THREE ESSAYS ON HEALTH AND AGING IN CANADA

By

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A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

Department of Economics
University of Manitoba
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ABSTRACT

This thesis consists of three papers on health and aging in Canada. The first essay is concerned with the opportunity costs of providing informal care to the elderly people. Using the General Social Survey (1996) data this essay examines the impact of informal care on the caregiver's labour market behaviour. This is achieved by estimating the impact of informal care on the caregiver's employment and work hours. The empirical results from estimating employment model suggest that caregiving has no impact on caregiver's employment probability. Caregiving has also no significant impact on the work hours of male caregivers. However, caregiving has significant negative impact on the work hours of female caregivers. The paper also discusses the policy implication of the results.

The second essay uses health production function framework to estimate the impact of formal home care and informal care on the health of elderly people in Canada. The study uses National Population Health Survey (NPHS)-1996-1997 data and adopts ordered probit approach in the estimation process. Formal home care is found to have a positive and statistically significant impact on the health of elderly people. The results also show that informal care improves the health of elderly except in the case of 80+ male groups.

The third essay uses NPHS-1998 data and examines the impact of chronic diseases such as Arthritis, High Blood Pressure, Diabetes, Heart Disease and Cancer on

the labour market behaviour of individuals over life cycle. The study uses probit method to estimate labor force participation equation, ordered probit method to estimate the impact on illness on the probability of having full time, part time and no employment and Heckman's sample selection model to estimate the earnings function. The paper finds that Arthritis, Heart Disease and High Blood pressure are the common diseases that have significant negative impacts on the labor market behavior and earnings of both male and female individuals.

Chapter 1
Introduction

The general objective of this dissertation is to examine three important issues relating aging and health care in Canada. The specific objectives of the three essays comprising the dissertation are as follows.

The first essay examines the opportunity costs of informal care to the elderly population by estimating the effects of informal care on caregivers' labor market participation and work hour. The objective of the second essay is to examine the relative impact of formal home care and informal care on the health status of elderly people. The third essay examines the impact of chronic diseases such as, Arthritis, High Blood Pressure, Heart Disease, Diabetes, and Cancer on individuals' labor market participation, work hours and income. This essay also examines how the labor market impact of chronic diseases varies over life cycle.

The population of Canada is aging as a result of decreased fertility and increased longevity. In 1998, seniors represented 12% of the Canadian population; by 2016, it is anticipated that seniors will represent 16% of the Canadian population (Statistics Canada, 1999). The fastest growth is occurring among those in the older age ranges. In 1998, 10% of the seniors were 85 years of age or older; by 2016 it is anticipated that seniors 85 years of age or older will represent 13.5% of the population of seniors (Statistics Canada, 1999). Old age is associated with increased disability and an increased use of home care and institutional care services. To serve the elderly population, in the mid 20th century Canadian government started to develop institutional care system. However, because of

costs constraint, during 1990s governments slowed down the pace of growth of institutional care facilities and started to give more emphasis on community-based care. Major component of community-based care is informal care defined as unpaid care provided by relatives, friends and neighbors. By shifting burden of care from publicly funded institutional care to community based care, the government might have saved public money. However, in this process government ignores many hidden costs involved with informal care. Labor market related costs constitute a major part of such hidden costs associated with informal caregiving. There is little known causal relationship between informal care and labor market behavior. The first essay fills this gap and estimates the impact of informal care on the labor market behavior of individuals.

As noted above the current government health care policy emphasizes on shifting burden of elderly care from public funded institutional setting to community based care. Community based care has two components: formal home care and informal care. In Canada, formal home care comprises a range of services, such as professional services provided in home; supportive non-professional services provided at home; community based services such as adult day care services. Main source of community-based care is informal caregivers who provide more than 80% of elderly care. Few studies deal with effectiveness of community based care as a whole in comparison to institutional care. However, no study in Canada so far discusses the relative impact of formal home care and informal care on the health status of the elderly. Such analyses are needed to help policy makers in deciding whether government should expand home care program or whether government should spend public money to encourage informal caregivers. The second essay of this dissertation sets out to fill this gap in health care literature in Canada.

Relationship between health and labor market outcomes is a well-discussed issue in health economics. However, only a few studies examined the relationship between chronic illnesses and labor market behavior and so far no study attempts to do such analysis using Canadian data. Canadian data suggests that incidence of chronic conditions rises with aging. The third essay of the dissertation analyzes the impact of various chronic conditions of individuals' labor market behavior and examines how the impacts vary over the life cycle.

The three essays in the thesis are closely related. All three essays deal with health issues. The first two essays specifically focus on elderly individuals. The third essay focuses on chronic illness, aging and labor market outcomes. The common link between the first and the third essay is that both deal with labor market.

The major findings of the research are as follows: (i) Informal caregiving to the elderly has significant negative impact on the work hours of female caregivers. (ii) Both formal home care and informal care have significant positive impacts on the health of elderly population in Canada. (iii) Arthritis, Heart Disease and High Blood Pressure have significant negative impact on the labor market behavior and earnings of both male and female individuals.

Chapter 2

The Opportunity Cost of Informal Caregiving in Canada

2.1 Introduction

Like many other developed nations, Canada is facing a growing elderly population. The number of Canadians over 80 years old has soared 41% since 1991, reaching a total of 932, 000 in 2001 (The Census on Age and Gender, July, 2002). At the same time, the number of seniors who have chronic diseases such as Diabetes, Cancer, and Alzheimer's have also increased. The rising incidence of chronic diseases has substantially increased the demand for caregiving (Senior Info Exchange, 1998). To meet the rising health care demand, the Canadian government has developed publicly funded institutional care facilities for the elderly. However, the increased cost of health care forced provinces, especially since the 1990s, to reduce spending on the institutional care system (Senior Info Exchange, 1998). Current government policy on healthcare has been to shift the burden of elderly care from publicly funded systems to community-based care (Fast, Williamson, and Keating, 1999). In contrast to publicly funded institution based care, which is provided by paid health care workers, a key component of community-based care is informal care (Parker, 1990; Wood, 1991). Informal caregiving is usually unpaid care given by the family members, neighbors or friends. Currently, informal caregivers provide 80% or more support to the elderly in Canada (Keefe, 2003).

