models

The initial discrete PH model development follows the same social determinants of health dimensions used in the bivariate results. This approach is continued to facilitate comparisons and understanding as well as provide an indication of the relative strength of each characteristic and dimension of the social determinants of health. Initial discrete PH models are developed by province for each of the following groups: demographics, income, socio-economic status, general health, chronic conditions, health behaviours, and activities of daily living. Interaction terms are also created to explore possible interaction effects (see the variable selection discussion in chapter 3 for more details). Basic diagnostics are conducted for each initial PH model. Significant factors from each initial discrete PH model are included in the final model development process. The final discrete PH models for the onset of disability are then presented by province followed by a discussion of their diagnostics.

DEMOGRAPHIC CHARACTERISTICS

The demographic variables included in the initial models for each province include age, gender, marital status, population size (rural or urban), English or French speaker, living alone, immigrant status and the following indicators of race: Aboriginal status, Black, Caucasian, Chinese, and South east Asian. As shown below in Table 13, the provinces present starkly different predictors of severe disability based on

demographic characteristics. Marital status is the most consistent predictor for the onset of disability because it is the only demographic variable that is significant for all three provinces. Not surprisingly, the hazard of experiencing a severe disability is lowest for single people, which tend to be younger. Single people in Nova Scotia have the lowest risk for the onset of a severe disability (-116.3%) compared to people that are married or common-law. Significantly lower risks for singles are also found in Ontario (-27.4%) and Quebec (-29.1%) but the protective effects are much weaker than Nova Scotia. The greatest hazard for marital status is also found in Nova Scotia for people that are divorced, separated or widowed. This group's risk is 136.2% higher than people that are married or common-law. People that are divorced, separated or widowed also have elevated risks in Ontario (+30.6%) and Quebec (+49.9%) compared to the reference group but the strength of these risks is much less than Nova Scotia. The healthy immigrant effect also seems to have longitudinal implications through decreased hazard ratios for immigrants and the effect is especially strong in Quebec where the risk reduction (-133.2%) is roughly a third larger than Ontario (-97.9%).

Some factors are only significant in one province, such as gender in Ontario and population size in Quebec. In Ontario, being male reduced the hazard of experiencing a severe disability by 55.8%, which is also consistent with the bivariate results shown earlier where women significantly outnumbered men in the severe category. Finally, an interesting result from Quebec is the effect of living in urban areas of different population sizes. Unfortunately the NPHS sample could not support publishing the bivariate results of the five categories of population size by severity. Nevertheless, this

variable is used in the multivariate analysis and shows that people living in urban areas of less than 30,000 people experienced a 70.4% greater risk of for the onset of a severe disability compared to the reference group of urban areas with 500,000 people or more. In fact, this population size is the only one to have greater hazards than the reference group. According to the NPHS data, the lowest risk population size is 100,000 to 499,999 people (-22.5%), followed by rural areas (-8.4%) and finally areas with 30,000 to 99,999 people (-4.5%; See Table 13).

As a group, the demographic variables present a number of different dimensions that may be impacting the future experience of a severe disability. From the social determinants of health perspective, this is the only group where nearly all characteristics are beyond an individual's control in the way that smoking status or even education and occupation can be changed over time. While immigrant status stands out as having the strongest effects through the largest hazard ratios, the risks from gender, marital status and even population size are noteworthy.

Table 13: Adjusted Proportional Hazard Ratios for Initial Demographic Model

Variable	Province		
	Ontario	N.S.	Quebec
<i>Demographic Characteristics</i>			
		PH Ratio	
Age	...	-0.0433 ***	0.0158 ***
Gender			
Male	-0.5578 ***	...	...
Female [§]	0.0000	...	...
Marital Status			
Married or common-law [§]	0.0000	0.0000	0.0000
Divorced, separated, widow	0.3059 ***	1.3618 ***	0.4990 ***
Single	-0.2735 **	-1.1629 ***	-0.2912 *
Population Size			
Rural	...	...	-0.0843
Less than 30,000 people	...	...	0.7036 ***
30,000 to 99,999 people	...	...	-0.0453
100,000 to 499,999 people	...	...	-0.2247
500,000 people or more [§]	...	...	0.0000
Immigrant Status			
Immigrant	-0.9794 ***	...	-1.3319 ***
Race			
Aboriginal	...	...	...
Black	...	...	...
Caucasian	...	...	...
Chinese	...	...	...
South East Asian	...	...	...

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05

** p < 0.01

*** p < 0.001

... Not a significant factor

[§] Reference category

SOCIO-ECONOMIC STATUS

The bivariate analysis uncovered some interesting relationships for the socio-economic status (SES) variables. For the initial model building, the SES group of variables include the highest level of education as categorical and dummy variables (separately), income adequacy expressed as deciles, occupational prestige score, labour force status, a separate dummy variable for unemployment is tested when labour force status is not significant, and dummy variables to indicate three of the most dangerous industry groups: forestry, construction and mining. As shown on Table 14, the provincial profiles are quite similar and point to powerful effects from income adequacy. The hazard of acquiring a severe disability decreases by over thirty percent for each standard unit increase in the decile of income adequacy. The strongest effects from

increases in income adequacy are found in Nova Scotia (-34.9%) and Quebec (-34.1%) although Ontario is not far behind (-31.2%).

The highest level of education also demonstrates increased hazards for severe disability with lower levels of education; however, this variable is not significant in Nova Scotia. Interestingly, the increase in hazards for having less than a high school education is essentially identical in Quebec (+20.1%) and Ontario (+20.0%) compared to the reference category (complete post-secondary). In fact, these results suggest that those who did not complete high school actually have less risk than people who completed high school in Quebec (+38.4%) and Ontario (+32.9%). The most surprising result from the education perspective is the lowest risk of developing severe disability belongs to people who attended but did not complete a post-secondary education and this result is consistent in both Ontario (-12.4%) and Quebec (-9.9%).

Occupation status is a challenging variable throughout this research and the multivariate results are at least consistent. Occupation is tested during the initial model building exercise as a continuous variable and with the quartile groups. The only variable that is significant is the quartile grouping. This variable is significant for all three provinces. Surprisingly, the lowest categories of occupational prestige also have the lowest hazards for experiencing severe disability compared to the reference category, which is the highest category of occupational prestige. This result is evident in all three provinces but strongest in Nova Scotia (-77.8%) followed by Ontario (-69.6) and then Quebec (-61.8%). The second quartile of occupational prestige also includes a lower risk than the reference category but the effect is not as strong. Quebec has the

lowest risk in this category (-30.0%) followed by Nova Scotia (-11.0%) and Ontario (-5.6%). The lone occupation group that experiences greater risk than the reference group is the third quartile but this result is inconsistent. The greatest hazard for severe disability belongs to the third quartile of occupational prestige in Quebec (+58.4%) while Ontario (+17.6%) is still higher than any other occupation quartile in that province. The lone exception is Nova Scotia (-32.9%), which is actually lower than the second quartile in that province. This variable is considered further in the discussion chapter.

As a group, the socio-economic status variables also appear to be strong predictors of future disability. While none of the hazard ratios are particularly large, the number of significant variables suggests there are several dimensions to socio-economic status that may be influencing the onset of severe disabilities.

Table 14: Adjusted Proportional Hazard Ratios for Initial Socio-economic Model

Variable	Province		
	Ontario	N.S.	Quebec
Socio-economic Characteristics		PH Ratio	
Highest Level of Education			
Less than high school	0.1995	...	0.2013
High school	0.3289 **	...	0.3842 **
Some post-secondary	-0.1240	...	-0.0991
Complete post-secondary [§]	0.0000	...	0.0000
Income adequacy			
Decile of income adequacy	-0.3121 ***	-0.3486 ***	-0.3411 ***
Occupational Prestige			
First quartile	-0.6958 ***	-0.7776 ***	-0.6176
Second quartile	-0.0562	-0.1100	-0.3004
Third quartile	0.1763	-0.3286	0.5836
Fourth quartile [§]	0.0000	0.0000	0.0000
Labour Force Status			
Employed [§]	...	...	...
Unemployed	...	...	...
Not in Labour Force	...	...	...
Unemployed dummy variable	...	...	...
Industry Group			
Forestry	...	...	...
Mining	...	...	...
Construction	...	...	...

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05

** p < 0.01

*** p < 0.001

... Not a significant factor

[§] Reference category

HEALTH INDICATORS

The bivariate results presented in the previous chapter imply that the health states of the three provinces are quite different, suggesting the multivariate results would also be quite different. Based on the initial results, Nova Scotians appear to be in poorer health than Quebecers and Ontarians often find themselves somewhere in the middle. Despite the bivariate evidence, the multivariate analyses find remarkably similar hazards for the physical and mental health indicator variables. In fact, none of the mental health indicator variables are significant in any of the provinces. Only the 1994 indicators for HUI and self-rated health are significant predictors of the onset of a severe disability. Overall, given the size of the hazard ratios, the health indicators group of variables appears to be strong predictors of severe disability.

Table 15 clearly illustrates that the HUI indicator for 1994 has a very strong effect on the hazard ratios, resulting in decreases of over two hundred percent in the risk of acquiring a significant disability for each standard unit increase in the initial HUI score. Nova Scotia experienced the strongest reductions in their risk (-217.5%) although sizeable reductions are also evident in Ontario (-203.7%) and Quebec (-201.0%).

Self-rated health in 1994 is also a significant predictor of experiencing severe disability during the follow-up period but the effects are not nearly as strong as those for HUI. The overall pattern of the self-rated health variable is logical; however, there are a couple of intriguing results. As expected, the greatest hazard for severe disability typically belongs to people who reported they are in poor health in 1994 but this is not always the case. Nova Scotia and Quebec report similar and expected hazard ratios while Ontario is quite unique. Specifically, Quebecers who reported poor health in 1994 have hazards 52.6% higher than those in excellent health and this relationship is also consistent in Nova Scotia where poor health in 1994 represents a 47.3% greater risk of severe disability. Ontario is the lone exception where people in poor health in 1994 still have a 14.9% greater risk of severe disability than those in excellent health. However, the greatest risk for severe disability in Ontario belongs to those who reported good health in 1994 (20.9%). This result is a combination of unusually high risk for Ontarians reporting good health compared to Quebec (3.7%) and Nova Scotia (7.7%) as well as very low risk for Ontarians reporting poor health (14.9%).

The second intriguing result for the hazard ratios of self-reported health is the lowest risk belongs to those who reported very good as opposed to excellent health in 1994.

This finding is consistent in all three provinces. The greatest difference is found in Quebec where people who reported their health as very good in 1994 have 32.6% less risk than people who reported excellent health. The same result is found in Ontario (-7.8%) and Nova Scotia (-6.2%) but these findings are much weaker than Quebec (See Table 15).

Table 15: Adjusted Proportional Hazard Ratios for Initial Health Indicators Model

Variable	Province		
	Ontario	N.S.	Quebec
<i>Health Indicators</i>	PH Ratio		
Health Utilities Index (HUI)			
HUI score	-2.0367 ***	-2.1751 ***	-2.0097 ***
Self-rated general health 1994			
Excellent [§]	0.0000	0.0000	0.0000
Very Good	-0.0779	-0.0617	-0.3260
Good	0.2090	0.0774	0.0374
Fair	0.1646	0.3243	0.4331
Poor	0.1491	0.4730	0.5261
Mental Distress			
Mental distress score	...	...	...
Depression			
Depression score	...	...	...
Personal Stress Index			
Personal stress score	...	...	...

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05
 ** p < 0.01
 *** p < 0.001
 ... Not a significant factor
 § Reference category

CHRONIC CONDITIONS

There are some unexpected results from the initial model for the chronic conditions group. Based on the bivariate results and the significantly higher rates of many chronic conditions in Nova Scotia, it is expected that chronic conditions would be associated with onset of disability. In fact, the opposite appears to be true for the initial chronic conditions model, however, the considerable number of people with multiple chronic conditions appear to cause significant diagnostic problems. Therefore, all chronic conditions are entered separately during the final model building to ensure that

none are missed due to poor diagnostics in the initial model. The initial chronic conditions model is not presented in this research due to the illogical nature of the results and significant diagnostic problems. The final results of the chronic condition variables can be found in the explanation of the results from the final models.

BEHAVIOURAL RISK FACTORS

The behavioural risk factor group of variables appear to be among the strongest groups of predictors from the social determinants of health perspective. There are several significant predictors of severe disability for each province and often with large hazard ratios. The bivariate results pointed to mixed results in the provinces but suggest that Nova Scotians tend to have poorer health behaviours through higher smoking and obesity rates. Once again the multivariate results tell very different stories in each of the provinces. There are five different health behaviours that are significant predictors of disability yet only two are significant in all three provinces. Beginning with the predictors common to all three provinces reveals that physical activity is indeed a significant predictor of future severe disability. The physical activity index provides clear evidence that being active significantly reduces the risks of severe disability in all three provinces. As shown on Table 16, the protective effects of physical activity are strongest in Nova Scotia (-181.6%) and Quebec (-163.5%) although Ontario (-113.8%) still enjoys significant reductions in risk through physical activity. Further, even moderate activity demonstrated protective effects in all three provinces. Nova Scotia also benefits most from moderate activity (-21.2%) followed closely by Quebec (-15.0%) and then Ontario (-6.4%). While these results suggest clear support for physical activity, the physical

activity index is a somewhat limited measure because it focuses on activity done for exercise. A more precise measure is the units of energy expenditure burned through activity each day because some people have very active jobs. This more precise variable reveals the exact same relationship between the provinces, with Nova Scotia experiencing the greatest reduction in severe disability risk through physical activity (-95.7%). Quebec also experiences strong reductions in risk (-79.9%) with increasing levels of energy expenditure while Ontario's reduction (-51.6%) is only slightly more than half that of Nova Scotia.

The impact of smoking status continues to be somewhat baffling in the multivariate results because the effects are not particularly large or even significant for Ontario. Generally speaking, smokers have a higher risk of severe disability; however, there are a few odd exceptions. For example, in Nova Scotia the highest risk of severe disability belongs to former smokers (+27.1%), which is slightly higher than people who were current smokers in 1994 (+24.6%). Occasional smokers in Nova Scotia present an odd result because their hazard ratio (-9.6%) is actually less than people who have never smoked. Quebec's results for smoking are quite similar to Nova Scotia. Current smokers in 1994 also have an increased risk of severe disability (+11.2%) but this ratio is notably smaller than that of occasional smokers (+34.8%). Similar to Nova Scotia, there is also one group in Quebec with a hazard ratio that is actually less than people who never smoked. Former smokers in Quebec report the lowest hazard ratio (-12.0%). However, the pattern is completely opposite because occasional smokers in Nova Scotia had the lowest hazard ratio while it is former smokers in Quebec. The significant

mortality rate associated with smoking likely plays a role in the inconsistent results, this possibility is considered further in the discussion of chapter 6.

Alcohol consumption is only a significant predictor for Ontario and Quebec. The results line up directly with previous research suggesting that moderate alcohol consumption can have positive health effects. Regular drinkers benefit from the lowest hazard ratios in both Quebec (-33.8%) and Ontario (-26.1%). Occasional drinkers in Ontario still benefit from some protective effects (-14.3%) while their counterparts in Quebec experience slightly higher risk (+2.1%) for severe disability. Former drinkers actually experience greater risk than people who have never drank. This relationship is much stronger in Quebec (+17.8%) but also somewhat evident in Ontario (+1.1%).

The final category of health behaviours examined in this research is Body Mass Index (BMI) but this characteristic is only significant in Ontario. As expected, Ontarians with a normal weight have the lowest hazard ratio (-66.1%) and people who are overweight have the next lowest hazard ratio (-28.6%). However, the overweight group is followed closely by people whose BMI is obese class one (-28.4%), indicating this group has an even lower risk for severe disability than the reference group, which is underweight. The remaining categories line up as expected with obese class two (+45.7%) experiencing a much higher hazard ratio and obese class 3 experiencing by far the greatest risk (+133.5%).

Table 16: Adjusted Proportional Hazard Ratios for Initial Behavioural Risk Model

Variable	Province		
	Ontario	N.S.	Quebec
Health Behaviours		PH Ratio	
Smoking Status			
Daily smoker	...	0.2460	0.1123
Occasional smoker	...	-0.0960	0.3481 *
Former smoker	...	0.2713	-0.1195
Never smoked [§]	...	0.0000	0.0000
Alcohol Consumption			
Regular drinker	-0.2611 **	...	-0.3383 ***
Occasional drinker	-0.1433	...	0.0205
Former drinker	0.0114	...	0.1783
Never drank [§]	0.0000	...	0.0000
Body Mass Index			
Underweight [§]	0.0000	...	...
Normal weight	-0.6608 ***	...	...
Overweight	-0.2856 *	...	...
Obese Class 1	-0.2840	...	...
Obese Class 2	0.4571 *	...	...
Obese Class 3	1.3345 ***	...	...
Physical Activity Index			
Active	-1.1384 ***	-1.8162 ***	-1.6354 ***
Moderate	-0.0638	-0.2121	-0.1496
Inactive [§]	0.0000	0.0000	0.0000
Energy Expenditure			
Units of energy expenditure	-0.5164 ***	-0.9565 ***	-0.7987 ***

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05

** p < 0.01

*** p < 0.001

... Not a significant factor

[§] Reference category

ACTIVITIES OF DAILY LIVING

The bivariate results indicate a definite rarity in the need for help with activities of daily living in 1994. Needing help with heavy household chores is by far the most common requirement and this need is most prevalent in Ontario. The multivariate analyses also found significant effects for some of the activities of daily living variables although some of the results are unexpected. The initial activities of daily living model is somewhat similar to the chronic conditions model in that the diagnostics are poor but not to the same extreme. Once again the diagnostics suggest that the results are influenced by poor model specification combined with very small counts for cases that need help with daily activities.

One of the strongest results noted thus far in the multivariate results section belongs to the need for help moving inside the house. According to Table 17, this variable appears to be an exceptionally strong predictor for the onset of a severe disability through the large increases in hazard ratios detected in both Ontario (464.8%) and Quebec (448.6%). Needing help with heavy household chores is also a significant predictor for severe disability, however, this characteristic is only significant in Ontario and seems to display protective effects through a decline in risk (-60.2%). This result is explored further in the discussion in chapter 6 of this research. Finally, the activity limitation questions are also significant in the initial ADL model but the direction of the relationship is also not as expected. Unexpected and significant reductions are evident in the hazard ratios for this variable in Quebec (-76.3%), Nova Scotia (-71.4%) and Ontario (-58.1). To ensure no significant variables are missed due to poor diagnostics from the initial models, all of the ADL variables are also entered separately in the final model building process due to poor diagnostics.

Table 17: Adjusted Proportional Hazard Ratios for Initial ADL Model

Variable	Province		
	Ontario	N.S.	Quebec
<i>Activities of Daily Living</i>	PH Ratio		
Help with Activities			
Preparing meals	...	...	...
Shopping	...	...	...
Regular housework	...	...	...
Heavy chores	-0.6019 *	...	...
Personal care	...	...	...
Moving inside house	4.6484 ***	...	4.4865 ***
Activity Limitation			
Activities are limited	-0.5810 ***	-0.7141 ***	-0.7637 ***

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05

** p < 0.01

*** p < 0.001

... Not a significant factor

FINAL MODELS

The initial models suggest that there are very different hazards for severe disability in each of the three provinces. Some predictors are universal in all three provinces such as marital status, income adequacy, self-rated health and physical activity. Nevertheless, there are a number of variables that are expected to play a major role from previous literature but are only significant in one province, for example Body Mass Index in Ontario. The final models pull all of the information gleaned from the bivariate results and initial multivariate results into separate models for each province. These final models provide the best indication of how the social determinants of health interact and which of these factors have the greatest impact on the risks for the onset of a severe disability.

The final discrete PH models for each province are built from the significant variables in the initial round of model building. Recall that the initial round is grouped by the various dimensions of the social determinants of health. Some of these

dimensions did not produce models with reasonable diagnostics (chronic conditions and activities of daily living) so all variables from these dimensions are entered separately in the final model building process. A series of interaction terms are also tested individually in the final models yet not a single one is significant. See the variable description in chapter 3 (page 65) for more details about the interaction terms included in this research. The final models are once again presented by the groups of social determinants to facilitate comparisons across the provinces and assess the relative contribution of each determinant. The complete models for each province are presented at the end of this section on Table 18 on page 147.

Demographic characteristics display several significant effects on the hazards associated with the onset of severe disability. These characteristics are generally fixed at the individual level (age, gender etc.) but their impact is important nonetheless. Age has proven to be one of the few universal predictors of disability regardless of which data or analytical techniques are used. In fact, age is one of only two factors in the final models that is a significant predictor of severe disability in all three provinces. The strongest effects for age are observed in Quebec, where each standard unit increase in age results in a 3.4% increase in the hazard ratios. The effect of age in Quebec is nearly double that of Ontario (1.8%) and still considerably higher than Nova Scotia (2.4%).

There is limited evidence of any gender effects in this research. Confirming the bivariate results noted previously, Ontario is the only province where gender is a significant predictor of severe disability. Specifically, men have a 48.6% lower hazard

ratio than women for the onset of severe disability. The final significant demographic variable is the population size and it is only significant for Quebec. The overall characteristics of population size are similar to the initial model but the size of the hazard ratios change somewhat in the final model. Consistent with the initial model, the lowest odds ratio belongs to people living in regions with a population between 100,000 and 499,999 (-20.9%). Rural areas are not far behind with the second lowest hazard ratio (-15.0%), still more than double the risk reduction of areas with 30,000 to 99,999. The only population size to have a greater risk than the reference category (500,000 or more people) is urban areas with less than 30,000 people (+39.9%).

Socio-economic status is receiving growing attention from current health research exploring different pathways to poor health (Nobles, Weintraub, and Adler, 2013; Braveman, Egerter, Williams, 2010; van Kippersluis, O'Donnell, van Doorslaer et al, 2010; Marmot and Wilkinson, 2006; Cockerham, 2004; Berkman and Kawachi, 2000; Kristenson et al, 1998; Power and Hertzman, 1997; Bobak and Marmot, 1996). This research notes a number of different socio-economic status indicators including education, income adequacy, occupational prestige, labour force status and industry group. Surprisingly, only one of these factors provides evidence of significant impacts on the long-term risk for severe disability and only for Quebec. The lack of significant SES indicators is explored further in the discussion chapter as well as the limitations section of chapter 7.

The results of the final model line-up more intuitively than the initial models, where the highest level of education results in the lowest risk for severe disability. Quebecers who completed a high school diploma but did not pursue further studies have the highest hazard ratio (+19.7%). Somewhat perplexing is the fact that people with some post secondary education have the next greatest risk (+11.6%) although this risk is not appreciably different from people with less than a high school diploma (+8.6%).

The initial round of model building reveals minimal effects for the non-physical health indicators including personal distress, depression and perceived stress but solid support for the Health Utility Index (HUI) and Self-Rated Health. The final model continues to show strong effects associated with the 1994 HUI score but not Self-Rated Health. In fact, the HUI hazard ratio is the only other factor aside from age that is significant in all provinces and presents the second largest hazard ratios.

The greatest reduction in the risk of acquiring a severe disability associated with increases in HUI scores are found in Nova Scotia (-3.7%) and Quebec (-3.7%). Given the large hazard ratios in Quebec and Nova Scotia, the notably lower risk reduction in Ontario (-2.8%) is somewhat surprising because the risk reduction is approximately 25% smaller than that of Nova Scotia or Quebec.

The final models for the provinces finally reveal some logical effects for the chronic condition factors, principally in Ontario. Interestingly, not a single chronic condition is a significant predictor of severe disability in Quebec. The significant effects

associated with arthritis in the bivariate results continue to be factors in the final models for Ontario and Nova Scotia. In the final model for Ontario, arthritis is a strong predictor of severe disability with slightly stronger effects in Ontario (+63.3%) compared to Nova Scotia (+57.9%). Arthritis is the lone chronic condition in the final model for Nova Scotia.

Back problems and high blood pressure are also in the final model for Ontario. In the final model for Ontario, back problems (+51.4%) have a larger hazard ratio than high blood pressure (+38.5%) but the risk is still less than arthritis (+63.3%). Overall, the effects of the chronic conditions are larger than the average for factors in the final models (+0.2%) yet they are still much smaller than the strongest factors such as HUI.

Behavioural risk factors are some of the few factors where individuals are actually able to directly influence their risk for the onset of severe disability through choices such as whether to smoke or exercise. Curiously, none of the indicators of exercise behaviour are significant predictors in the final models for any of the provinces. In the initial behavioural risk factor models, smoking is a significant factor for Nova Scotia and Quebec. In the final models, only Quebec retains smoking as a significant predictor although the strength of the risks for daily smokers increases from 11.2% in the initial model to 37.3% in the final model. The risk for occasional smokers offers weak protective effects (-4.4%) while former smokers also have a negative relationship which grows to -21.0%.

Alcohol consumption displays some mild protective effects in the initial models for Ontario and Quebec and these effects continue in the final models but only for Ontario. The strongest protective effects are noted for former drinkers although their hazard ratio is not particularly strong (-20.6%). Occasional drinkers also benefit from weak protective effects (-16.8%) while regular drinkers (-2.2%) are almost identical to people who have never drank.

Body Mass Index is the final behavioural risk factor that remains in the final models. Recall that BMI is only significant in the initial model for Ontario; however, due to poor diagnostics in the initial model all health behaviour factors are entered separately during the final model development. As a result of this approach, BMI becomes a significant factor for both Ontario and Quebec in the final models. The normal weight category benefits from the strongest protective effects of all the BMI categories. These protective effects are strongest in Quebec (-32.6%) and Ontario is not particularly different (-26.8%). The overweight category in Quebec also demonstrates some very weak protective effects (-2.2%) while the risks are somewhat higher in Ontario (+9.4%). The obese class one category in Ontario also demonstrates protective effects (-24.6%) while Quebec displays the greater risks expected with obesity (+8.1%). The hazard ratios become even stronger for the obese class two category in Quebec (+80.4%) although the growth in risk is considerably less in Ontario (+10.2%). The obese class three category in Ontario has the strongest effects of all the BMI categories (+115.6%) while Quebec demonstrates a weak protective effect (-4.4%), which is debated in the discussion of chapter 6.

The activities of daily living dimension is the last group with significant factors in the final models. While the initial models had serious diagnostic problems, the variables that remained significant in the final model are almost identical. The strength of the relationships remains relatively consistent as well. There are three different significant factors in the activities of daily living group including help with heavy chores, help moving inside the house, and reporting an activity limitation.

Requiring help with heavy household chores displays moderate protective effects in both the initial (-60.2%) and final models (-54.8%) but only for Ontario. The reasons for these protective effects are speculated in the discussion of chapter 6. Requiring help to move around inside the house is also a significant factor in the initial and final models for both Ontario and Quebec although the magnitude changes in opposite directions depending on the province. The hazard ratio for Ontario decreases from 464.8% in the initial model to 388.6% in the final model. At the same time, the hazard ratio in Quebec increases from 448.7% in the initial model to 566.2%. These effects are the strongest of all the factors in the final models and roughly a third larger than the next largest hazard ratios in each province (HUI). The implications for such a strong predictive factor related to disability are discussed in the next chapter.

The last significant factor in the final models is reporting an activity limitation during the initial NPHS interview in 1994. Mild activity limitations are not always sufficient to result in HUI scores that would be categorised as severe in this research. While activity limitations can involve difficulty seeing or hearing, they may not be

serious enough to be detected by HUI. However, activity limitations are serious enough to be significant predictors of increased risk for the onset of a severe disability. The hazard ratios for reporting an activity limitation are virtually identical for Ontario (+20.8%) and Nova Scotia (+20.0%; See Table 18).

Table 18: Adjusted Proportional Hazard Ratios for Final Models

Variable	Province		
	Ontario	N.S.	Quebec
	PH Ratio		
Age	0.0175 ***	0.0241 ***	0.0338 ***
Gender			
Male	-0.4861 ***	...	...
Female [§]	0.0000	...	...
Population Size			
Rural	...	...	-0.1504
Less than 30,000 people	...	...	0.3989 ***
30,000 to 99,999 people	...	...	-0.0708
100,000 to 499,999 people	...	...	-0.2088
500,000 people or more [§]	...	...	0.0000
Highest Level of Education			
Less than high school	...	...	0.0858
High school	...	...	0.1966
Some post-secondary	...	...	0.1157
Complete post-secondary [§]	...	...	0.0000
Health Utilities Index (HUI)			
HUI score	-2.7881 ***	-3.7366 ***	-3.7012 ***
Chronic Conditions			
Arthritis	0.6331 ***	0.5785 *	...
Back problems	0.5137 **	...	...
High blood pressure	0.3847 *	...	...
Smoking Status			
Daily smoker	...	...	0.3730 **
Occasional smoker	...	...	-0.0442
Former smoker	...	...	-0.2100
Never smoked [§]	...	...	0.0000
Alcohol Consumption			
Regular drinker	-0.0222	...	...
Occasional drinker	-0.1678	...	...
Former drinker	-0.2059	...	...
Never drank [§]	0.0000	...	...
Body Mass Index			
Underweight [§]	0.0000	...	0.0000
Normal weight	-0.2683	...	-0.3256
Overweight	0.0942	...	-0.0219
Obese Class 1	-0.2457	...	0.0812
Obese Class 2	0.1017	...	0.8042
Obese Class 3	1.1556 *	...	-0.0444
Help with Activities			
Preparing meals	...	...	...
Shopping	...	...	...
Regular housework	...	...	...
Heavy chores	-0.5480 *	...	...
Personal care	...	...	...
Moving inside house	3.8857 ***	...	5.6616 **
Activity Limitation			
Activities are limited	0.2076 **	0.2004 *	...

Source: Statistics Canada, National Population Health Survey 2010, Cycles 1-9.

* p < 0.05

** p < 0.01

*** p < 0.001

... Not a significant factor

[§] Reference category

MODEL DIAGNOSTICS

One of the most crucial steps for any model building exercise is verifying the diagnostic characteristics to ensure that the model is valid. This research uses a number of approaches to confirm that the models are accurate including the Hosmer and Lemeshow goodness of fit test, tests for multicollinearity, the Receiver Operating Characteristic curve (ROC curve), and the detection and analysis of outliers using two different techniques. The techniques include the one step difference in chi-square and Pearson residuals. The diagnostics are presented separately for each province.

The Hosmer and Lemeshow goodness of fit test uses predicted probabilities to sub-divide the cases into ten groups or deciles. A chi-square test between the observed and expected values for each group is calculated to test the null hypothesis that there is no difference between the observed and expected values. If the chi-square test is significant the null hypothesis can be rejected, meaning the model fits the data well (UCLA: Statistical Consulting Group, 2012; Hosmer and Lemeshow, 1989). It should be noted that the diagnostic functions of the SAS procedure SURVEYLOGISTIC are quite limited due to its recent introduction. Therefore, the Hosmer and Lemeshow goodness of fit test is the only diagnostic test performed using the bootstrap weights. The remaining diagnostic tests are performed without the bootstrap weights using the regular SAS logistic regression procedure (PROC LOGISTIC). Since variance estimation is not required for the remaining diagnostic procedures the PROC LOGISTIC procedure is acceptable.

The tests for multicollinearity are included to ensure that the logistic results are combinations of independent factors and not collinear factors. The VIF function in the SAS linear regression procedure (PROC REG) is used to test for multicollinearity. VIF scores below 2 are considered acceptable in this research.

The receiver operating characteristic (ROC) curve is a plot of the specificity (X axis) and sensitivity (Y axis) to illustrate the performance of binary categories as the effects within the model are varied. The curve represents the trade off between false positives (specificity) and false negatives (sensitivity). A perfect model will produce a straight line at a forty-five degree angle from zero to one (Roos et al, 1997).

The one-step difference in Chi-square and Pearson residuals are used to detect outliers that are not well predicted by the model. The one-step difference in Chi-square provides a measure of the change in the Pearson Chi-square statistic if a given case is deleted from the analysis data. Analysing the residuals is also useful for detecting poorly fitted cases so this research examines a plot of the Pearson residuals (SAS Institute Inc., 2008). Extreme outliers are analysed to determine why the model is a poor fit for them.