Shifting the burden of care from publicly funded care systems to informal caregivers may have reduced public expenditures. However, a substantial amount of

economic costs as well as non-economic costs are associated with this type of informal caregiving. There is evidence that informal caregivers incur significant non-economic costs relating to declines in emotional, physical, and social well-being (Health Canada, 2002, Seniors Info Exchange, 1998). Informal caregivers also experience substantial economic costs in the labour market in the form of foregone income (Health Canada, 2002; Fast, Williamson, and Keating, 1999). It has been estimated that about 70% of male caregivers and 46% of female caregivers are employed fulltime. In order to fulfill their responsibilities as caregivers, many of these individuals reduce hours in the labour market, or are forced to relinquish employment opportunities (Fast, Williamson, and Keating, 1999). Calculations of the true cost of informal caregiving, must include all the economic and non-economic costs associated with informal care. Any government policy regarding caregiving should be based on the true cost of informal caregiving.

To date, there have been a wide range of published studies discussing the non-economic costs incurred by Canadian informal caregivers (Health Canada, 2002; Cranswick, 1997; VON of Canada, 1997; Gignac et al. (1996); Keefe et al., 1997; CARNET, 1993). However, only a handful of studies have been published discussing the economic costs of informal caregiving. And of this handful, only a few went so far as to utilize descriptive statistics techniques to find the correlation between caregiving and labor supply, rather than actually quantitatively estimating the impact of caregiving on labor supply (Health Canada, 2002; Fast et al., 1999; Cranswick, 1997; CARNET, 1993). The following analysis will attempt to fill the gap in quantitative analysis on the impact of caregiving on the labour supply, by specifically focusing on the economic costs of informal caregiving.

Decreases in either labour force participation or total number of work hours has a negative effect on earned income. Thus to calculate the opportunity cost of informal caregiving requires an estimate of (a) the impact of informal caregiving on labor force participation, and (b) the impact of informal caregiving on the work hours of those in the labour market.

This chapter is divided into 6 sections. Section 2.2 reviews the literature on the labor market impact of informal caregiving. Section 2.3 develops the theoretical issues behind the model, as well as the empirical model for the study. Section 2.4 describes the data and other empirical features. Section 2.5 presents the results and conclusions of the study.

2.2 Brief Literature Review

Quantitative studies on the impact of informal caregiving on labor market outcomes primarily stem out of the United States (US), using US data. Although numerous studies have been conducted on informal caregiving in Canada, they have been mainly concerned with the psychological and sociological consequences of caregiving. The majority of the studies reviewed in this literature review used US data, and present mixed conclusions about the impact of caregiving on the labor supply.

Using data from the US *National Long Term Care Survey* (NLTCS), Stone and Short (1990) found that primary caregivers and those caring for elders with the greatest care needs were more likely to use 'work accommodation' such as taking unpaid leave, reducing work hours, or rearranging work schedules. The estimation results of the model also suggest that the prospect of having to accommodate work to the demands of caregiving would substantially reduce the likelihood of being employed.

Boaz and Mueller (1992) used 1982 NLTCS data to examine the impacts of caregiving responsibilities on working hours. The study found that the responsibility of caregiving, measured by predicted hours of unpaid help, does not affect part time work. However, caregiving has a slight negative impact on full time work. The estimates suggest that one additional hour of unpaid help per week reduces the probability of full time employment by 0.3%.

Kolodinsky and Shirey (2000) used an eleven year pooled cross-sectional sample compiled by the *Panel Study of Income Dynamics* (PSID) to examine the impact of co-residence with an elderly parent on an adult daughter's labour supply and hours of work. The study found that simple co-residing with an elderly parent has no effect on hours of work, but living with a disabled elderly parent decreases work hours by 10 hours per week. This result suggests that an elderly parent's poor health requires the daughter to forgo market work so that she may devote more time on informal home care.

Ettner (1996) used data from the 1987 US *National Survey of Families and Households* (NSFH) to estimate the impact of caring for disabled elderly parents on the work hours of males and females. The results of the study suggest that caring for parents who live outside the household and parents with disabilities who live within the household negatively affect the labour supply of both males and females. However, the negative impact was only statistically significant in the case where the daughter was the caregiver to a parent not co-residing in the household.

Wolf and Saldo (1994) estimated the effect of caring for an elderly parent on the employment and work hours of married women using NSFH data. The results suggest

that among married women, caring for an elderly is not associated with any reduction in employment or in hours of work.

Using the 1985 United Kingdom (UK) *General Household Survey* (GHS), Carmichael and Charles (1998) empirically investigated the influence of informal care responsibilities on the labour supply of women. The study concluded that the opportunity cost of informal caregiving, in terms of forgone labour supply, is relatively small. Caregiving has a negative impact on labour market participation only where it involves a substantial time commitment. Where caregiving takes up more than 20 hours per week, it was found that careging reduces the probability of labour market participation by just 2%. Yet, caregiving reduces work hours by about 2.4% per week. The study also found that informal caregivers, who provide care less than 20 hour per week, are more likely to participate in the labour market but tend to work fewer hours than those who do not provide informal care.

The studies are not without limitation of course. Studies using NLTCS data, which consists of only the 'frail' elderly population and their caregivers, suffer from selection bias. Because of this bias, the conclusions drawn from these analyses cannot be generalized to the entire elderly population. The NSFH data is also problematic since the definition of 'caregiving' used in the survey is vague. In the NSFH survey, the respondents were asked if they helped their parents at some point during the last 12 months—with no qualification about the intensity of the care provided. Also in this survey there is no information about whether respondent actually provided any care to the coresiding elderly. The studies using sophisticated econometric techniques such as Wolf and Saldo (1994), and Carmichael and Charles (1998) focused only on female caregivers.

The main objective of this study is to estimate the impact of caregiving on the labor market behaviour of males and females. This study will take into account the limitations of prior studies, and will aim to improve upon them. The econometric study presented here is the first of its kind using Canadian data. It will use data from the 1996 *Canadian General Social Survey* (CGSS) that surveyed both caregivers and non-caregivers across Canada. Consequently, this study will not suffer from selection bias. This study will focus on both male and female caregivers—which may be children, grandchildren, spouses, friends or neighbours of the elderly.

2.3 Theoretical Issues and the Empirical Model

2.3.1 *Theoretical issues behind the model*

The simple standard microeconomic model of time allocation may be utilized to analyze the impact of caregiving on labour supply. In its simplest form, this is a model in which time, a fixed resource, is allocated between two uses: labour rewarded at a fixed wage rate (W), and leisure (L). Hours of work are chosen so as to maximize a single period utility function that depends on leisure (L), and the consumption of goods (C), subject to a budget constraint. The budget constraint is defined by non market income (V), and the wage rate (W).

Following Wolf and Saldo (1994), the basic neoclassical framework can be expanded to include the role of caregiving in time allocation decision-making. The individual will maximize the utility function:

$$U = U(C, L, CG) \qquad (2.1)$$

where CG denotes the choice of non-market work: caregiving. In this utility function, consumption and leisure are expected to positively impact utility, implying that more consumption and more leisure will increase utility. It is also assumed that individuals gain utility by caring for others.

There are two constraints in the model. The first constraint is that total available time may be allocated to market labour (H), leisure (L) or caregiving (CG). The first constraint is expressed as:

$$T = H + L + CG. \qquad (2.2a)$$

The second constraint is that an individual's consumption level is limited by available income, which originates from two sources: wage income and non-wage income. Wage income is determined by the market labor supply (H) and the market wage (W). Non-wage income is denoted by V. The second constraint is written as:

$$C = WH + V. \qquad (2.2b)$$

In the Mincerian Human Capital Model, the market wage offer that individuals receive depends on level of education (E) and age (A). Carmichael and Charles (1998) found that the responsibility of informal caregiving has a significant impact on wage offers. Following Carmichael and Charles (1998) the wage equation can be written as:

$$W = w(E, A, CG, \varepsilon_1). \qquad (2.3)$$

The error term in the wage function reflects omitted variables; and errors in the functional form are captured in ε_1. Both education and age are expected to positively impact the wage rate. Education enhances productivity of the workers, while age reflects the experience of the workers. Carmichael and Charles (1998) found that caregiving

negatively impacts wage offers if the caregiver spends 20 hours or more per week caregiving.

The basic idea behind labor supply model is that in making the decision whether to work or not, individuals compare market wage rates with non-market or shadow wage rates. An individual will not work if the market wage rate is less than the shadow (reservation) wage at zero hours (i.e. the opportunity cost of not working). The labor supply decision equation can be written in the following way:

$$H^* = W - r; \qquad (2.4a)$$

where H^* denotes desired work hours, and r is the reservation wage at zero hours.

$$H=0 \text{ if } H^* < 0 \text{ and } H = H^* \text{ if } H^* \geq 0 \qquad (2.4b)$$

The labor supply model may suggest how caregiving effects labor market behavior. The responsibility of caregiving can influence the labor supply most directly through the time constraint. Caregiving time reduces the time available for paid work, which reduces the labor supply. Carmichael and Charles (1998) suggested that because of caregiving responsibilities, caregivers often remained absent from work. Moreover, fatigue caused by excessive caregiving responsibilities, resulted in reduced worker efficiency in labour market work. This reduced productivity may well serve to lower wages of caregivers, which may reduce work incentives to work.

2.3.2 *Econometric specification*

Following Killingsworth (1983) the empirical labour supply model can be specified as follows:

$$H^* = \alpha + \beta_1 E + \beta_2 A + \beta_3 CG + \ + \beta_4 V + \beta_4 Z + \varepsilon_2; \qquad (2.5)$$

where H* represents the desired work hours; Z denotes socio-demographic variables such as marital status, the presence of children, number of household members, country of birth, and health status; and ε_2 denotes the error term, a mean zero random variable reflecting the impact of the unmeasured variables on the labour supply.

$$\text{Work} = 1 \text{ if } H^* \quad 0, \text{ Work} = 0 \text{ if } H^* < 0 \qquad (2.5a)$$

$$\text{Work Hour } H = H^* \text{ if Work} = 1 \qquad (2.5b)$$

Education and work experience are expected to positively impact productivity, and hence the wage level. The more educated and more experienced individuals are, higher is the expectation they will work more. Caregiving reduces the time available to work, as well as worker productivity. Thus, the responsibility of caregiving is expected to reduce the number of desired work hours. Availability of non-wage income provides opportunities to work less, implying that non-wage income will negatively impact desired work hours. Married individuals typically have greater family responsibilities than single individuals, therefore it is expected that married persons work more than single persons. The presence of children is expected to negatively impact the number of desired work hours of females since child-rearing time reduces time available for paid work. The impact of the number of household members on desired work hours is expected to be positive. If females receive assistance in child-rearing activities from other household members over the age of 15, then their desired work hours increase. The impact of the country of birth on desired work hours is uncertain. Health is expected to positively influence desired work hours since health positively influences productivity.

Estimating the structural impact of the wage rate, however, is not an objective of this study. For this reason, the labour supply model here is estimated in reduced form

with respect to the wage rate, implying that the structural determinants of the wage rate rather than the wage rate itself are entered into the labour supply model.