ONTARIO

Overall, the diagnostics for the Ontario model are generally quite good. The Hosmer and Lemeshow goodness of fit test is significant so we can reject the null hypothesis and say the model fits the data well. There are also no multicollinearity problems in the final Ontario model, all VIF scores are less than two. The ROC curve for

the final Ontario model is presented on Figure 20. The trend line indicates the overall direction of the ROC curve and demonstrates that while the model errs on the side of false negatives, it is generally not too far from the ideal curve. The lower values of the ROC curve are somewhat more problematic. However, as the values approach their maximums, the ROC curve flattens to more closely resemble the ideal curve. While a straight line is preferable, the reasons for the deviations from the ideal curve are explored further during the exploration of residuals and outliers.

Figure 20: Receiver Operating Characteristic Curve for Final Ontario Model

The analysis of the one-step difference in chi-square reveals eight outliers that are poorly fit by the model. There are several reasons that explain this result. Seven of the eight cases experienced serious accidents during the follow-up period of NPHS. These accidents coincided with a sharp decline in their HUI scores and trigger a transition into the severe disability population. Contrary to the model and due to the

randomness of accidents, these seven cases acquired severe disabilities that could never be predicted based on their attributes as represented in the model. The unpredictable outcomes result in significant model fit problems because their initial scores give no indication of future disability. Most of these cases are under 40 and the eldest was 52. These cases also have good HUI scores before the accident, minimal prior chronic conditions, no prior activity limitations or any of the other significant predictors of severe disability for Ontario. Four of the seven report increased HUI scores in subsequent cycles, suggesting their injuries were temporary.

The reasons why the eighth case does not fit the model are less clear. This case reports a sudden onset of a number of chronic conditions and a sharp drop in their HUI score in the same follow-up cycle without any logical explanation such as an accident, injury or other serious event. This case is also very young and does not present any characteristics suggesting a future onset of disability after a thorough review of their NPHS responses. Digging into their HUI scores reveals that the reason for the decline in HUI is related to their responses to the cognition questions. In the cycle preceding the onset of severe disability the HUI score decreases somewhat due to some cognitive difficulties. This small drop is followed in the next cycle by a sharp drop in HUI due to a sudden onset of severe cognitive difficulties. This situation is plausible for someone with a condition such as early onset Alzheimer's, which is very difficult for this model to predict based on the information available from the NPHS data. The Pearson residual analysis also reveals seven of the eight cases detected by the one-step difference in Chi-square. The odd case and six of the seven cases that experienced accidents have the

highest Pearson residuals. These are the highest cases on Figure 21. While there are a number of cases with elevated Pearson residuals, the vast majority of the almost 3,000 cases cluster tightly near zero, as shown by the trend line. In fact, the average Pearson residual score is 15.6 and this average is inflated by 0.9 just because of the eight extreme scores discussed previously. While these residuals are not ideal, they are to be expected when trying to predict a complex and dynamic phenomenon such as disability that is subject to random effects such as accidents, injuries and genetic disposition to certain conditions that cannot possibly be predicted with typical survey data.

Figure 21: Pearson Residuals for Final Ontario Model

Overall, the Ontario model appears to function well. The significant Hosmer and Lemeshow goodness of fit test indicates the data fit the model and the lack of multicollinearity suggests the results are valid. The ROC curve is not perfect but few models can perfectly predict a complex phenomenon such as the acquisition of a severe

disability. The outliers detected by the one-step difference in Chi-square and the Pearson residual analysis make sense due to the randomness of serious accidents and injuries. Furthermore, the onset of a severe disability due to a random serious accident cannot be predicted from the 1994 baseline NPHS data. Therefore, given the results of the diagnostics, the results of the Ontario model are considered valid.

NOVA SCOTIA

The diagnostics for the final Nova Scotia model are also quite good. The Hosmer and Lemeshow Goodness of Fit Test is also significant, meaning the null hypothesis can be rejected and we can say that the model fits the data well. There are not any multicollinearity problems in the Nova Scotia model either, with all VIF scores less than two. Figure 22 presents the ROC curve plot for Nova Scotia and suggests a slightly better curve for Nova Scotia than Ontario. The trend line on the Nova Scotia ROC curve begins closer to zero and more closely resembles the ideal forty-five degree angle.

Figure 22: Receiver Operating Characteristic Curve for Final Nova Scotia Model

The one-step difference of chi square analysis reveals 4 outliers that are easily explainable through additional analysis. All four of these cases experienced serious accidents during the NPHS follow-up period that resulted in sharp drops in their HUI scores. Only one of these decreases in HUI scores is permanent, the rest are only temporary reductions in their HUI scores. One of the most significant reasons for the problems fitting the model is all four outliers were less than 20 when NPHS began, which is the complete opposite of the significant aging effects suggested by the final model. These cases also did not have any other characteristics that would suggest the onset of disability, resulting in large residuals. Therefore, these cases that experienced random accidents are understandable in terms of the problems they create for the model diagnostics and do not point to problems with the final model.

A total of twelve cases with large Pearson residuals are detected. The four largest outliers shown by Figure 23 are the same four cases discussed previously. The eight additional cases detected by the residual analysis present quite similar characteristics to the first four cases although there are two cases that require exploration and are discussed later. The cases that are similar also experienced temporary decreases in their HUI due to accidents or injuries for one cycle only. They tended to be less young than the original four that were detected (40-60 years) so they fit the model better than the younger people but the accidental nature of the onset of their disability is still unpredictable. The onset of disability for the remaining two cases is less clear. One case reports a lower HUI score for one cycle only but it was low enough to trigger the designation of a severe disability. Further exploration reveals that this case is being treated for cancer and underwent major surgery in the past year. The final case is quite interesting. They had been a consistent respondent for many cycles of NPHS and had not reported any difficulties or health problems in any cycle. The final cycle for which there is a response for this case was completed by proxy (another person). The proxy reported that the selected respondent has dementia accompanied by significant cognitive difficulties as well as mobility problems. Predicting this case would be impossible based on the 1994 baseline NPHS data. The Pearson residuals and additional analysis indicate that the extreme outliers are logical exceptions to the model and should not be considered indicators of a poor model.

The plot of the residuals on Figure 23 clearly shows there are some residuals in the model yet the vast majority of residuals cluster near zero. The trend line clearly

indicates that while the Pearson residual is not zero, the average is close to zero (11.6). In fact, the Pearson residual score for all cases in this analysis increases by 0.7 due to the extreme values of just the first four extreme cases noted above.

Figure 23: Pearson Residuals for Final Nova Scotia Model

In general, the final Nova Scotia model fits the data quite well. The Hosmer and Lemeshow goodness of fit test is significant, there are not any multicollinearity problems, and the ROC curve appears to be slightly better than that of Ontario. The one-step difference in Chi-square and Pearson residual analysis reveal several outliers that are due to random accidents and other situations that are explainable. While these cases do cause problems for the diagnostics, they should not be discarded because they are valid cases that experienced the onset of disability, although this onset could not be predicted from the 1994 baseline NPHS data. Therefore, the results of the Nova Scotia model are considered valid given the results of their diagnostics.

QUEBEC

The diagnostics for the Quebec model are also good but do not appear to be quite as good as the Nova Scotia and Ontario models. Once again the Hosmer and Lemeshow Goodness of Fit Test is significant, indicating the model fits the data well. This test is performed using the bootstrap weights so the variance is not inflated. There are also no multicollinearity problems detected in the final Quebec model, with all VIF scores below two. Thus far, the Quebec model has performed at the same level as Ontario and Nova Scotia; however, as shown on Figure 24, the ROC curve for Quebec suggests the Quebec model may not be quite as precise. The trend line clearly shows that the ROC curve begins much further away from zero than either Ontario or Nova Scotia and runs deeper into the sensitivity hemisphere, away from the ideal curve.

Figure 24: Receiver Operating Characteristic Curve for Final Quebec Model

The one-step difference in Chi-square reveals nine outliers. Eight of the nine outliers also experienced some type of accident that coincided with sharp drops in their HUI scores. Six of the eight respondents recovered to higher levels of HUI in subsequent cycles although 2 participants reported decreases in their HUI scores for the remainder of the NPHS follow-up. One of the key reasons why these cases have high one-step differences in Chi-square is their age. Similar to Ontario and Nova Scotia, these participants are also quite young. In fact, six of the eight people that experienced accidents were less than 35 when the NPHS began, with the eldest being 51. Once again, these eight extreme outliers and their random accidents could not possibly have been predicted by the 1994 baseline NPHS data. However, the ninth extreme outlier is worthy of discussion. This participant reports many chronic conditions throughout the NPHS follow-up (chronic conditions not significant in Quebec), although none of these conditions are noted for being directly related to disability (allergies, asthma etc.). Similar to the unique Ontario case, this case also reports significant cognition problems that appear to worsen over time. However, this case reports increasing memory problems as opposed to difficulty thinking clearly. While this case has acquired a severe disability, there are not any clues to the reasons for this occurrence in the NPHS data. This result also suggests that this case could not have been predicted from the 1994 baseline NPHS data.

The cases with the highest Pearson residual are also the same nine cases detected by the one-step difference in Chi-square analysis. Figure 25 clearly indicates these nine extreme cases with the largest Pearson residuals. Once again, there are

some cases randomly scattered between the extreme cases and zero yet the majority of nearly 2,200 cases cluster tightly around zero as shown by the trend line. Moreover, the nine extreme cases raise the average Pearson residual by 1.3 while the overall average Pearson residual is 14.8.

Figure 25: Pearson Residuals for Final Quebec Model

On the whole, the final Quebec model performs well but not to the same level as the Ontario and Nova Scotia models. The Hosmer and Lemeshow goodness of fit is significant and there are no multicollinearity problems. The ROC curve is not quite as good as those of Ontario and Nova Scotia but it was not particularly problematic either. The one-step difference in Chi-square and Pearson residual analysis revealed nine extreme outliers, however, eight of the nine cases are easily explainable from random accidents that are virtually impossible to predict. Therefore, the results of the Quebec model are considered valid given the results of their diagnostics.

This chapter on the multivariate presents the results of the survival analysis models developed using the NPHS longitudinal data. These models provide the hazard ratios for each of the factors related to the onset of disability during the 16 year follow-up period of the data. These models follow the social determinants of health as a guide to understanding the discrepancies in disability rates between provinces. These results are intended to set the stage for the discussion in chapter 6 where the effects of these hazard ratios are used to understand current estimates of disability in Nova Scotia, Ontario and Quebec.

CHAPTER 6: DISCUSSION - DIVERGENT DISABILITY RATES IN CANADA

The purpose of this chapter is to discuss the implications of the analytical results presented in the previous bivariate and multivariate chapters and connect them together with the hypotheses of this research and the results of existing literature. The first section of this discussion chapter begins by reviewing the hypotheses of this thesis and provides a brief evaluation based on the bivariate and multivariate results. This component prepares readers for the second section which evaluates the various dimensions of the social determinants of health in terms of the hypotheses of this research and compares the results to previous research. The concluding section is a final evaluation of the hypotheses and discussion of the implications of these results for understanding current disability rates.

There are three primary hypotheses for this research that involve the social determinants of health and how these determinants may be affecting disability rates over time in Canada, leading to the divergent disability rates in Quebec and Nova Scotia. As noted in chapter 2, the three hypotheses of this research are as follows:

Hypothesis 1 (H₁): The main hypothesis of this research is as follows: the social determinants of health influence the prevalence of conditions associated with disability (impairments), thereby influencing disability rates. This hypothesis contends that many dimensions of the social determinants of health are involved in the onset of disability in Canada through their influence on the prevalence of conditions associated with the onset of disability. Examining the onset and prevalence of disability through a social

determinants lens provides significant explanatory power to this research. Following this hypothesis, the origins of conditions that may be underlying disability are shifted away from their historically biological sources in favour of explanations based on demographic, socio-economic status, behavioural risk factors and economic circumstances. Health indicators and chronic conditions are not excluded from the social determinants of health perspective, but they also do not play the central role typically portrayed using medical explanations of the onset of disability.

The results of this research suggest clear evidence that the social determinants of health are impacting the prevalence of conditions associated with disability through a number of different areas. For example, as noted in the bivariate and multivariate results chapters, there are several bivariate results from social determinants suggesting that Nova Scotia should have high rates of disability and Quebec should have lower disability rates but the results are not universal. The final multivariate models also reveal several social determinants that are significant predictors of disability including age, gender, population size, education, and BMI. These results are explored further in the discussion below.

Hypothesis 2 (H₂): This hypothesis builds upon hypothesis 1 by suggesting that the high rates of disability detected in Nova Scotia are partially due to the presence of many risk factors according to the social determinants of health. Specifically, hypothesis 2 is as follows: the biological underpinnings of the impairments associated with

disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability.

The bivariate results for Nova Scotia reveal a number of significant results supporting the social determinants of health model. These factors include low levels of education and fruit and vegetable consumption as well as higher smoking and obesity rates when compared to Ontario. Taken together, these risk factors suggest that Nova Scotia should have high rates of disability according to the social determinants approach. However, Nova Scotia also scores well on a number of social determinants including indicators of physical activity, alcohol consumption and labour force status. These findings are discussed further below.

Hypothesis 3 (H₃): This hypothesis also builds upon hypothesis 1 but in the opposite direction to hypothesis 2. Hypothesis 3 is as follows: the biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health. Fewer risk factors from the social determinants of health may result in a lower prevalence of conditions associated with the onset of impairment and disability.

The results of this thesis provide mixed evidence for hypothesis 3. Quebec does demonstrate some characteristics to support this hypothesis such as high levels of education and fruit and vegetable consumption in addition to reporting high levels of general health and low overall rates of chronic conditions. At the same time, Quebec also has high rates of low education, low income, high unemployment, and an age

structure much more similar to Nova Scotia. These results are discussed further below as well.

EVALUATION OF THE SOCIAL DETERMINANTS OF HEALTH

This research has uncovered a number of bivariate and multivariate results regarding the effects of the social determinants of health and the onset of disability. The NPHS data are used to approximate the evolution of disability statistics over the sixteen year period between 1994 and 2010 to shed light on how the discrepancy in the disability rates may have evolved. The following section evaluates these results for each dimension of the social determinants and discusses their meaning in terms of support for the hypotheses and disability research more broadly. However, the discussion does not evaluate every variable examined for this research. This discussion focuses on variables with significant or unexpected results and provides possible explanations for these results where appropriate.

DEMOGRAPHIC CHARACTERISTICS

The results for the demographic characteristics included in this research generally provide support for the social determinants of health, although some of the results are inconsistent. The majority of results line up as expected while others do not or they are not significant. Age is the lone factor that is significant for all provinces while gender is only significant in Ontario and population size in Quebec. There are also a number of variables that previous research suggested would be significant factors

such as race, immigrant status, and marital status that are not significant in the final models of this research.

The expected association between age and increasing levels of disability is evident both in the bivariate results presented in chapter 4 as well as the multivariate results presented in chapter 5. Overall, age is one of the most consistent predictors of disability. As age increases, so does the likelihood of reporting disability. This result is consistent with the already significant research supporting this notion (den Ouden et al, 2012; Melo and Valdes, 2011; Altman and Gulley, 2009; Chen, Chang and Yang, 2008; Dunlop et al, 2007; Brunner and Marmot, 2006; Cockerham, 2004; Rietschlin and MacKenzie, 2004; Berkman and Kawachi, 2000). However, the age results are not completely straightforward. The results for Ontario and Nova Scotia behave as expected but the results from Quebec raise a number of questions. Recall that the age structure of Quebec is quite similar to Nova Scotia. If disability rates were calculated strictly based on age structure, the disability rate in Quebec should be very similar to Nova Scotia. Nevertheless, Quebec reports a disability rate that is about half that of Nova Scotia and much lower than Ontario as well. Continuing with the results of this research, the strength of the age effect appears to be different in Quebec compared to Ontario and Nova Scotia but the multivariate results tell a somewhat conflicting story. As noted, Quebec has the largest hazard ratio for increases in age although the difference is small. The age variable is entered as individual years so the difference between Quebec's hazard ratio (+3.4%) is not appreciably different from Nova Scotia (+2.4%) or Ontario (+1.8%). To confuse matters more, according to PALS data Quebec

reports similar rates of mobility, agility and pain disabilities, which are increasingly common with age. This research tries to follow the social model approach as much as possible and avoid direct linkages between personal characteristics and disability yet the heavy overlap between age and disability is unavoidable. Combining the age structure of Quebec with the high rates of age-related disabilities (mobility, agility and pain) suggests that the people who report disability in Quebec are not that different from people who report disability in other provinces. The difference lies with the people in Quebec that do not report disability. This point is discussed further in the final section of this chapter. In general it seems that there are different age effects at work in Quebec but there are many other factors to consider from this research.