2.3.3 *Problems in the econometric application*

The econometric application of this model will run into two major problems: (i) selectivity bias; and (ii) endogeneity bias. First, we will deal with the selectivity bias problem. The work hours of non-participants are not observed. The work hours of the participants are observed, but the participants are self-selected, and thus not a random sample. The selectivity bias problem arises because errors in the work hour equation are correlated with the errors in the selection equation. For example, preferences for work, ε_1, are higher, on average, in a sample of workers than they would be in the general population. Consequently, the regression line derived from the data for the working sub population will provide statistically biased and inconsistent measures of the structural labour supply parameters.

To get rid of selection biases, the following two-stage procedures suggested by Heckman (1979) are adopted. A reduced form Probit model will be fitted for the probability of working, and the estimated coefficients will then be used to form the measure of selection variable λ for each observation. Only the data for H_i, E_i, A_i, CG_i, V_i and λ_i of workers are used to obtain estimates in the selection bias-corrected regression equation:

$$H = \alpha + \beta_1 E + \beta_2 A + \beta_3 CG + \delta\lambda + \beta_4 V + \beta_4 Z + \varepsilon_3. \qquad (2.8)$$

The estimated coefficients of λ, and δ are equal to $\rho\sigma_\varepsilon$. The correlation between the error terms of the selection equation and the linear regression for work hours is represented by

ρ. If $\delta = 0$, then ρ must equal zero since σ_ε must be positive. In this case, the two equations can be estimated separately without causing any bias. In the case where $\delta \neq 0$, then there selection bias exists, and the work hours equation should be estimated with λ included in the regression model.

Secondly, the endogeneity bias occurs if one endogenous variable is regressed on another endogenous variable. It is typically suspected that informal caregiving hours is an endogenous variable in the work hours equation. Any shock that increases work hours will lead to reductions in caregiving hours, which in turn leads to further increases in work hours. Wolfe and Saldo (1994) performed their analysis under the assumption that caregiving is an endogenous variable. Ettner (1996) estimated the labor supply equation using both endogenous and exogenous caregiving variables. Carmichael and Charles (1998) found, using the Hausman Test, that caregiving was an endogenous variable. Due to data limitations, he used the caregiving variable as a predetermined factor in his regression. The endogeneity bias will lead to an inconsistent estimate of the effect of the endogenous regressor on the dependent variable.

The instrumental variable method may be utilized to eliminate the endogeneity bias. This method uses the following two steps:

(i) The endogenous variable, itself, is regressed on all the exogenous variables, as well as the instruments in the system. A predicted value is constructed using the regression estimates.

(ii) The predicted value is substituted for the actual value of the endogenous regressor in the second stage equation.

2.4 The Dataset

The data used in this study is from the 1996 *General Social Survey* (GSS-cycle 11) published by Statistics Canada.[1] The target population of this large scale household survey was all persons aged 15 and over, excluding residents of the Yukon Territory, the Northwest Territories, and full-time residents of institutions. Approximately, 13,000 respondents were interviewed between February and December 1996, with a response rate of 85%. The 1996 GSS focused on assistance given or received, due to temporary difficult circumstances, long-term health issues, or physical limitations.

This research examines persons within the ages of 15 and 64. Following Hum and Simpson (1996), the study will conduct separate analyses for males and females. The sample is made up of 3,181 males, and 3,623 females. The socio-economic characteristics of the sample population are given in Table A.2.1 in the Appendix. Table 2.1 below displays the labour market related characteristics of caregivers and non-caregivers.

[1] The study uses unweighted data and consequently the results of the study will reflect sample characteristics.

Table 2. 1 ***Labour Market Related Characteristics of Caregivers and Non-Caregivers***

	Caregiver Male	**Caregiver Female**	**Non-Caregiver Male**	**Non-Caregiver Female**
Sample Size	531	816	2650	2807
Labor Market Participation				
Work	433 (81.6)	561(69)	2154 (81.2)	1928 (68.6)
Non-work	98 (18.4)	255 (31)	496 (19.8)	879 (31.4)
Average Weekly Hours Worked	42.9	33.68	43.36	35.17

Note: The figures in the parentheses show the percentage of respective categories.

The data reported in Table 2.1 indicate that 16% of the male sample and 25% of the female sample provide care to elderly persons. Of male caregivers, 81% work; where 69% of female caregivers work. On average, all working caregivers work less hours per week than do working persons who are not caregivers. The majority of caregivers, both male and female, belong to the 25 - 54 age group (see Table A.2.1). The socio-economic profiles also identify that the majority of caregivers are married and have no children. It is also shown that the majority of caregivers hold at least a high school diploma, and are Canadian born.

Table A.2.2 in the Appendix compares the socio-economic characteristics of working and non-working individuals. About 81% of males and 76% of females work. About 16% of working males and 22% of working females provide care to the elderly. Approximately 76% of working males and 77% of working females are between the ages of 25 and 54. About 60% of working males and 56% of working females are married. About 36% of non-working females and 15% of non-working males have children.

Data on age and income are available in grouped form. The midpoints are found for estimation purposes. However, the use of midpoints leads to biased estimators. According to Haitovsky (1973), all the variables for which data is in grouped form should be grouped in an equal number of categories, and the mid points should be weighted by the square root of group frequencies. Data on age are grouped in eleven categories, while data on income are grouped in twelve categories. Following Haitovsky, the twelve categories of income data are collapsed into the following eleven categories: no income, 1 - 4,999; 5,000 - 9,999; 10,000 - 19,999; 20,000 - 29,999; 30,000 - 39,999; 40,000 - 49,999; 50,000 - 59,999; 60,000 - 79,999; 80,000 - 99,999; 100,000 – over.

There is no data for the 'other income' variable. However, data is available for total household income. The data for the 'other income' variable is constructed by subtracting individual income from total household income. The 'caregiving' variable is constructed as a dichotomous variable. This variable takes a value of unity if the sample member provides unpaid care to an elderly person and a value of zero otherwise.

2.5 Empirical Results

Table 2.2 gives the results of the Probit equation for employment probability. In this equation, the dependent variable is equal to unity if the individual is employed and equal to zero otherwise.

Table 2.2 ***Probit estimation (dependent variable: employed = 1, otherwise = 0)***

	MALE		FEMALE	
VARIABLE NAME	ESTIMATED COEFFICIENT	T-RATIO	ESTIMATED COEFFICIENT	T-RATIO
CONSTANT	-4.0800	-12.282	-3.0055	-10.15
AGE	0.0049055	8.1908	0.0032100	5.7270

AGE SQUARE	-0.000003	-8.3932	-0.00000209	-5.768
MARITAL STATUS (BASE CATEGORY: SINGLE)				
MARRIED	0.37805	3.6546	-0.18656	-2.104
DIVORCED	0.14568	1.2433	0.053229	0.5860
WIDOW	-0.028277	-0.1241	-0.22021	-1.625
# OF 15+ HOUSE HOLD MEMBER (BASE: 1 MEMBER)				
# 2-4	-0.18499	-1.9193	0.27541	3.2619
# 5 AND MORE	-0.13950	-0.7798	0.44653	2.5036
PRESENCE OF CHILDREN	0.20903	2.6524	-0.22472	-4.082
CAREGIVING	-0.061078	-0.8066	-0.065718	-0.712
EDUCATION (BASE CATEGORY: HIGH SCHOOL)				
ELEMENTARY SCHOOL	-0.51978	-4.0020	-0.92229	-7.345
SOMECOLLEGE/ UNIVERSITY	0.24989	2.9415	0.36803	5.5274
TRADE DIPLOMA	0.44607	6.3089	0.69305	12.526
BACHELOR/MASTERS/PH.D.	0.38913	2.8587	1.0921	6.4513
COUNTRY OF BIRTH (BASE CATEGORY: BRITAIN)				
CANADA	1.0463	9.3306	0.70096	6.8354
UNITED STATES/EUROPE	0.98694	6.6390	0.55355	4.2261
ASIA/AFRICA	0.69407	4.5075	0.36356	2.5745
OTHER INCOME	-.0000004	-0.4580	-.00000023	-3.654
HEALTH INDEX	2.4499	11.560	1.7935	9.5653
	MALE		**FEMALE**	
NUMBER OF OBSERVATION	3181		3623	
MADDALA R-SQUARE	0.1585		.1525	
MCFADDEN R-SQUARE	0.17926		.1335	
LOG LIKELIHOOD	-1257		-1947	

The data in Table 2.2 indicate that caregiving negatively affects, albeit insignificantly, the probability of employment for both genders. The probability of being employed increases at a decreasing rate with age. Being married has a positive impact on

the probability of being employed for males, but has a negative effect for females. For females, the presence of a household member over the age of 15 and significantly increases the probability of being employed. The presence of children increases males' probability to work positively, yet decreases females' probability to work. Education has a positive affect on the probability of being employed for both males and females. Having 'other income' has a significant negative impact on females' probability to work. For males, the coefficient of 'other income' is negative, but insignificant. An increase in the health index increases the probability of being employed for both males and females.

The Inverse Mills Ratio (lambda), derived from the above Probit model, are used in the Generalized Least Square (GLS) regression with weekly work hours as the dependent variable. This regression is restricted to individuals who are employed. The result of the regression is given in Table 2.3.

Table 2.3 ***Generalized least squares regression (dependent variable: weekly work hours)***

	MALE			**FEMALE**		
VARIABLE NAME	ESTIMATED COEFF.	T-RATIO	P-VALUE	ESTIMATED COEFF.	T-RATIO	P-VALUE
CONSTANT	19.309	1.088	0.277	-24.291	-1.03	0.302
AGE	0.064496	4.240	0.000	0.086017	7.129	0.000
AGE SQUARE	-0.00003	-3.70	0.000	-0.000046	-6.54	0.000
MARITAL STATUS (BASE CATEGORY: SINGLE)						
MARRIED	3.4436	2.718	0.006	-1.5536	-1.50	0.132
DIVORCED	2.0794	1.679	0.093	2.5198	2.485	0.013
WIDOW	-0.11863	-.046	0.963	-2.2296	-1.25	0.210
# OF 15+ HOUSE HOLD MEMBER (BASE: 1 MEMBER)						
# 2-4	-1.8334	-1.67	0.094	2.6438	1.937	0.053
# 5 AND MORE	-2.2236	-1.18	0.235	4.8931	1.960	0.050

PRESENCE OF CHILDREN	-0.86632	-1.16	0.245	-4.7769	-5.07	0.000
CAREGIVING	-0.69514	-0.90	0.353	-2.3126	-3.43	0.001
EDUCATION (BASE CATEGORY: HIGH SCHOOL)						
ELEMENTARY -SCHOOL	-3.1404	-.107	0.172	-8.5328	-1.57	0.115
SOMECOLLEGE/ UNIVERSITY	-0.90558	-0.81	0.414	3.1685	1.860	0.063
TRADE DIPLOMA	-1.6441	-1.39	0.162	6.5294	2.558	0.011
BACHELOR/MASTERS/PH.D .	0.77127	0.525	0.599	11.431	2.838	0.005
COUNTRY OF BIRTH (BASE CATEGORY: BRITAIN)						
CANADA	-2.7969	-0.87	0.384	5.9992	1.921	0.055
UNITED STATES/EUROPE	-3.8505	-1.18	0.234	5.6743	1.858	0.063
ASIA/AFRICA	-4.5722	-1.68	0.092	2.1278	0.830	0.406
OTHER INCOME	-.000007	-0.84	0.398	-0.000004	-3.87	0.000
HEALTH INDEX	0.21576	0.027	0.978	17.180	2.387	0.017
LAMBDA	6.5741	0.90	0.365	16.216	2.140	0.032
NUMBER OF OBSERVATION	2587			2489		
R-SQUARE	0.1322			.1017		
ADJUSTED R-SQUARE	0.1258			.0948		

In this regression, White's Heteroskedasticity-Consistent Covariance Matrix estimation was used to correct the estimates for heteroskedasticity. Table 2.3 results show that lambda is statistically significant in the female regression, which suggests the presence of positive selectivity bias. However, lambda is not significant in the male regression, which implies the absence of selectivity bias.