Ontario is the lone province where gender is a significant predictor for disability. Recall that men's risk for severe disability is 48.6% lower than that of women in the final model, one of the larger HR's in this research. This finding is somewhat expected given the significant difference in the ratio of men and women with severe disabilities detected by the bivariate analysis of NPHS. However, this finding is consistent with Lee (2011) who observed less risk for disability in the male population as well. It should also be noted that the life expectancy of men is typically lower than women (Denton and Walters, 1999). Since this research excludes people who became deceased before reporting an HUI score of 0.70 or less, women could be at a higher risk of severe disability because they are living to older ages where disability is increasingly prevalent. Men may be experiencing mortality before they reach the older age groups, thus reducing their likelihood of experiencing a severe disability. Untangling this mystery

would require a hybrid model that includes the deceased population as well as those transitioning to disability, which is beyond the scope of this research.

Quebec is the only province to report significant differences that are dependent on the population size where the respondent is living. Current research suggests there should be a higher hazard ratio in rural areas given the scarcity of health care and other services that may help people prevent disability or recover from health conditions associated with disability (Melo and Valdes, 2011). Nevertheless, the greatest risk was not rural areas but urban areas with less than 30,000 people. There is some research suggesting that people with disabilities living in rural areas tend to move into nearby urban areas because they are most accessible or offer more services (Keating, Swindle and Fletcher, 2011), which would also be consistent with the results of this research. The hazard ratio for the largest population areas is higher than expected because logic suggests these areas would have the greatest availability of supports and services for people with disabilities and be the most accessible, preventing disability in the first place. That said, population growth in large urban areas has been very high for many years (Marmot and Wilkinson, 2006) and may have far exceeded the growth rate of supports and services so the issue may not be their proximity but the lack of availability that is driving the hazard ratio higher in large urban areas.

There are also several demographic characteristics that previous research suggested could be key predictors of disability yet they are not significant in the final models for any of the provinces. These characteristics include race, (Lee, 2011; Louie

and Ward, 2011; Warner and Brown, 2011; Dunlop et al, 2007; Andreson and Miller, 2005), immigrant status (Choi, 2012; Ng, 2011; Newbold, 2006), and Aboriginal status (Reading and Wien, 2010). There is some evidence in the bivariate results and initial multivariate results that immigrant status has an effect but unlike Ng, (2011) these effects are not significant in the final model. Aboriginal status and the racial indicators were removed surprisingly early in the model building process due to high P values. For rare characteristics such as these, a possible explanation is the small number of people that actually transitioned to a severe disability during the sixteen year follow-up period. While it may seem odd to suggest that the sample size of a survey with almost 20,000 respondents is too small, the number of people with these rare characteristics that actually made the transition into the severe disability population is too small for significant effects. A longer follow-up period for NPHS would have yielded more transitions for analysis. A research project that is able to stratify by these rare characteristics during sample selection so they can specifically target people transitioning to disability may also be able to achieve significant evidence for these characteristics.

In terms of the hypotheses of this research, hypothesis 1¹ is clearly supported by the results of the demographic characteristics, particularly age and population size. The higher rate of disability in Nova Scotia and lower rate in Ontario is consistent with the

¹ Hypothesis 1: The social determinants of health influence the prevalence of conditions associated with disability (impairments), thereby influencing disability rates.

results from both provinces while also suggesting support for hypothesis 2². The only hypothesis that does not appear to be supported by the results of the demographic characteristics is H₃³. The older age structure in Quebec combined with their very low rate of disability is completely contrary to what is expected based on the results of this research and existing literature discussed previously.

Overall, the demographic characteristics provide evidence that they have significant effects on the onset of disability. While age is the only variable that is significant in all three provinces, the effects of gender and population size are also clearly visible. The effects of the demographic characteristics may not be as strong as some of the other dimensions but there certainly seems to be some demographic effects according to the results of this research.

SOCIO-ECONOMIC STATUS

Socio-economic status is easily the most challenging dimension of the social determinants of health included in this research. According to Semyonov, Lewin-Epstein and Maskileyson (2013), there is near universal agreement among social scientists that health and economic resources are linked yet this research struggled significantly to adequately represent socio-economic status in the analysis and found minimal support in the results. Possible explanations for each variable are provided below although it

² Hypothesis 2: The biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability.

³ Hypothesis 3: The biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health.

should be noted that there is one underlying factor in the Canadian context that may be at least partially responsible for the minimal effects noted between the onset of disability and the social determinants of health. Canada's universal health care system ensures that all Canadians receive a minimum standard of care regardless of their income. Even though Canada's universal health care system does not provide coverage for some services such as physiotherapy or eye examinations, the vast majority of conditions that are often associated with disability are covered by universal health care. It should be noted that this research does not make any causal inferences between the provision of healthcare and the onset of disability. However, receiving treatment for conditions associated with disability can have significant effects on the outcomes of these conditions and eliminate the presence of impairments that may be experienced as disabilities in unsupportive environments. While the results suggest evidence for many elements of the social determinants, the minimal affects attributable to socio-economic status may reflect the diminished importance of economic resources for receiving quality healthcare in Canada.

The lone variable from the socio-economic status dimension that is a significant predictor of the onset of disability in the final models is highest level of education. There are some unusual results in the initial models but the final results are similar to the expected gradient noted by previous research such as Lee (2011), Prus, (2011), McDonough et al, (2010), Chen, Chang and Yang (2008), and Kristenson (1998). In these results, people who have completed a post-secondary degree have the lowest risk for the onset of a severe disability and the risk increases as the highest level of education

decreases yet there is one interesting exception. People that did not complete high school had the second lowest risk for the onset of disability. The differences are quite small compared to some of the other results in this research but they are significant nonetheless. A possible explanation for this result is the research suggesting that the mortality rate for people with low education is notably higher (Jylha, 2009). Unfortunately for this research, the focus is on people who transitioned to a severe disability, which again means that people who become deceased before experiencing severe disability are excluded.

A large number of income variables are tested in this research including personal income, household income and various ratios of income adequacy and inequality. Some significant effects for the ratios of income adequacy are detected in the initial models for all three provinces but this variable is not significant in any of the final models. While this result is unexpected it is not entirely uncommon in previous research. For example, Kjellsson (2013), Sun et al (2011) and Denton, Prus and Walters (2004) also did not find significant effects from income. At the same time some previous research has found significant effects including Kachi et al, (2013), Melo and Valdes, (2011), Hacker, Ormandy and Ambrose, (2010), Chen, Chang and Yang, (2008), Denton and Walters, (1999) although only Denton and Walters (1999) used data from Canada that would include effects from Canada's universal health care.

According to the results of this research, Quebec experiences the lowest levels of income for the three provinces studied in this thesis. Nevertheless, combined with

Canada's universal health care and provincial social programs such as inexpensive daycare, the effects of this low income situation are clearly not evident in Quebec through their extremely low disability rate. In Ontario and Nova Scotia, the expected effects of income are evident even if it is not a significant predictor in the final model.

Occupation is another variable that is expected to demonstrate significant effects on the onset of disability. Similar to income, there is also some weak evidence in the initial models supporting the effects of occupational prestige, however, this evidence is generally contrary to the expected effects, likely due to poor diagnostics in the initial models. While these results are disappointing they are not particularly surprising given the difficulty of working with occupation information from the data sources used in this research. Previous research has also produced mixed results for occupation. For example, Kjellsson, (2013), van Kippersluis et al, (2010), Denton, Prus and Walters, (2004) and Kristenson (1998) were all able to uncover significant effects from occupation. The most notable previous research is Denton, Prus and Walters (2004) which used the NPHS data and found that being a female professional was a significant predictor of HUI and distress scores. The remainder of previous research typically divides occupation into manual versus non-manual so this may be a direction for future research using the CCHS or NPHS data. At the same, this is not the only research that did not find significant effects from occupation. One of the most closely related studies to this research is Melo and Valdes, (2011), which also did not find significant effects for occupation in their study of the social determinants of disability.

In terms of future research, there are two areas where further work is required. First, the availability of occupation codes from most health surveys in Canada, including the NPHS and CCHS, is problematic because the survey only collects the current occupation of people who are working or have worked in the past year or two. While this information can be useful for cross-sectional results, a more useful data element for longitudinal research is a detailed history of occupations. The detailed history can indicate the types of work and environments the person may have been exposed to before they reached their current occupation. Further, people that have not worked in the past few years result in missing values and become excluded from the analysis, diminishing precious sample size and possibly removing significant effects.

A second difficulty to working with occupation data is the key analytical variables are not yet clearly defined. The key variables for other indicators such as income and labour force status are well-defined but occupation variables seem to remain a work in progress for the social determinants perspective. As noted in chapter 3, there are five hundred and twenty different categories within the National Occupation Classification for Statistics (NOC-S) variable and they are not in a useable order. Therefore, this research relies upon a scoring system proposed by Boyd (2008) to organise and rank the occupation codes available from NPHS and CCHS. The only scale that shows a glimmer of possibility is the grouped quartile variable for prestige score but this variable is not significant in any of the final models. One possible explanation for the ineffectiveness of the Boyd (2008) occupation system could be the very nature of the scoring system. Recall that this system ranks occupation categories based on their prestige in terms of a

score. For the purposes of the social determinants, perhaps a better approach would be to group occupations further into sub-groups where certain other characteristics are also considered in the ranking system such as exposure to environmental contaminants, time spent sitting each day, or stress. Unfortunately this type of work is beyond the scope of this research. Therefore, future research could benefit from additional testing of the various occupation scales available to evaluate their appropriateness for use with social determinants of health research.

The industry where people work is also included to examine the effects of exposure to dangerous environments. As noted earlier, forestry, mining and construction are typically very dangerous industries where it is not uncommon for people to acquire impairments that are associated with disability. The industry variable has some of the same problems as occupation because the most recent industry is only collected for people who have worked recently. People who are in the age range most likely to be transitioning to disability are least likely to have worked recently. Further, the lack of significance is not surprising given the small amount of sample that works in these industries.

The final non-significant socio-economic status variable that should also be discussed is labour force status. This variable likely also has the potential to be a significant predictor for the onset of disability similar to previous research such as Kachi et al, (2013), Melo and Valdes, (2011), McDonough et al, (2010), Reading and Wien, (2010), Denton, Prus and Walters, (2004), Denton and Walters, (1999). To be consistent

with previous research such as Kasl et al. (1998) and Jin, Shaw and Svoboda (1995) this research also tests a dummy variable to indicate unemployment but this variable is also not significant. One possibility for the lack of significant results is the analytical possibilities are limited by the data. The NPHS is one of the few health surveys that make the distinction between 'unemployed' and 'not in the labour force' instead of grouping these two concepts together into 'not working' the way many health surveys such as CCHS are doing. However, even this distinction does not provide enough detail for a social determinants analysis because there are many reasons why someone may not be in the labour force. For example, students and retirees are not in the labour force because they choose not to be while people in poor health or with disabilities may not be in the labour force because they are completely unable to work or unable to find an employer willing to accommodate their accessibility needs. Separating the not in labour force group into people who are not interested in working versus people who are interested in working but cannot would require additional questions in the survey. Nevertheless, this added detail would significantly improve the utility of the labour force status variable for proper analysis of the social determinants of health.

Overall, the socio-economic status dimension presents mixed results for the social determinants of health and the hypotheses of this research. For example, the expected results for education are present in the bivariate results but they are only significant in Quebec according to the multivariate models. Moreover, Quebec's highly polarised educational attainment suggests the disability rate should at least be closer to the mid-point rather than an extremely low level, which is contrary to hypothesis 3. If

education was the only variable suggesting the Quebec disability rate should be higher it could be an exception to expectations. However, education is one of many variables suggesting the Quebec disability rate should be higher. This point is considered further in the final section of this chapter.

The income adequacy variable also demonstrates some support for the social determinants of health approach in the bivariate results and the initial multivariate models. This variable is very consistent with previous research suggesting that increasing income is associated with better health; however, this result is also completely contrary to hypothesis 3 suggesting that Quebec's disability rate should be higher due to the prevalence of low income. Overall, the lone surprising result related to income is the decline in significance for the final models of all three provinces.

The occupation variables clearly did not perform as anticipated for evaluating the social determinants of health. Occupation was expected to combine and intensify the effects of the income and education factors. Nevertheless, the lack of a ranking system amenable to the social determinants of health approach seems to affect the performance of the occupation variables. Future research involving the social determinants of health could benefit from the development of such a classification system.

In terms of labour force status, the bivariate models do suggest some support for the hypotheses even though these variables are not significant in the multivariate models. Recall that Nova Scotia reports somewhat weaker labour force status numbers

while also reporting the highest disability rates. However, contrary to this finding is the notably lower rate of employment in Quebec, which should be associated with a higher prevalence for risk factors affecting impairment and disability according to previous research (Kasl, Rodriguez and Lasch, 1998; Jin, Shaw and Svoboda, 1995). While Nova Scotia's slightly weaker labour force appears to be associated with a higher disability rate and supporting hypothesis 2, Quebec's complete reversal of existing research and hypothesis 3 is puzzling once again.

HEALTH INDICATORS

The health indicators variables also reveal a number of interesting findings from both the bivariate and multivariate results. The most important health indicator for predicting the onset of severe disability is the HUI score from 1994. This single variable is the second most powerful predictor from all the variables included in this research. This result should not be completely surprising given that the dependent variable is based on transitions in the HUI during the years following 1994 but this result involves a few different angles that require explanation. First, this research is designed so that transitions to an HUI score considered a severe disability require several years during which time the other predictor variables can also exert their effects. While the 1994 HUI score is certainly among the strongest effects it is also a summary score of the effects of other factors in this research such as the many behavioural risk factor variables. Second, as shown on Table 6 in chapter 4, the HUI score in 1994 does not directly correlate to subsequent HUI scores resulting in continuously changing distributions of HUI. That said, the multivariate results clearly show that less than

perfect health in 1994 is a strong precursor to severe disability. The effects are much stronger in Nova Scotia and Quebec but still strong in Ontario.

The bivariate results also reveal some interesting findings for Nova Scotia. In 1994, the distribution of HUI scores from NPHS suggest that Nova Scotia has significantly poorer health than Ontario or Quebec. After 16 years of aging and the effects of all the factors included in this research, there is a notable shift by the populations in all three provinces towards the extremes of the disability scale by 2010. Surprisingly Nova Scotia reports the largest increase in the proportion of their population with no disability while Quebec has the greatest shift into the severe disability category. Overall, the 1994 HUI score variable is one of the strongest predictors for the onset of severe disability but the manner by which this variable functions requires careful consideration due to the changes over time.

Self-rated health does not always demonstrate significant effects yet the results that are significant provide some important results for this research. As noted in chapter 2, self-rated health is often used as an outcome measure in existing research (Kjellsson, 2013; Kim, 2011; Prus, 2011; McDonough, Worts and Sacker, 2010; Shooshtari, Menec and Tate, 2007; Denton, Prus and Walters, 2004). This research uses self-rated health as a predictor of disability which has not been done by previous research. Research that has used self-rated health to predict other outcomes has generally focused on mortality as opposed to disability (Jylha, 2009; Bardage, Isacson and Pedersen, 2001; Idler and Benyamini, 1997).

In these results, the stark discrepancy between the self-rated health in Quebec and Ontario compared to Nova Scotia found in both the CCHS and NPHS data strongly suggest that the high disability rate in Nova Scotia should be expected, especially when combined with many of the other factors suggesting the disability rate should be high in this province. In contrast, the pronounced similarity between Ontario and Quebec once again raises questions about the very low rate in Quebec. The multivariate results provide some additional information from the initial models even though self-rated health does not remain in any of the final models. The initial models for all three provinces reveal the expected gradient from the lowest risk for excellent health to the highest risk with poor health aside from one exception. Interestingly, people with very good health (as opposed to excellent) have the lowest hazard ratio for severe disability and this effect is much stronger in Quebec. While this result is only from an initial model with basic diagnostics, the consistency of this result in all three provinces combined with the strength of the effects in Quebec is unusual and there is no obvious explanation. This result would be fascinating for future research on a detailed study of the predictive validity of self-rated health on disability. Further, additional cycles of NPHS would provide more transitions to study and a larger sample for the multivariate results to become significant.