The caregiving variable has a negative sign for both males and females. In the female sample, the caregiving coefficient is negative and significant with respect to the dependent variable of weekly work hours. However, the impact of caregiving on male

work hours is not significant.[2] These results are consistent with those reported in the United States by Ettner (1996). For males and females, work hours increase with age, albeit at a decreasing rate. Compared to single males, married and divorced males work more hours in the labour market. Being divorced has a statistically significant positive effect on female work hours. The number of household members also significantly impacts female work hours. Yet the presence of between two and four members of the household over 15 negatively impacts male work hours with statistical significance. The presence of children has a significant negative impact on the work hours of females. None of the education variables are significant for males. But education positively impacts female work hours. Compared to females who are British born, females who are North American born, work more hours per week. The coefficient on 'other income' is negative and insignificant for males and negative and significant for females. Improvement in health scores has significant positive impacts on female work hours.

Davidson and Mackinnon (1993) suggested that in the absence of selectivity bias, one should not include lambda in the final GLS regression for employed individuals. Since it is found that in the male sample that lambda has an insignificant coefficient, following Davidson and Mackinnon (1993), another equation is estimated for males using the GLS method. The result of the estimation of model without lambda is given in Table 2.4.

[2] The t-statistic formula $(b_1 - b_2) / \{\text{Est. Var}[b_1] + \text{Est. Var}[b_2]\}^{1/2}$ with $(n_1 + n_2 - 4)$ degrees of freedom rejected the null hypothesis at 1% level that caregiving variable has similar impact for both male and female.

Table 2.4 ***Generalized least square estimation (dependent variable: weekly work hours)***

	MALE		
VARIABLE NAME	ESTIMATED COEFF.	T-RATIO	P-VALUE
CONSTANT	3.3357	0.771	0.440
AGE	0.76914	11.07	0.000
AGE SQUARE	-.000039	-10.2	0.000
MARITAL STATUS (BASE CATEGORY: SINGLE)			
MARRIED	4.1769	3.845	0.000
DIVORCED	2.3297	1.946	0.051
WIDOW	-0.38358	-0.15	0.881
# OF 15+ HOUSE HOLD MEMBER (BASE: 1 MEMBER)			
# 2-4	-2.2038	-2.03	0.042
# 5 AND MORE	-2.4491	-1.31	.189
PRESENCE OF CHILDREN	-0.51653	-0.86	0.421
CAREGIVING	-0.82601	-1.08	0.276
EDUCATION (BASE CATEGORY: HIGH SCHOOL)			
ELEMENTARY-SCHOOL	1.4104	0.817	0.414
SOMECOLLEGE/ UNIVERSITY	-0.28091	-0.32	0.748
TRADE DIPLOMA	-0.71439	-1.16	0.246
BACHELOR/MASTERS/PH.D .	1.6291	1.453	0.146
COUNTRY OF BIRTH (BASE CATEGORY: BRITAIN)			
CANADA	0.12343	0.090	0.928
UNITED STATES/EUROPE	-1.0390	-0.62	0.531
ASIA/AFRICA	-2.3793	-1.33	0.182
OTHER INCOME	-.000007	-0.95	0.341
HEALTH INDEX	6.9168	2.254	0.024
	MALE		
NUMBER OF OBSERVATION	2587		

R-SQUARE	.1318		
ADJUSTED R-SQUARE	.1257		

The results of Table 2.4 do not greatly vary from those in Table- 2.3. The caregiving variable still has a negative but insignificant impact on males work hours. However, the health index now has a significant and positive coefficient, which implies that improvements in health induce males to work longer.

Several studies have found that informal care responsibilities are endogenously determined (Carmichael and Charles, 1998; Ettner, 1996). Following Reichman and Florio (1996), this study used the Haussman test to check whether this endogeneity result is valid for Canadian data. The study first identified variables which are both correlated with the responsibility of caregiving and have no direct influence on labour market decisions. The instruments selected are: number of brothers, number of sisters, geographic proximity to mother (i.e. co-residence or not), and geographical proximity to father (co-residence or not). A probit regression of the caregiving variable was run on the instruments and all the exogenous variables in the model. Table A.2.3 in the Appendix gives the result of this regression. It is found from the F-statistics, Wald tests, and Chi-square statistics that the six instruments are jointly significant in the regressions for both males and females.[3] These results imply that the identified instruments have significant impacts on the probability of being a caregiver. The predicted probabilities obtained from probit regressions were included in the OLS regression along with the caregiving variable. The purpose was to examine whether the predicted probability variable (Phat)

[3] For male regression F = 4.8491899 with 6 and 3157 degrees of freedon P –Value=.00006
Wald Chi Square Statistics= 29.0951 with 6 degrees of freedom P –Value = .00006
For female regression F = 10.6433 with 6 and 3239 degrees of freedom P-value= .00000
Wald Chi Square test = 63.8599 with 6 degrees of freedom P-Value= .00000

had a significant impact on work hours. Table A.2.4 in the Appendix shows the result of this exercise. In neither of these two equations, did the predicted probability variable (Phat) turn out to be significant, which suggests that caregiving is not an endogenous variable in this study.

The study has some limitations relating to the availability of the appropriate data. As earlier noted, the GSS provides age data and income data in-group form. Obviously there involves some errors when one attempts to transform group data into continuous data. In this estimation both age and 'other income' data are used in continuous form. The Haitovsky correction process that was adopted in this study will only minimize the bias, not completely eliminate it.

2.6 Conclusion

This study used the traditional labor supply model to examine the impacts of caregiving to elderly persons on Canadian caregivers' labour market behaviour. In the empirical estimation, the study adopted a two-stage Heckman procedure to check for selectivity bias that may arise from excluding individuals who are not employed. The results showed evidence of selectivity bias in the case of the female data, but not in the male data. The results of OLS regression for employed individuals suggest that caregiving negatively impacts the number of work hours for both males and females. However, the impact is significant only in the female sample. Other results of the study are as follows: (1) compared to single persons, both married and divorced individuals work more; (2) the presence of children reduces female work hours; (3) increase in 'other

income' significantly reduces female work hours; and (4) the health index positively influences the number of hours worked by both males and females.

The Probit estimation of the employment probability model suggests that caregiving has a negative but insignificant effect on the probability of being employed. The probability of being employed increases at a decreasing rate with age. Being married positively impacts males' probability of being employed but negatively impacts females' probability of being employed. In the female sample, the presence of household members aged 15 and over has a significant positive effect on the probability of being employed. The presence of children positively affects the male's probability to work, but negatively affects the female's probability to work. Education has a positive affect on the probability of being employed for both genders. Other income has a statistically significant negative impact on females' probability to work. For males, other income has a negative but insignificant impact. An increase in the health index increases the probability of being employed for both males and females.

This study clearly points towards the cost of caregiving in terms of forgone labour supply, especially for female caregivers. The result suggests that those females who provide care to elderly persons work about 2.3 hour (about 6.6% of average female weekly work hour) less per week. Thus the employed caregivers face financial loss in terms of reduced current income and employment benefits. Recent research suggests that the caregiving role is creating stress and difficulties among caregivers who are employed, since they face financial loss while attempting to balance between work and caregiving (Health Canada, 2002). Studies also suggest that such stress has negative impacts on the quality of informal care (Phillip, McKee et.al. 1997; Tsuji, Whalen and Finucane, 1995).

Appropriate supports that lessen the stress arising from financial loss and time conflicts would enable informal caregivers to perform their caregiving role more effectively.

Support to informal caregivers may come from the federal government and/or private employers. A supportive private employer ought to be more flexible in work hours if employees have caregiving responsibilities. The federal government may consider providing paid leave for persons who must leave jobs temporarily to care for a family member with a disability or chronic care needs. Currently, the federal government is providing very limited amounts of tax credit benefits to informal caregivers. These credits are non-refundable benefits, thus caregivers whose incomes are below the threshold of paying income tax cannot benefit from current tax credits. The federal government ought to consider increasing the amount of these credits, and making them refundable.

This study did not distinguish between part-time employees and full-time employees. Future studies may benefit from looking further into the impact of caregiving on the probability of being employed full time versus part time. Besides reduced work hours, absenteeism from work is often cited as an employment related cost of caregiving, and future studies may focus on this issue to quantify the impact of informal caregiving on absenteeism. The physical health of caregivers may be affected due to the stress from caregiving, thus health care utilization by caregivers may increase. It may be interesting to examine the impacts of caregiving on health care utilization by caregivers.

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Table A.2.1 ***Socio-economic profiles of individuals***

	Caregiver Male	**Non-Caregiver Male**	**Caregiver Female**	**Non Caregiver Female**
Sample Size	531	2650	816	2807
Labour Market Participation				
Work	433 (81.5)	2154 (81.3)	561 (68.75)	1928 (68.6)
Non-Work	98 (18.4)	496 (18.7)	255 (31.25)	879 (31.3)
Average Weekly Work Hour	42.90	43.36	33.68	35.17
Age Group				
15-24	72 (13.5)	469 (17.7)	88 (10.7)	484 (17.2)
25-39	190 (35.8)	1051 (39.6)	263 (32.2)	1147 (40.8)
40-54	188 (35.4)	806 (30.41)	344 (42.1)	820 (29.2)
55-64	81(15.2)	324 (12.2)	121 (14.8)	356 (12.6)
Marital Status				
Single	138 (25.9)	869 (32.8)	191(23.4)	785 (27.9)
Married	350 (65.9)	1497 (56.5)	482 (59)	1568 (55.8)
Divorced	41 (.07)	233 (8.8)	108 (13.2)	364 (12.9)
Widow	2 (.003)	51 (1.9)	35 (4.2)	90 (3.2)
# Of Children Less than 15				
No children	362 (68.1)	1872 (70.6)	539 (66)	1761 (62.7)
Single	66 (12.4)	311 (11.7)	124 (15)	455 (16.2)
2 or more	103 (19.5)	467 (17.6)	153 (19)	591 (21.1)
Respondents Personal Income				
No Income	11 (2.48)	88 (4.1)	64 (9.9)	220 (10.4)
Less than $5,000	27 (6.09)	123 (5.8)	76 (11.7)	273 (12.9)
$5,000- $14,999	66 (14.9)	302 (14.3)	179 (27.7)	569 (26.9)
$15,000-$29,999	120 (27.08)	502 (23.8)	175 (27.0)	554 (26.2
$30,000-$49,999	138 (31.15)	591 (28.5)	107 (16.5)	369 (17.4)
$50,000-$79,999	58 (13.09)	379 (18)	37 (5.7)	115 (5.4)

$80,000 & Over	23 (5.19)	121 (5.8)	8 (1.2)	14 (.06)
Education Level				
Elementary School	16 (3.06)	104 (4.04)	28 (3.4)	119 (4.3)
High School	221 (42)	1161 (45.1)	281 (34.6)	1012 (37)
Some College/University	49 (9.31)	199 (7.7)	146 (17.9)	469 (17.1)
Trade Diploma	142 (27)	630 (24.5)	237 (29.2)	698 (25.5)
Bachelor/Masters/PhD.	98 (18.6)	475 (18.45)	122 (14.9)	431 (15.8)
Country of Birth				
Canada	462 (87.3)	2137 (83)	730 (89.3)	2274 (83.5)
USA	13 (2.4)	61 (2.3)	17 (2)	106 (3.8)
United Kingdom	12 (2.2)	68 (2.6)	12 (1.32)	82 (3.1)
Europe/ Oceania	20 (3.7)	149 (5.8)	32 (3.98)	119 (4.3)
Asia/Africa	22 (4.1)	160 (6.2)	26 (3.71)	142 (5.2)

The parentheses give the percentage figures with respect to respective categories.