Self-rated mental health is another area where Nova Scotia's high disability rate seems reasonable and consistent with H_2 , even though this variable is not significant in the multivariate models. According to the bivariate results from the NPHS and CCHS data, Nova Scotia stands out with significantly poorer levels of self-rated mental health.

This result is consistent with Mock and Arai (2011) which also used self-rated mental health to predict other health problems. At the same time, Quebec's sharp increase in mental distress between 1994 and 2010 is also concerning because it occurs at nearly double the rate of people in Nova Scotia with severe disabilities. This result is again completely contrary to hypothesis 3 and previous research, suggesting high rates of mental distress should be associated with higher rates of disability.

The importance of monitoring self-perceived stress is evolving in the literature (Braveman, Egerter and Williams, 2011; Brunner and Marmot, 2006; Cockerham, 2004; Berkman and Kawachi, 2000) yet there are quantitative studies already demonstrating the effects of stress on physical health (Kristenson, 1998) as well as HUI scores, distress and chronic conditions (Denton, Prus and Walters, 2004). However, in this research, self-rated stress is also the only area where the bivariate results are completely contrary to every hypothesis of this research, although the overall effects may not be very strong because this variable is not significant in any of the multivariate results. The similarities between the CCHS and NPHS results are also not as strong as most of the other factors but it should be noted that these variables are measured differently between the two surveys. According to CCHS, Nova Scotia reports very low levels of stress compared to the other provinces. The NPHS results also indicate Nova Scotia tends to report less stress but the separation is less extreme and not significant. Regardless, the low level of stress in Nova Scotia is contrary to H₂ suggesting the disability rate should be low when stress is low because there are fewer conditions associated with the onset of disability.

Quebec reports similar stress to Ontario yet hypothesis 3 suggests their disability rate should be higher given their self-reported stress rates are mid-pack.

There is ongoing debate about whether health indicators should be considered social determinants of health (Marmot and Wilkinson, 2006). Nevertheless, some of the health indicators in this research demonstrated clear effects on the long-term risk for the onset of a severe disability, suggesting they should be included in the social determinants of health because they clearly have long-term effects in the determination of health and disability. The Health Utility Index (HUI) is one of the strongest predictors in this research and the only factor representing the health indicators dimension in the final model. Self-rated health is also significant in the initial models. The surprising result is the lack of significant support for the social determinants from self-reported mental health and stress. As noted previously, existing research has found significant effects on health from both of these indicators. However, the NPHS mental health and stress measurement instruments date back to the early nineteen nineties and were not changed to ensure trend analysis throughout the entire longitudinal follow-up period. Current instruments that have been validated may be better able to detect the significant effects of stress and mental health reported by existing research. Overall, the health indicators dimension offers strong support from the significant predictors while the results of stress and mental health remain inconclusive.

CHRONIC CONDITIONS

The results of this research demonstrate clearly that there are some key chronic conditions that are linked to the subsequent onset of severe disability. These results are very consistent with all of the hypotheses. At the same time, there are many other conditions that appear to have minimal effects on health. Some of these conditions may not have been significant due to sample size issues because arthritis, back problems and high blood pressure are the most significant and they are also the most common chronic conditions. Recall from the bivariate results that these are the only three chronic conditions from NPHS that have sufficient sample to produce estimates by province and severity type.

The strongest effects from chronic conditions are observed for arthritis and back problems although high blood pressure is also a significant predictor. Recall from the bivariate results of the Participation and Activities Limitations Survey (PALS) that the most common types of disability are the mobility, agility and pain trio by a considerable margin. Digging deeper into the PALS data and the medical conditions associated with disability reveals a strong connection between arthritis and back problems with the mobility, agility, pain trio. The strong relationship between arthritis, back problems and the most common disability types in PALS provides strong support for the results of the multivariate models from this research indicating that these conditions are linked to the onset of severe disabilities. Further, while previous research using chronic conditions to predict the onset of disability is rare, Dunlop et al (2007) also found that some chronic conditions are very powerful predictors of the onset of disability. The results of this

research combined with Dunlop et al (2007) suggest further evidence for hypothesis 1 and the notion that chronic conditions should be included in the social determinants of health as a risk factor for future health challenges.

Hypothesis 2 also receives strong support from the results for arthritis, back problems and high blood pressure. Arthritis is clearly an important factor in the onset of disability and the distribution of arthritis is highly skewed by province. Nova Scotia reports the highest rates of arthritis in both the CCHS and NPHS data for every category of disability and many of them are statistically significant. According to these results, the disability rate in Nova Scotia should be much higher than either Ontario or Quebec due to the significantly higher prevalence of arthritis. Dunlop et al (2007) also found that arthritis was a critical predictor of disability. Similarly, the rates of back problems and high blood pressure in Nova Scotia are also consistently very high compared to Ontario and Quebec. There are also a few other conditions such as cancer and heart conditions that are rarely significant but point to Nova Scotia having consistently higher rates of these conditions. Dunlop et al (2007) also identified these conditions as critical predictors of disability. In the bivariate results of this research the difference for Nova Scotia is rarely significant and only arthritis is significant in the final Nova Scotia model. However, the frequency at which Nova Scotia consistently reports the highest rates of various chronic conditions suggests further support that the disability rate should be higher than the other provinces. Consistent with the social model, the prevalence of chronic conditions is not a direct causal factor of disability yet it is not unreasonable to

expect that an elevated prevalence of conditions that are often linked with disability will be associated with a higher disability rate.

Hypothesis 3 is also supported by strong bivariate evidence from arthritis, back problems and high blood pressure even though none of these variables are statistically significant in the final multivariate model for Quebec. The bivariate results for arthritis are the most telling because Quebec consistently reports the lowest arthritis rates and these differences are often significant as well. The evidence for back problems and high blood pressure is not quite as clear and there are few significant differences, nonetheless, Quebec is always among the lowest rates for these conditions. Combined with the results for arthritis, these three conditions suggest the disability rate in Quebec should definitely be lower than the other provinces. A final point of support for hypothesis 3 is the rate of change in the rate of chronic conditions in Quebec versus Nova Scotia and Ontario. Quebec reported the largest increase in the prevalence of chronic conditions between 1994 and 2010 while also reporting the largest increase in disability according to the four category HUI variable used throughout this research. Combined, these results suggest further support for hypothesis 3 through the apparent linkage of chronic conditions and the impact on disability.

The overall presence of chronic conditions was expected to be a significant factor in the onset of severe disability yet this strength is mostly evident in the bivariate results. There are significant correlations between chronic conditions and disability in the bivariate CCHS and NPHS analysis but the effects are not always significant in the

final models. The most likely explanation is the number of non-significant chronic condition predictors that are also included in the overall presence of chronic conditions variable. Even though this variable is not significant in the multivariate models, there is solid support from the bivariate results to suggest that the overall presence of chronic conditions variable is associated with the onset of disability but this variable needs to be further refined. Future research could benefit from constructing the overall chronic conditions variable exclusively from chronic conditions proven to have significant effects on the onset of disability by previous research.

Support for the social determinants of health approach is very mixed from the chronic conditions dimension. A handful of chronic conditions provide solid support as noted yet the majority of conditions included in this research demonstrated minimal effects. This result is very consistent with Dunlop et al (2007) which also found that some chronic conditions are powerful predictors of disability while others demonstrate minimal effects. For example, in this research a number of conditions are expected to be important factors but are not, such as diabetes, epilepsy, heart conditions, stroke and Alzheimer's. Even though this result is similar to Dunlop et al (2007), sample size and the limited follow-up period of NPHS may also be an issue once again because the most significant conditions are also the most common. Overall there is solid support for the social determinants of health from selected chronic conditions while many chronic conditions appear to have minimal effects.

BEHAVIOURAL RISK FACTORS

Behavioural risk factors are widely recognised as one of the most important elements of long term health (Marmot and Wilkinson, 2006). Not only are the effects of behavioural risk factors very powerful, but unlike genetic conditions, the outcomes linked to behavioural risk factors are modifiable at the individual level. The ability to modify behavioural risk factors is good news because this dimension has several significant factors in the final models, including smoking status, alcohol consumption, and Body Mass Index (BMI). There are also some factors that appear to be influential according to the bivariate results but they are not significant in the multivariate models.

Smoking status produced very mixed results in this research, which is surprisingly consistent with existing research. For example, Denton, Prus and Walters (2004) and Gilmour (2008) both found mixed results for smoking using the NPHS data. Nevertheless, there is existing research that has found significant effects on health such as Warner and Brown, (2011), Chen, Chang and Yang, (2008), and Power and Hertzman, (1997). A possible explanation for these mixed results likely involves the design of this research and other research that has used the NPHS data. This point is discussed following a summary of the results of this research. Recall that the smoking rate is always lower in Ontario compared to Quebec and Nova Scotia, regardless of which data source is used, and these differences are almost always significant. Further, Quebec is the only province where smoking status is a significant predictor of severe disability. Aside from Quebec, the results generally make sense but Quebec is an odd result. As expected, daily smokers have the greatest risk for severe disability. However, the

lowest risk belongs to former smokers and not people who never smoked, which is not expected. The most likely explanation for the odd results of smoking involves the design of this research, which excludes mortality if a severe disability was not reported before death occurred. This decision was made due to the large number of fatalities relative to cases that report the onset of disability to prevent the influence of mortality from dominating the results. The problem with this approach is strong predictors of mortality such as smoking may cause death before the person is able to report the onset of a severe disability. The relatively weak hazard ratio for smoking in Quebec is further evidence that smoking is a more complicated factor than can be adequately analysed using the research design of this thesis.

Even though the full effects of smoking are not evident in this research, there are still enough results to provide support for H₂. Nova Scotia and Quebec consistently report the highest smoking rates in this research, suggesting that Nova Scotia's disability rate should be high compared to Ontario. While smoking is not significant in the final model for Nova Scotia, sample size likely played a role once again because there are far fewer cases in Nova Scotia, especially those that acquired a severe disability during the follow-up period of NPHS. A larger sample or longer follow-up period likely would have resulted in significant effects for smoking in Nova Scotia according to the multivariate results. There is general support for hypothesis 1 from the bivariate smoking results for Ontario and Nova Scotia. The higher smoking rates in Nova Scotia correlate to the higher disability rates as do the lower smoking rates in Ontario. Nevertheless, the results for Quebec do not support hypothesis 1 or hypothesis 3.

Alcohol consumption also performs somewhat differently than expected but the results are logical. As noted, previous research has shown that some alcohol consumption has health benefits (Anttila et al, 2004; Mukamal et al, 2003; Reynolds, 2003) but abuse of alcohol brings health consequences (Meyerhoff et al, 2005). Previous research trying to predict health outcomes using alcohol consumption have also produced unexpected results such as Bardage, Isacson and Pedersen, (2001) that tried to predict mortality using alcohol consumption and other factors. Similar to this research, Bardage, Isacson and Pedersen (2001) found minimal effects for alcohol consumption. Nevertheless, there could be other reasons for the minimal effects noted in this research. The NPHS data from cycle 1 do not provide the opportunity to separate moderate alcohol consumption from alcohol dependence. The alcohol consumption guidelines were also recently updated based on previous research and it will take time for these changes to be reflected in data sources such as CCHS. Therefore, given the rarity of alcoholism this research must assume that the majority of people reporting alcohol consumption are consuming moderate amounts and the percentage abusing alcohol is very small. This assumption is somewhat visible in the final multivariate results for Ontario where the lowest hazard ratios are reported for former drinkers and occasional drinkers. Regular drinkers have slightly less risk than non-drinkers but the positive benefits of moderate drinking may be masked by the consequences of heavy alcohol consumption. Future research can take advantage of new data sources that can isolate the effects of moderate and heavy alcohol consumption to clarify this relationship.

Overall, hypothesis 1 receives some support from the results for alcohol consumption with some limitations. The higher rates of alcohol consumption detected by both data sources in Quebec point to a lower disability rate than either Ontario or Nova Scotia. At the same time, Nova Scotia's alcohol consumption is not significantly different from Ontario, suggesting their disability rate should be the same and contrary to hypothesis 2. Hypothesis 3 receives limited support from alcohol consumption because even though this factor is not significant in the multivariate models, the bivariate evidence points to clear differences in the alcohol consumption patterns of Quebec versus Ontario and Nova Scotia.

Body Mass Index is the final significant factor from the behavioural risk factors dimensions and this factor is significant for both Ontario and Quebec. The effects of BMI line up as expected, where people with normal weight have the lowest risk and people in the obese categories have the highest risk yet as noted in chapter 5 there are some intriguing exceptions. Two of the three classes of obesity in each province demonstrate increasing risks of disability with increasing obesity but one class in each province breaks the trend. The most confusing is the highest obesity class in Quebec, which reports the second lowest hazard ratio. Given the strong established relationship between severe obesity and mortality, this result is likely also linked to the onset of mortality before disability can be experienced. Granted this result is not observed in Ontario where severe obesity has the highest risk of severe disability, however, the small number of transitions to severe disability during the follow-up period likely also play a role in the odd result for Quebec. Ontario's odd result is less concerning because

it involves the lowest class of obesity, although it does suggest that people in the first category of obesity have almost the same risk of severe disability as people with a BMI in the normal range. Finding mixed results for the BMI categories is not uncommon given previous research. For example, Orpana et al (2010) also do not find the expected linear association between BMI and mortality using NPHS data. Further, Shelton (2009) also does not find significant evidence of poor health associated with higher BMI scores. Nevertheless, there is existing research that has found the expected linear association between BMI and poor health including O'Neill et al (2012) and Power and Hertzman, (1997). While there are certainly some slightly unexpected results in this research, the observation of expected relationships for all the other BMI categories suggest the odd result for the obese class 1 category likely also involves the small number of transitions to severe disability during the follow-up period.

There are also two variables in the behavioural risk factor dimension that are not significant in the models but yield some important background information to understanding the results of this thesis. These variables are fruit and vegetable consumption and physical activity. Fruit and vegetable consumption was not included in the initial NPHS content so it could not be included in the models. The cross sectional evidence from the 2010 CCHS data indicate that residents of Quebec consume significantly more fruits and vegetables than their Nova Scotia counterparts and they are often superior to Ontario as well. Combined with previous research suggesting that fruit and vegetable consumption is a good proxy for the overall quality of nutrition being consumed (De Irala-Estévez et al, 2000), the CCHS results imply that the overall nutrition

consumed by Quebecers is vastly superior to that consumed by Nova Scotians, with Ontario located in the middle in terms of nutritional quality. This is a significant difference between the three provinces that lines up exactly with all three hypotheses of this research. Unfortunately the longitudinal effects of fruit and vegetable consumption cannot be measured but appear as though they could be significant. Future longitudinal health surveys would benefit from including fruit and vegetable consumption from the very beginning to observe their full effects.

Physical activity is also widely regarded as critical to long-term health and preventing disability yet there is minimal evidence to support this position according to this research. The data sources used different methods to measure activity, ranging from leisure physical activity to daily energy expenditure to include activity for people with physical jobs. There are minimal differences from the bivariate analysis, so little that there are few significant differences. While Quebec occasionally appears to be somewhat less active compared to the other provinces, the differences are rarely significant. The multivariate results are encouraging for the initial models, where physical activity and energy expenditure are both highly significant predictors in all three provinces but none remain in the final models. Previous research has generally supported the relationship between physical activity including O'Neill et al (2012), Prus (2011), and Denton, Prus, and Walters, (2004) have found significant effects on health through physical activity or a lack of physical activity (Prus, 2011). At the same time, Denton and Walters (1999) found limited support for physical activity while also using the NPHS data. For this research, the lack of significance in the final models likely

involves the strength of the other variables that are included as well as overlap in some concepts. For example, someone with arthritis or a less than perfect health according to the HUI scale may be less likely to be physically active because of their other health issues, causing overlap with the measurements of the physical activity variables. An interesting research project would be to look at the predictors of physical activity to determine the strength that factors such as health and chronic conditions play.

Overall, the behavioural risk factors dimension provides clear support for the social determinants of health and the hypotheses of this research based on a number of different factors. While smoking and alcohol consumption do not provide definitive results, it is clear that choosing a healthy lifestyle decreases the risk of a severe disability. Body Mass Index provides the most obvious support for the social determinants and hypotheses by demonstrating the increased risk of severe disability associated with less healthy BMI scores. Combined with the lower BMI's in Quebec and higher BMI's in Nova Scotia, all three hypotheses receive firm support. Perhaps the strongest evidence for the social determinants and hypotheses comes from fruit and vegetable consumption even though this variable is not included in the models. Quebec's high fruit and vegetable consumption and low disability rate clearly demonstrates support for both the social determinants in general in hypothesis 1⁴ and hypothesis 3⁵. Conversely, Nova Scotia's worse nutrition and high disability rate also

⁴ Hypothesis 1: The social determinants of health influence the prevalence of conditions associated with disability (impairments), thereby influencing disability rates.

⁵ Hypothesis 2: The biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability.

supports hypothesis 2⁶ as well as the social determinants. While not all variables produce the expected results, the clear message from the useable results suggest strong support for the social determinants and the hypotheses.

ACTIVITIES OF DAILY LIVING

The activities of daily living dimension also provide three significant predictors of severe disability, which include needing help with heavy household chores, moving around inside the house, and reporting an activity limitation in 1994. Historically, these variables have also been used as indicators for disability so it is not surprising that they are also strong predictors of severe disability during the follow-up period. Further, the strength of these variables is likely also due to the speed at which severe disability occurs once one or more of these variables are reported. A case level bivariate exploration of the time between reporting one of these variables followed by the onset of severe disability appears to be shortest for these variables but there are exceptions.

The strongest predictor of disability by a wide margin is someone that reports they need help moving around inside the house. This predictor is strongest in Quebec but also highly significant in Ontario. Digging deeper in to the data reveals that people who report this kind of need often report lower HUI scores that are still above the 0.70 cut-off but they are often closer to the cut-off than they are to perfect health. As time passes and age increases, it does not seem to take long for people reporting this type of need to move into the severe category of disability. This result is consistent with

⁶ Hypothesis 3: The biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health.

previous research (Nobles, Weintraub, and Adler, 2013) as well as PALS and it's much more detailed screening of disability. Although the cross-sectional nature of PALS does not offer the opportunity to determine the order of events, the PALS data show that people with severe or very severe disabilities are much more likely to report needing help with moving around inside their house than people with moderate or mild disabilities. Overall, needing help with moving about inside the house appears to be a precursor on the way to severe disability, rather than having a long-term causal relationship.

Activities of daily living are not typically included as part of the social determinants but there is some evidence to discuss regarding hypotheses 2⁷ and 3⁸. The bivariate results for NPHS do not reveal any significant differences between the provinces for this predictor but interestingly, Nova Scotia reports the greatest need while Quebec reports the least need. There are significant differences between Nova Scotia and Quebec using the CCHS data and these results provide clear support for hypotheses 2 and 3. Nova Scotia's rate of needing help moving inside the house is significantly higher than Quebec's, suggesting Nova Scotia's disability rate should also be much higher, consistent with hypothesis 2. Quebec's rate is significantly lower than Nova Scotia and Ontario, suggesting Quebec's disability rate should also be lower, which provides support for hypothesis 3.

⁷ Hypothesis 2: The biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability.

⁸ Hypothesis 3: The biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health.

One of the oddest results in this research involves needing help with heavy household chores. This factor reveals significant protective effects in the final model for Ontario, which is the opposite of the results seen for needing help moving inside the house. While this finding appears contradictory at first, one possible explanation might be that people who are willing to ask for help with heavy household chores are more likely to ask for help in other difficult situations and less likely to injure themselves or be prevented from doing something they want or need to do. Bivariate results are only available from NPHS because this activity of daily living is not asked in CCHS. As noted previously, there are no significant differences between the provinces for any of the severities of disability. However, Nova Scotia consistently reports the highest rate of needing help but the difference is not significant. Overall, the results are inconclusive even though this factor shows significant protective effects in the final Ontario model. Unfortunately there is no previous research using this variable in this manner for comparison.

The final ADL variable that is significant in the final models is reporting an activity limitation in 1994. Given the association between activity limitations and disability, this variable was expected to be a significant predictor yet it is one of the weaker factors in the final models for Ontario and Nova Scotia and not even significant in Quebec. The weakness of this variable may involve the other variables in the model that ask more specific questions about activity limitations, such as needing help to move around inside the house. The activity limitation variable is more of a generic indicator that the person has some kind of limitation but the type and severity is unknown. Further, recall that to

create this variable a number of different types of activity limitations and severities are combined, which may smooth out significant effects. Regardless of the strength of this factor in the final models, the activity limitations variable provides solid support for hypotheses 2⁹ and 3¹⁰ from the bivariate and multivariate results.

Looking at the bivariate data reveals the much lower rate of reported activity limitations for Quebec, a very high rate for Nova Scotia, and Ontario almost exactly in the middle. This distribution is exactly as predicted according to H₂ and H₃. The significant effects of this variable in the multivariate models underscore the bivariate results, especially for H₂ and Nova Scotia. The higher prevalence of activity limitations in 1994 according to NPHS appear to translate into higher disability rates in 2010.

IMPLICATIONS OF THE RESULTS

The three hypotheses of this research receive varying levels of support from the results discussed in this chapter. The majority of the results have been supportive of the hypotheses yet there are some results that must be carefully considered. This section provides a final evaluation of the hypotheses for this research and explains the decisions regarding whether the hypotheses are correct.

⁹ Hypothesis 2: The biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability.

¹⁰ Hypothesis 3: The biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health.

HYPOTHESIS 1 (H₁)

Hypothesis 1 (H₁) proposes that the social determinants of health influence the prevalence of conditions associated with disability (impairments), thereby influencing disability rates. This research found significant evidence suggesting that elements of the social determinants are influencing the onset of severe disability. While the classic elements of the social determinants are not particularly strong in this research, education demonstrated the expected effects in Quebec and the income variables point toward significant effects as well even though they are not significant in the final models. According to this research, the strongest effects of the social determinants are from the behavioural risk factors dimension, specifically smoking, drinking, BMI and to a lesser extent fruit and vegetable consumption and physical activity. Further, the health indicator variables also support the social determinants approach and the notion that these variables can be used as risk factors to indicate future health challenges. While there are clearly effects from the more traditional medical perspectives such as chronic conditions and aging, there is also ample evidence to suggest that the social determinants of health also play a role in the onset of disability. Despite the inclusion of clearly medical concepts, this research has attempted to implement the social model as much as possible by focusing the analysis on the prevalence of conditions or impairments that could interact with unsupportive environments to result in disability. While not ideal, this approach is necessary given the available data sources and reveals a number of influential factors on the prevalence of impairments while using the social determinants approach.

HYPOTHESIS 2 (H₂)

Hypothesis 2 (H₂) suggests that the biological underpinnings of the impairments associated with disability could be more prevalent in Nova Scotia due to various elements of the social determinants of health, resulting in a higher prevalence of disability. Overall there is solid support for H₂ with extensive evidence suggesting why the disability rate in Nova Scotia is higher than Ontario or Quebec. Nova Scotia's older age structure sets the stage for many of the results that follow to support H₂. According to the social determinants, income is one of the most important elements and this is one area where Nova Scotia stands out for having low income. While income is not significant in the final models, there is ample bivariate evidence to suggest that income is much lower on average in Nova Scotia than it is in Ontario, fostering the potential for increased prevalence of conditions associated with disability. Education levels are also much lower in Nova Scotia than Quebec or Ontario and these differences are often significant in the NPHS data. Even though education is not significant in the model for Nova Scotia, the effects are significant in Quebec and point to important effects from this factor.

Behavioural risk factors also play a critical role in supporting H₂ for this research. Nova Scotia reports a number of behavioural risk factors that previous research has linked to significant health consequences. For example, smoking is one of the strongest predictors of mortality (Shields, 2005) and poor health (Shelton, 2009). Even though the results for this variable are mixed in this research, the fact that Nova Scotia has a very high smoking rate is not a sign of good health behaviours. Moreover, Nova Scotia's high

rate of obesity and low consumption of fruits and vegetables also points to poor health behaviours and increased risk for conditions associated with disability. Evidence of the results of these health behaviour choices are clearly evident in the chronic condition and health indicator dimensions where Nova Scotia reports the greatest rates of chronic conditions and poorest levels of general health. Considering all of this evidence together paints a portrait of poorer overall health in Nova Scotia relative to Ontario and Quebec. Therefore, the high disability rate does not appear unusual given the increased prevalence of risk factors associated with the social determinants of health that have also been linked to impairment and disability by this research.

Overall, the social determinants appear to play an important role in the onset of severe disability in Nova Scotia. The heavy overall rate of chronic conditions and poor health behaviours appear to play a particularly strong role in Nova Scotia but there are clearly other factors at work as well. Age is a significant predictor in all provinces and difficulty with activities of daily living also seem to play an important role and likely worsen as time passes.

HYPOTHESIS 3 (H₃)

The evidence for hypothesis 3 (H₃) is less clear. Recall that hypothesis 3 is as follows: the biological underpinnings of the impairments associated with disability may be less prevalent in Quebec, resulting in a lower prevalence of disability because of the social determinants of health. There is considerable evidence to support and refute H₃, suggesting that the social determinants play less of a role in the disability rates of

Quebec than they do for Nova Scotia. The first key piece of information to note is the stark differences in health between Quebec and Nova Scotia considering that their age structures are very similar. The fact that such similar age structures experience vastly different health outcomes and disability suggests that other powerful factors are also at play in Quebec. One of the key pieces of evidence to refute the social determinants argument in Quebec is the lack of effects that are detected in relation to low income. Recall that Quebec reports consistently low income levels in CCHS and NPHS. However, the effects of this low income are not evident as the social determinants of health approach predicts. In fact, the results of this research have shown that the opposite is true because Quebec often reports superior health according to a number of factors compared to Ontario and Nova Scotia. A second inconsistency between this research and the social determinants is the lack of effects for labour force indicators. Quebec's labour force statistics are notably weaker compared to Ontario and even Nova Scotia. The weaker labour market is expected to result in higher rates of poor health as well, which is again contrary to the results and does not support the social determinants approach. However, the amount of time required for these types of effects to become evident is not clear and this research is limited by the sixteen year follow-up period of NPHS. It should be noted that during the NPHS follow-up, Quebec experienced the largest growth in severe disability and chronic conditions. As the effects of the social determinants continue to run their course, the rates of poor health and disability may increase to the expected levels. Quebec's growing rates of poor health and disability

may also be driven by some individual factors such as their high rates of smoking, rapidly increasing mental distress scores, and somewhat lower rates of physical activity.

There is also evidence to support the social determinants of health in Quebec. Perhaps the strongest evidence is the significance of education in the final model. Even though the results are not perfectly linear, the fact that people in the highest education group have the lowest risk for severe disability suggests there are some protective effects from high levels of education. Combined with Quebec's highly polarised educational attainment, this result suggests that having high education is more influential on health than having low education. Quebec's high consumption of fruits and vegetables and their low BMI scores also suggest support for H₃. While the fruit and vegetable consumption and BMI scores are likely related, the BMI scores in particular provide solid support. The BMI scores are important not only because they are significant in the final model but also because Quebec tends to report smaller proportions of their population being overweight and obese. Finally, the extremely low rate of arthritis in Quebec as well as the low prevalence of chronic conditions in general also suggests that the disability rate in Quebec should be low and provides strong support for H₃. In fact, the common thread between Nova Scotia and Quebec that most supports the understanding of the differences in their disability rates relates to the chronic conditions and their overall rates. The high rates of chronic conditions in Nova Scotia seem to be directly related to the high disability rate while the low disability rate in Quebec also appears to be related to the low overall rate of chronic conditions. As noted, previous research has shown that low rates of chronic conditions are attributable

to the social determinants as well (O'Neill et al, 2012), although this research was not designed to examine this type of effect. As much as this thesis has tried to follow a social model approach in the analyses of these data, the results of this research suggest that the overall rate of chronic conditions and arthritis in particular, are closely related to the prevailing disability rates for each province. This research has focused on the factors associated with the onset of severe impairment and disability. Future research may benefit from studying the onset of chronic conditions while making the assumption that high rates of chronic conditions will be associated with high disability rates and low rates of chronic conditions will be associated with low disability rates.

Overall, the evidence for H_3 is less consistent than H_2 so there may be additional factors at play in the Quebec data. Education is the sole classic indicator from the social determinants to suggest that the disability rate should be low while income and labour force activity do not appear to have major effects. The BMI scores are also significant yet the high rates of smoking and growing rates of chronic conditions and mental distress during the follow-up suggest Quebec's disability rate should be higher in the 2010 CCHS data because it is unlikely these effects began at the same time as the NPHS interview in 1994 so their effects have likely been at work for more than 16 years. Future research can explore this hypothesis through a longitudinal survey with a longer follow-up period that focuses on the impact of chronic conditions. This research must accept that support for the social determinants of health is not absolute in Quebec. The disparity in the Quebec disability rates may be due to additional factors beyond the

social determinants of health and demographics. Directions for future research are discussed in the final chapter of this research.

SUMMARY

The results of this research show that the social determinants of health play a key role in the onset of disability. In Nova Scotia, the combination of demographic factors, limited SES indicators, health indicators, behaviours and chronic conditions join together to paint a picture that clearly explains why the disability rate is consistently high in this province. As noted, the 1994 NPHS data show that Nova Scotia demonstrates high rates for a number of risk factors according the social determinants of health framework, which explains the historically high rate of disability in this province. Turning to the 2010 NPHS and CCHS data further reveals the negative health outcomes associated with the high rates of risk factors compounded over time. The CCHS data clearly show that Nova Scotia continues to report high rates for many risk factors so the high disability rates will likely continue for many years in the future. The results of this research combined with historical disability rates from other provinces and data sources suggest Nova Scotia's disability rates appear to be logical. The most striking characteristic is the heavy impact of chronic conditions. Nevertheless, the limitations of the data sources and the analytical approach may have limited an even fuller understanding of the impact of chronic conditions. This topic is discussed in the future research section of the final chapter of this thesis.

The explanation for Quebec's historically low rates of disability is less clear. The social determinants of health do not appear to play nearly as strong a role in Quebec as they do in Nova Scotia. Unlike Nova Scotia, Quebec's low income, weaker labour market and high smoking rates do not appear to have significant effects on the disability rates. The limited support for the social determinants stemming from education, BMI, fruit and vegetable consumption, arthritis and a low overall rate of chronic conditions suggest that there is at least some support but there may be other factors at play. The direct evidence regarding the social determinants combined with the indirect evidence drawn from the low rate of chronic conditions suggest some support for the notion that the social determinants are at work in Quebec. Nonetheless, the results also suggest that the explanation for Quebec is more complex and may involve other factors beyond the social determinants of health, possibly including topics such as culture and social identity. As noted in chapter 2, the individual decision whether to report a disability is a complex individual process that may be impacted by other factors beyond the social determinants of health more strongly in Quebec than the other provinces. Given the unique cultural history of Quebec this possibility does not seem unreasonable but more research is needed.

In conclusion, there is clearly support for the notion that the social determinants of health can affect disability rates but this association is not absolute, particularly in Quebec. A number of significant factors influencing the onset of severe impairment and disability are identified and discussed in relation to historical patterns and current trends. This research has also identified several areas for future research to expand

upon this work and endeavours to point out its limitations. The final chapter of this thesis discusses the limitations of this research in detail while also suggesting directions for future research on discrepancies in disability rates.

CHAPTER 7 – CONCLUSION

The goal of this thesis is to shed light on the unusual distributions in the patterns of the disability rates in Quebec and Nova Scotia. The notable consistency of these patterns across time, between survey contexts and different assessment questions clearly warranted further investigation. The limited previous research in this area meant this thesis could break new ground to help explain this phenomenon and begin to provide some understanding for the factors behind this astounding consistency. Even though this thesis cannot explain all of the discrepancies, particularly in Quebec, this thesis has opened the door for future research to continue moving forward. The purpose of this final concluding chapter is to discuss some of the limitations associated with this research as well as highlight some possible directions for future research.

LIMITATIONS

There are a few important limitations to understand when considering the results of this research. None of these limitations are believed to compromise the integrity of this research but it is important to be aware of these limitations when considering the results. One of the most important limitations stems from the theoretical position of this research yet due to the extensive use of data in this research, many of the limitations involve the data sources and surveys in general or the analytical techniques and assumptions that are used. The discussion of limitations in the data sources begins with the theoretical discussion before beginning the discussion of

limitations that are applicable to most surveys and then focuses specifically on CCHS and NPHS.

The major theoretical limitation of this research is the inability to study the disability reporting discrepancies at an individual level using a social model perspective that could also involve dimensions of power and the creation of the disability category. This level of detail is simply not available from quantitative sources because it would need to involve discussions of the individual's decision to report disability as well as their conscious perceptions of the experience of the disability category creation process. Qualitative research would also be hard-pressed to provide information this abstract so it is unlikely that future research will ever be able to fully explore all of the factors influencing the discrepancies in disability rates in Canada data sources.

The remainder of limitations in this research involve the data specifically. For example, statistical agencies commonly rely on surveys administered to a tiny portion of the total population for a number of reasons but primarily to minimise costs and reduce burden on citizens. In the example of CCHS or NPHS, asking a 45 minute health questionnaire to the entire population of Canadians (35,056,064 in 2013) would cost hundreds of millions of dollars each year and place an additional burden on every Canadian and that is just for one survey. National statistical agencies often have dozens of different surveys collecting information on a wide variety of topics ranging from labour force participation, health, victimization, internet use and many others. Sampling theory has shown that selecting a small fraction of the total population for a

survey can yield results that are extremely precise for a tiny fraction of the cost of interviewing the entire population (Govindarajulu, 1999). For example, the CCHS sample is the second largest of all regular household surveys at Statistics Canada at 65,000 people but this 'large' sample is only 0.2% of the total population twelve years of age and older that it is trying to represent ($65,000 / 30,361,441 * 100$). While Statistics Canada uses a complex survey design to ensure that the sample is as representative as possible, there is still a possibility of missing portions of the population, particularly those with rare characteristics like disability, or selecting a less than perfectly representative sample. In addition, there are always respondents that refuse to participate or do not participate for other reasons (health, absence, institutionalisation etc). The characteristics of this portion of the sample are unknown so it is impossible to know if there is a correlation in the non-response pattern that could bias the sample. Statistical agencies assume that the non-response is random because there is not any information on these people to prove otherwise. Non-response is a particularly important limitation for longitudinal surveys such as NPHS because the rate of non-response typically grows with every cycle. By the ninth cycle of NPHS, the representativeness of NPHS was still considered very good due to the large initial sample size, although approximately 1,500 of the original 17,276 members of the longitudinal panel had stopped responding to NPHS and approximately 3,000 died. Nevertheless, the fact that NPHS and CCHS are sample based surveys should not discredit the results. Sample surveys form the basis of national statistical systems around the world and Statistics Canada is a well respected national statistical agency

that makes every effort to ensure the results are accurate. While this limitation is certainly valid, the risk of the results being completely wrong due to sampling errors or non-response errors in NPHS and CCHS is extremely remote. This limitation is mentioned to ensure that caution is used when making conclusions based on the results of this research.

A second limitation that applies to most surveys, including NPHS and CCHS, suggests that human behaviour is too complex to be measured by standardised questionnaires with closed-ended questions designed for simplicity rather than clarity (Cloke, Philo and Sadler; 1991). While this criticism is particularly relevant for very complex topics such as criminal behaviour or voting intentions, this criticism is much less applicable to NPHS and CCHS data because many of the answers are truly dichotomous (i.e. Have you ever been diagnosed with cancer by a health professional?). As noted in chapter 3, many of the questions that do have multiple categories such as self-rated health and the questions that comprise the Health Utilities Index have been validated repeatedly and are considered to be good representations of the realities being reported by the respondents. Direct physical measures from the Canadian Health Measures Survey (CHMS) would eliminate this concern. However, the exceptional cost of this approach to data collection results in extremely small samples that cannot produce provincial estimates, even after combining multiple years of data. This topic is discussed further in the future research section of this thesis.

A third limitation to the results of this research involves the lack of a true disability measurement instrument on Canada's national health surveys. The history and politics behind Canada's lack of a proper disability measurement instrument on its surveys are beyond the scope of this thesis but the important point to note is that such a module is long overdue. This research modifies the HUI to function in a manner that respects the principles of the social model of disability yet several of the questions in the HUI module could also use modification to reflect these principles more precisely. Therefore, the modified HUI measure is the best available measure of disability but a true measure of disability consistent with the social model would be preferred.

Another limitation that is encountered through this research involves the sample size of the data sources. Even though CCHS is the second largest ongoing survey at Statistics Canada, studying a rare population such as disability and then stratifying by various characteristics often results in small samples or suppression. These small samples are often publishable but differences that appear to be meaningful are rarely significant. This limitation is especially problematic in Nova Scotia where many apparent differences are not significant, even though smaller differences for the same characteristics involving Quebec and Ontario are significant. A secondary problem related to sample size is the reduction in sample that is experienced when industry or occupation variables are used. As noted, Censuses and surveys typically ask about the industry and occupation for people who have worked recently. People who have not worked recently are excluded from these questions. This limitation has an important impact because most people age 70 and beyond are excluded from the multivariate

analysis automatically due to their missing values for industry and occupation yet these people are the most likely to be transitioning to a health state that is of interest to this research. Further, the length of time that appears to be necessary for the social determinants effects may stretch well beyond the working years and into retirement. However, it should be noted that these cases are only excluded when the occupation and industry variables are included in the models. Once these variables are removed, the excluded cases are included in the analysis because they no longer have missing values for variables included in the model. While this data gap does limit the ability of researchers to understand the full impact of occupation and industry on future health and disability status, the NPHS did follow people for 16 years. The people that were about to retire when NPHS began in 1994 would have provided their industry and occupation and this information is included in the models so powerful effects could have been detected.

The small sample size for NPHS also limited this research due to the limited availability significant differences as well as the limits placed on the analytical techniques that are possible. In fact, the small sample size of NPHS results in such a small number of transitions between severity categories that only transitions into the severe disability category contained adequate sample for analysis. As noted in chapter 3, the transitions included for analysis comprise all cases that began the longitudinal panel in any category below severe and transitioned into this category at some point during the follow-up period of the NPHS.

There are also some limitations that are specific to the NPHS that should be mentioned. The most notable limitation regarding NPHS is the short follow-up period for this longitudinal survey. Human health does not typically change dramatically over a period of 16 years so a longitudinal health survey should continue for more than 16 years to ensure significant changes in the participants are detected. With a longer follow-up period, this research would have benefited from more time to observe the effects of the social determinants and other factors over time while also accumulating more cases for analysis that have transitioned into the population with severe disability.

A final limitation that relates strictly to NPHS concerns the longitudinal nature of the survey and the decision not to top up the sample with each cycle of data collection. When NPHS began in 1994, it was representative of the entire population of Canada. However, as noted previously, the representativeness of NPHS compared to the general Canadian population decreased as more time passed due to births, immigrants, mortality and non-response. Therefore, the comparability of NPHS to CCHS declined over the 16 years, meaning estimates from the two files should not be directly compared. In this research, data from the two sources are not directly compared; CCHS data are taken as the true population estimates for 2010 while the NPHS data provide estimates for the NPHS longitudinal panel as it existed in 2010. The estimates for the NPHS longitudinal panel are used to approximate the influence of factors affecting impairment and disability over time, to provide understanding for why the current CCHS estimates are distributed the way they are. While this approach is not ideal, the extensive overlap between CCHS and NPHS make this arrangement the best possible

approach using the data sources that are available. The ideal situation would be either cross-sectional estimates from NPHS or a longitudinal component to CCHS but neither of these options is currently available.

A final global limitation to this research is its inability to conduct a proper evaluation of the social model. This research makes every effort to use a social model approach through methods such as re-programming the HUI macro and including activities of daily living elements yet this is not enough for a true evaluation of the disability rates using a social model approach. The key missing data involves the influence of the environment on the person with an impairment but this type of data does not currently exist. It is hoped that future data sources will be able to provide this information so that a proper evaluation of the social model of disability can be conducted.

In summary, none of the limitations are believed to represent major risks to the quality or precision of the results provided in this thesis. Many of these limitations relate to most research that involves a statistical nature or attempts to test the social model. While it is important to recognise and understand the implications that are associated with these limitations, they should not be interpreted as significant criticisms regarding the validity of this research.

FUTURE RESEARCH

The final section of this chapter suggests possible areas for future research to expand upon this thesis and provide further contributions to the literature. These

suggestions are grouped into three categories including assumptions, survey content improvements, and new research topics. The common thread joining these suggestions is they expand upon knowledge uncovered in this research and have the potential to take it in many different directions.

ASSUMPTIONS

One of the most critical assumptions in this research assumes that Ontario residents report disability using the same thought processes and subject to the same forces as other provinces, meaning they can be used to make neutral and valid comparisons to Quebec and Nova Scotia. This assumption seems reasonable based on the results of this research combined with historical statistics. Nevertheless, the only way to know for certain would be to conduct a study that examines the disability rates and characteristics of all Canadian provinces and territories separately to determine the factors underlying the evolution of disability rates as well as the neutrality of Ontario's results. This approach is beyond the scope of this research but would be a valuable contribution to future literature.

A second related assumption concerns the reliability of self-reported survey data. The NPHS and CCHS rely upon the honesty and accuracy of the self-reported data to avoid the enormous costs of sending medical professionals to conduct detailed physical assessments and collect specimens for laboratory analysis. While Canada does have a survey that uses this approach called the Canadian Health Measures Survey (CHMS), the sample size is extremely small due to the enormous cost of collecting such

detailed information from each person. Currently, the first two cycles of CHMS are not sufficient to produce estimates below the national level due to small sample sizes. Future research will benefit from combining multiple cycles of CHMS to analyse the physical assessments by province but this possibility is still several years into the future.

A final assumption that could be improved upon by future research involves the conceptual approach of this research and the treatment of chronic conditions. This research has attempted to examine the impact of the social determinants of health on the onset of severe disability. Chronic conditions are included because they can be used to indicate risk factors for future health challenges and also because they can be found underlying many forms of disability. Every effort is made to study the effects of the social determinants through numerous dimensions because this approach is most consistent with the social model of disability. Nevertheless, the powerful effects of chronic conditions and the overall impact point to the importance of better understanding the role of chronic conditions in the onset of severe disability. As much as the social model would like to argue that the presence of a chronic condition is irrelevant or medical model based, the results of this research suggest that more work is needed in this area. Future research could examine the onset of severe disability strictly from a chronic condition perspective by determining the factors that predict the onset of chronic conditions and make the assumption that high rates of chronic conditions will be associated with high rates of disability. While this assumption contradicts the social model, effective measures of the accessibility of environments are still many years away. Moreover, the lack of significance for the overall presence of chronic conditions

indicator could be due to the inclusion of chronic conditions that are not associated with the onset of disability. Future research could analyse which chronic conditions are most associated with the onset of disability and include only those chronic conditions in the index that is used in the models. This approach would require significant research both statistically and conceptually and is therefore beyond the scope of this research.

SURVEY CONTENT IMPROVEMENTS

Surveys undergo extensive consultations and revisions during their development to ensure that critical data needs are measured properly and nothing is overlooked or neglected. The best available questions and modules are used to provide the maximum utility from the data. Nevertheless, ongoing research is always discovering new and better ways to ask questions or uncovering problems with existing questions. This research follows the same tradition and has uncovered a few areas where future research could improve upon this work if content changes were made to future surveys, particularly longitudinal surveys.

The first cycle of NPHS was a landmark victory in the history of health statistics in Canada and broke new ground in countless areas. Nevertheless, there are two key concepts that were not included in the initial cycle that would have significantly improved the quality of this research. Future longitudinal health surveys could benefit from including these indicators because this research and existing literature suggest they could have significant effects. The first concept is fruit and vegetable consumption. This information was added to NPHS in cycle 5 but the lack of this data in the first four

cycles significantly reduced the effectiveness of this research to detect significant effects. The CCHS regularly collects this information so it is likely that any future longitudinal health survey would do the same but it should be mentioned to be sure. The second key concept that was missed in the initial cycle of NPHS was alcohol dependence. There are variables to indicate of what the type of drinker the person is (regular, occasional etc). However, separating social drinkers from alcoholics is not possible until the alcohol dependence module was introduced for cycle 2 and it was not a regular component of NPHS. A final key concept that is missing for many NPHS respondents is the historical occupation and industry information for people who have not worked recently. As noted above, the occupation (and industry) variables are missing for people who have not worked recently, resulting in a smaller sample and lack of knowledge regarding their occupation history. Obtaining an overview of the occupation and employment history from each respondent would provide a much more useful portrait of the type of work they did, their occupational status and the types of environments they were exposed to. Adding fruit and vegetable consumption, more precise alcohol measures, and more detailed industry and occupation information could have significantly enhanced this research so it is hoped that they would be included in future longitudinal health surveys.

The final area for future research concerning survey content improvements involves the measurement of disability itself. As noted during the limitations discussion, the lack of a proper disability measurement module is an obstacle for this research. Fortunately, in 2010 the government of Canada embarked on a new disability data

strategy announced by the Federal Disability Reference Guide (Human Resources and Skills Development Canada, 2010). It is hoped that this strategy will include a new approach to measuring disability that is consistent with the social model and properly validated for the target population. Following the implementation of this new approach to measurement, future research will have the opportunity to explore whether the Quebec and Nova Scotia effects exist and further explore the factors associated with these effects using a new and improved measure of disability.

NEW RESEARCH TOPICS

The final area for future research involves new directions for research that are not covered in the assumptions or survey content improvement sections above. One of the key limiting factors in the testing of the social determinants is the lack of a validated occupation index that would be appropriate to the study of health and disability. Many of the possible indexes available approach occupation strictly based on prestige or a similar variable (Boyd, 2008). Recall that this research employed the Boyd (2008) index for occupation prestige yet this scale did not have any significant effects in this research. The lack of information about the occupation and industry of the respondent is also a problem, as noted in the previous section. A key area for future research would be to develop an occupational classification system that is appropriate for studying the long-term effects of occupation on the future health and disability of the survey participants. This classification system would incorporate the many different types of physical and psychological environments that workers may be exposed to ranging from the physical, chemical and biological environments to the amount of stress and perceptions of self-

mastery that can also affect long-term health. A similar type of classification system could also be developed for industries. The ultimate goal of this index would be to score the various industries and occupations on a scale ranging from minimum to maximum long-term risk for health and disability. While this area of research would be extremely challenging, this work would be very useful to researchers across the field of health research.

A final direction for future research would be to examine the effects of mortality in the longitudinal NPHS panel on the results of this research. Some of the factors included in this research appear to be affected by the much higher mortality rates associated with them. Smoking is the best example. There is extensive research proving the increased mortality risk associated with smoking (Fenelon, 2013; Kreuger, 2011; Lanz, 2010) yet the effects on disability remain unclear. This research found some indication that regular smokers have a higher risk for acquiring a severe disability but this relationship is among the weakest in this research. Future research could explore the effects of mortality on the performance of smoking and other factors in relation to predicting the onset of severe disability through the use of more frequent follow-up periods with a smaller cohort of smokers. This research could also be linked to factors predicting morbidity and feed into current understandings of not only mortality but also morbidity.

A final area for future research would be to continue investigation of the Quebec effect using different methods from this research. While this research does find support

for the hypothesis that Quebec's disability rate should be lower than Nova Scotia and occasionally Ontario, there is also evidence to suggest that other factors are at work in Quebec. This research problem may require an element of qualitative research, possibly through a mixed-methods design. One possible approach may be to develop a model of disability reporting behaviour for Canada without Quebec and then apply this model to Quebec to identify whether there are cases that are not reporting disability as expected according to the model. These cases could then be isolated for analysis and invited to a qualitative interview. This interview would provide a unique opportunity to discuss their perceptions of reporting disability and compare these perceptions to participants in other provinces. This type of approach could also identify whether cultural or social identity effects are also at work, which could never be uncovered through a strictly quantitative approach.

There are many areas for future research to expand upon this thesis. These areas include adjusting the assumptions, improving survey content and entirely new approaches to studying this topic. While there has been limited previous work in this area, it is hoped that this thesis and future research can continue to provide further understanding of these unique phenomena.

CONCLUSION

This research attempts to explore the reasons behind the Quebec and Nova Scotia effects by examining the factors affecting the onset of severe impairment and disability over time. Cross-sectional data are used to examine current estimates while

risk factors over time are assessed with the longitudinal data. There is solid evidence to suggest that Nova Scotia should have a significantly higher disability rate. While there is little they can do about their age structure, behavioural risk factors such as poor nutrition and high obesity suggest that modifications are possible. Quebec's results are more intriguing. The limited evidence for the social determinants suggests they are a factor in Quebec yet the inconsistency of the results, particularly the high smoking rate, suggest Quebec's disability rate should be higher. Quebec's disability rate did increase the most between 1994 and 2010, suggesting it may be catching up, yet the other results suggest there are other factors at work in Quebec as well.

In conclusion, this research provides new information to the understanding of the Quebec effect and the Nova Scotia effect. The incredible persistence of these effects is less of a mystery than before this research but much work remains to be done. The new information contributed by this research has the potential to assist disability researchers in their understanding of the data and interpreting their conclusions while also guiding future researchers to more effective results. Finally, it is hoped that this research will contribute to global understanding of the risk factors for severe impairment and disability and the appropriate measurements that are needed for the analysis of discrepancies in disability rates.

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APPENDIX A: BACKGROUND OF THE DATA SOURCES

BACKGROUND AND OBJECTIVES OF THE NATIONAL POPULATION HEALTH SURVEY

The late 1980s and early 1990s were a time of considerable development for health information in Canada. In 1991, the Health Information Roadmap was created by the National Task Force on Health Information and included provisions for a large nationally representative health survey (Statistics Canada, 2012a). This survey would become the National Population Health Survey and collected its first cycle of data in 1994/95. The objectives of the NPHS were as follows:

- Aid in the development of public policy by providing measures of the population's health status, analysis of these measurements, and trends observed.
- Provide data for analytical studies that will assist in understanding the determinants of health.
- Collect data on the economic, social, demographic, occupational and environmental correlates of health.
- Enable better understanding of the relationship between health status and health care utilization, including alternative as well as traditional services.
- Provide information on a panel of people who will be followed over time to reflect the dynamic process of health and illness.
- Provide the provinces and territories and other clients with a health survey capacity that will permit supplementation of content or sample.
- Allow the possibility of linking survey data to routinely collected administrative data, such as vital statistics, environmental measures, community variables, and health services utilization (Statistics Canada 2012a).

Many of these objectives are attractive to this research but two stand out in particular. First, collecting information to help understand the determinants of health is perfect for this research as discussed in chapter 2. Second, following a panel of people over time provides the longitudinal data needed for this research. In 1994, there was considerable

doubt whether a large panel could be followed over time but the NPHS was able to do so for 9 cycles, providing a rich data source for this research.

TARGET POPULATION

The target population of the NPHS Household component is all household residents in the ten provinces ages zero and older. The NPHS is representative at the national and provincial level but it is not representative of the Territories or for sub-provincial estimates. The NPHS program had a separate survey specifically for the Territories. There are also a few exclusions to note. These exclusions include persons living on Indian reserves and Crown lands, residents of health institutions, full-time members of the Canadian Forces living on Canadian Forces bases, and residents of some remote areas in Ontario and Quebec.

For this research, the most critical exclusion is people living on Indian Reserves and in institutions because of the much higher disability rates experienced by Aboriginal people (Ng, 1996) and people living in institutions (Statistics Canada, 1990). These areas are typically excluded from all Statistics Canada surveys due to the operational considerations related to the complexities of negotiating access to Reserves and the burden placed upon institutional staff to respond for their institutionalised residents. The impact of these exclusions is discussed in the next section. Unfortunately, data on the distribution of disability among full-time members of the Canadian forces are not available but there is no reason to expect that the distribution is anything but random given the very young age distribution of the Canadian forces and regular movement between military bases. The number of people living on Crown lands and in remote

areas is so tiny that no bias could result from their responses in a large survey such as CCHS, especially after adjustments that are made during the weighting process.

The impact of excluding people living on Indian reserves and in institutions is difficult to measure precisely due to a lack of specific information about the prevalence of disability within those populations. It is widely recognised that disability rates are much higher within both of these populations so the question becomes how equal is the distribution of these populations across the country and what is the effect of an unequal distribution. Therefore, this section endeavours to examine the impact of the exclusions as a percentage of the total population as well as an assessment of the distribution of people living on reserves in relation to the different types of institutions that are also excluded.

Overall, approximately 1.7% of the Canadian population resided in some type of institution and 1.1% of the Canadian population lived on an Indian reserve according to the 2006 Census of Population (Custom data extraction, August 2011). However, there is considerable variation between provinces for both On-reserve and institutional populations. The large populations of Aboriginal people in the Prairie regions are clearly evident on Figure 26 while there is also substantial disparity across the country in terms of the types of institutions where people were living.

The most common type of institution is related to healthcare. This group can include caring for seniors (i.e. old-age homes), persons with physical disabilities, persons who are developmentally delayed, persons with psychiatric disabilities, persons with

alcohol and drug problems, and emotionally disturbed children (Statistics Canada, 2012b). Prisons and shelters are much less common and roughly equally distributed at the Canada level. Group homes are extremely rare and fairly evenly distributed across the country as well (See Figure 26).

The impact on this research from excluding the On-reserve population and people in institutions appears to be minimal for several reasons. First, as a percentage of the population, these two groups combined represent just 2.8% of the total Canadian population. Second, the composition of institutionalised residents in Nova Scotia is very similar to the Canadian average so any biases introduced for Nova Scotia should be minimal given the size of the population. Third, while Quebec does have the third highest percentage for institutionalised populations that could potentially lower their disability rate, Newfoundland and Labrador and Prince Edward Island have even higher institutionalisation rates without any perceivable effect on their disability rates. Further, the Quebec institutionalisation rate is fairly similar to Ontario, whose disability rate also appears unaffected by people with disabilities being in institutions. Therefore, while disability is more common among some of the populations excluded from NPHS, their very small size combined with fairly even distributions for Ontario, Quebec and Nova Scotia suggest that any bias introduced by these exclusions should be minimal.

Figure 26: People Living on Reserve and in Institutions by Province, 2006

SAMPLE DESIGN

The sample design of the NPHS is a multi-stage stratified sample of dwellings selected from within clusters (Statistics Canada 2012a). A clustered design was chosen to allow personal interviews. A stratified random sample would have resulted in selected respondents scattered all over the country. A clustered design 'clusters' the respondents within certain regions to facilitate personal interviews and minimize travel costs. An interviewer does not have to travel to every respondent's area in the country, they can just travel to a cluster and there will be a number of interviews to do nearby within that 'cluster.' The drawback to a cluster design is a less efficient sample design that results in a higher design effect. The sampling frame for all provinces (except

Quebec) was people who had participated in the Labour Force Survey (LFS) because the LFS is also a cluster design and offers good contact information. In Quebec, the sampling frame was people who had been interviewed by the Quebec Ministry of Health (Santé Québec) for their 1992-93 Enquête Sociale de la Santé (ESS). Overall, 19,600 dwellings were selected for participation in the 1994 NPHS. Once a dwelling was selected within a cluster from the LFS or ESS sampling frame, the dwelling was contacted, all occupants were listed and one dwelling occupant was randomly selected to become the NPHS respondent. This respondent also became a member of the longitudinal panel. The 1994 NPHS obtained 17,276 completed interviews for a response rate of 88.1%. Nearly all of the interviews in the first cycle were conducted in person and this approach slowly changed to the point that only about 5% of all the interviews in 2010 were done in person. The rest were done by telephone (Statistics Canada, 2012a).

One of the most important risks to a longitudinal panel is attrition or a loss of panel members. By 2010, NPHS only had 9,293 cases that had participated in all 9 cycles of NPHS. Some cases had been lost to mortality (~3,000), while others had refused to continue participating in the panel (~1,500) or they had disappeared and could not be re-contacted for subsequent participation (~2,000). The remaining 1,500 cases had participated in multiple cycles of NPHS but they had not participated in all nine cycles of NPHS (Custom data extraction, September 2012).

The final point to note about NPHS is this survey began as both a longitudinal and cross-sectional survey in 1994 and this profile was maintained during the first three

cycles. There were augmentations to the sample to achieve cross-sectional representation but these additional cases did not become part of the longitudinal NPHS panel. They were strictly used as cross-sectional participants. The popularity and success of the early NPHS cycles led to significant interest in expanding Canada's health survey portfolio. These changes led to NPHS becoming strictly longitudinal in 2000 and the creation of the CCHS to continue providing cross-sectional estimates but with much more geographic detail.

BACKGROUND AND OBJECTIVES OF THE CANADIAN COMMUNITY HEALTH SURVEY

The CCHS has four primary objectives:

- Support health surveillance programs by providing health data at the national, provincial and intra-provincial levels
- Provide a single data source for health research on small populations and rare characteristics
- Timely release of information easily accessible to a diverse community of users
- Create a flexible survey instrument that includes a rapid response option to address emerging issues related to the health of the population. (Statistics Canada, 2011b)

These objectives offer a number of attractive possibilities for this research. First, the large sample size of CCHS data allows for detailed analysis at the provincial level. Second, the ability to study rare characteristics in considerable detail also makes CCHS a logical choice because disability is quite rare in the general population. Finally, the exceptionally quick release of the CCHS data allows for research based on data that are never more than 18 months old.

TARGET POPULATION

The target population of the CCHS is all persons age 12 and older living in private households in the 10 provinces and three territories. People living on Indian Reserves or Crown lands, living in institutions, full-time members of the Canadian Forces and residents of certain remote regions are not included in the CCHS (Statistics Canada, 2011b). These are the same exclusions as the NPHS and they are very typical for Statistics Canada surveys. As noted previously, any bias introduced to these surveys due to the exclusions should be minimal.

SAMPLE DESIGN

The sample design of CCHS was designed from the very beginning to be representative at the health region level. The exact sample design of CCHS is highly complex, much more so than NPHS and involves considerable technical discussion that is beyond the scope of this thesis. Therefore, this thesis only provides a general overview of the approach, for more information see Statistics Canada (2011b).

Each year, the CCHS endeavours to provide complete data for 65,000 households per year. To ensure that the data produced by CCHS are reliable and valid at the health region level of geography, the multi-stage cluster sample design includes a minimum of 500 households for nearly all of the 121 health regions in Canada. This step alone requires a total of 60,500 households to ensure reliable data. The only health regions that contribute less than 500 households to the CCHS sample are those with sparse populations where there would be a serious response burden placed upon local

residents (i.e. a majority of residents would be selected). They would have a much higher chance of being selected by CCHS and any other survey that stratifies at low levels of geography (LFS, NHS etc). The remainder of the households are randomly selected and allocated proportionally according to the population size of each province. This approach yielded a total of 65,762 households in 2010, including an additional sample purchased for the province of Ontario. These sample sizes are then increased to account for expected non-response rates based on previous years of CCHS. The total raw sample size was 107,711 for 2010. Approximately half of the households were contacted by telephone and the other half were contacted in person. Lastly, within each household, one participant 12 years of age or older was randomly selected and they became the CCHS participant. In total, 63,191 people participated in the 2010 CCHS.

BACKGROUND AND OBJECTIVES OF THE PARTICIPATION AND ACTIVITY LIMITATION

SURVEY

Canada has a rich history surveying persons with disability. Canada was the first country in the world to launch a survey that respected the principles of the World Health Organization's (WHO) first attempt at a disability classification system (International Classification of Impairment Disability and Handicaps, ICIDH; 1980) through the 1986 Health and Activity Limitations Survey (HALS; McColl, 2006). Canada was also the first country to produce time series data for persons with disability by making the 1986 and 1991 HALS surveys comparable, allowing researchers to study

trends in the disability population and compare labour force characteristics between the economic boom of the mid 1980s and the recession of the early 1990s. By the late 1990s the ICIDH had become obsolete as global thinking about disability shifted away from the medical model-based ICIDH toward the social model. Canada needed a new disability survey based on the social model and the ICF. In 1999, development of a new disability survey began based on the ICF. In the fall of 2001, PALS began its first cycle of data collection and the PALS would be repeated again in 2006, once again offering time series data about the population of persons with disabilities (Statistics Canada, 2007a). In the spring of 2010 the PALS program was cancelled and replaced by a similar yet slightly different survey called the Canadian Survey on Disability (CSD). The CSD began data collection in late 2012 and will release its first results December 3rd 2013, which is too late for this research. The PALS and CSD are similar conceptually but differences are sufficient to terminate the time series comparability.

PALS 2006 also had several objectives relating to the collection, analysis and dissemination of statistical information for the population of persons with disability. These objectives included:

- Develop a comprehensive database on persons with disabilities.
- Disseminate a profile of persons with disability by province/territory and age groups.
- Assist social policy development by governments at all levels.
- For 2006: Maintain time series comparability with the 2001 PALS. (Statistics Canada, 2007a)

TARGET POPULATION

The 2006 PALS target population included all adults and children with an activity limitation or participation restriction associated with a physical condition, mental condition or health problem and were living in Canada at the time of the Census. This population included people living in private and some collective dwellings in all provinces and territories. However, similar to NPHS and CCHS there were some exclusions for operational reasons. These exclusions include people living on First Nations reserves, residents of institutional and some non-institutional collective dwellings, full-time members of the armed forces, as well as campgrounds and parks (Statistics Canada, 2007a). As noted during the NPHS target population discussion, these exclusions represent a very small portion of the population and any bias introduced into this survey should be minimal. The lone difference between the NPHS/CCHS and PALS is the specific exclusion of people living in campgrounds and parks. This exclusion is due to the fact that all PALS interviews were done by telephone and telephone numbers are rarely available for these dwellings. NPHS and CCHS could send interviewers to the camp sites and parks if these dwellings were to be selected but this is not possible with the telephone interviews conducted by PALS. Once again, this exclusion represents a tiny fraction of the Canadian population, so small that it is not even published on 2011 Census counts of dwellings (Statistics Canada, 2012b).

SAMPLE DESIGN

The rarity of the population of persons with disability requires a very different sample design compared to CCHS and NPHS. General population surveys such as CCHS and NPHS can use almost any sampling frame that is representative of the target population at the required level of geography. If a disability survey is going to produce reliable estimates with acceptable quality it needs to begin with either a massive sample size (600,000+ for MinP= 10%, CV=16.5%; Statistics Canada, 2011c) or a sampling frame of people that have been pre-identified to have a disability. A massive sample size requires an even more massive budget to collect the data thus PALS opted for the latter. To produce a sampling frame for PALS, a set of four questions was inserted into the Census long form to ensure a sufficiently large sampling frame of pre-screened persons with disability. The set of four questions were as follows:

Do you have any difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities? *Answer categories:*

- Yes, sometimes
- Yes, often
- No

Does a physical condition or mental condition or health problem reduce the amount or the kind of activity you can do:

- At home?
- At work or at school?
- In other activities, for example, transportation or leisure?

- *Answer categories:*

- Yes, sometimes
- Yes, often
- No

These questions produced a sampling frame for PALS that offered approximately 6.6 million persons with disability from which to sample. While there is no indication of the type of disability the person has, a crude severity variable was created by summing the responses using a point system. Zero points are assigned for no disability, one point for sometimes and two points for often. This crude severity scale was one of the stratification variables for sample selection.

The sample design of PALS was relatively simple compared to NPHS and especially CCHS. PALS used a multi-stage stratified random sample design. Multi-stage term refers to the initial sampling frame creation through the Census followed by selection for PALS. The stratification variables for PALS were province/territory, followed by age groups (0-14, 15-24, 25-44, 45-64, 65-74, 75+), gender and the crude severity scale noted previously (Statistics Canada, 2007a). Since PALS only conducted telephone interviews it did not use clusters so it was a very efficient design.