Table A.2.2 ***Socio-economic profiles of individuals***

	Working Male	**Non-Working Male**	**Working Female**	**Non-Working Female**
Sample Size	2587	594	2489	1134
Caregiving variable				
Caregiver	433 (13.6)	98 (16.49)	561(22.53)	255 (22.48)
Non-Caregiver	2154 (67.7)	496 (83.50)	1928 (77.46)	879 (77.51)
Age Group				
15-24	397(15.35)	154 (25.9)	392 (15.74)	180 (15.8)
25-39	1122 (43.34)	119 (20.07)	1067 (42.87)	343 (30.15)
40-54	854 (33.01)	140 (23.56)	858 (34.47)	306 (27.17)
55-64	214 (8.27)	181 (30.47)	172 (6.91)	305 (26.82)
Marital Status				
Single	766 (29.63)	241 (41.11)	704 (28.28)	272 (23.98)
Married	1578 (61.04)	269 (45.98)	1395 (56.04)	655 (57.77)

Divorced	216 (8.35)	59 (10.08)	327 (13.13)	145 (12.77)
Widow	25 (.91)	16 (2.74)	63 (2.53)	62 (5.46)
# Of Children Less than 15				
No children	1722 (66.82)	502 (84.51)	1584 (63.64)	716 (63.13)
Single	337 (13.07)	40 (6.73)	421 (16.91)	158 (13.93)
2 or more	518 (20.10)	52 (8.75)	484 (19.44)	260 (22.92)
Respondents Personal Income				
No Income	16 (.07)	83 (20.95)	258 (11.74)	28 (4.94)
Less than $5,000	107 (4.9)	43 (10.85)	177 (8.06)	172 (30.38)
$5,000- $14,999	226 (10.54)	142 (35.85)	463 (21.08)	285 (50.35)
$15,000-$29,999	533 (24.87)	79 (19.95)	666 (30.32)	63 (11.13)
$30,000-$49,999	695 (32.43)	34 (8.58)	465 (21.17)	11 (1.94)
$50,000-$79,999	425 (19.83)	12 (3.03)	148 (6.73)	4 (.70)
$80,000 & Over	141 (6.57)	3 (.75)	19 (.86)	3 (.53)
Education Level				
Elementary School	63 (2.44)	57 (11.00)	31 (1.47)	116 (12.27)
High School	879 (34.10)	252 (48.64)	1014 (48.37)	620 (65.60)
Some College/University	428 (16.60)	71 (13.70)	209 (9.97)	65 (6.87)
Trade Diploma	687 (26.65)	85 (16.40)	736 (35.11)	132 (13.96)
Bachelor/Masters/PhD.	520 (20.17)	53 (10.23)	106 (5.05)	12 (1.36)
Country of Birth				
Canada	2165 (84.04)	434 (82.04)	2131 (86.10)	873 (81.84)
USA	66 (2.56)	8 (1.51)	78 (3.15)	45 (4.21)
United Kingdom	69 (2.67)	12 (2.36)	63 (2.54)	31 (2.90)
Europe/ Oceania	135 (5.24)	34 (6.42)	96 (3.87)	55 (5.15)
Asia/Africa	141 (5.47)	41 (7.75)	107 (4.32)	63 (5.90)

The parentheses give the percentage figures with respect to respective categories.

Table A.2.3 ***Probit Regression*** **(Dependent variable: Caregiving=1, No Caregiving =0)**

	MALE		**FEMALE**	
VARIABLE NAME	ESTIMATED COEFF.	T-RATIO	ESTIMATED COEFF.	T-RATIO
CONSTANT	0.13128	1.530	-24.291	-1.03
AGE	-0.00002	-2.01	-0.000083	-0.50
AGE SQUARE	0.000002	2.708	.00000249	2.444
MARITAL STATUS (BASE CATEGORY: SINGLE)				
MARRIED	0.043450	1.792	0.00421	0.167
DIVORCED	-0.00430	-0.15	-0.02140	-0.82
WIDOW	-0.11163	-1.85	0.029191	0.707
# OF 15+ HOUSE HOLD MEMBER (BASE: 1 MEMBER)				
# 2-4	-0.00414	-0.17	0.0017442	0.071
# 5 AND MORE	0.077989	1.708	0.080022	1.535
PRESENCE OF CHILDREN	-0.08017	-0.47	-0.019649	-1.22
# BROTHERS (1-3)	-0.00738	-0.48	0.019044	1.143
# BROTHERS (4-MORE)	0.071743	2.895	0.022381	0.866
# SISTERS (1-3)	0.009588	0.603	-0.012913	-0.78
# SISTERS (4-MORE)	0.016148	0.644	-0.05311	-2.16
CORESIDENCE (MOTHER)	0.063924	3.185	0.14336	7.070
CORESIDENCE (FATHER)	0.004503	0.020	-0.01796	-0.79
EDUCATION (BASE CATEGORY: HIGH SCHOOL)				
ELEMENTARY-SCHOOL	-0.05387	0.958	-0.042094	-1.15
SOMECOLLEGE/ UNIVERSITY	0.029166	1.722	0.042953	2.124
TRADE DIPLOMA	0.027556	2.067	0.035015	2.148
BACHELOR/MASTERS/PH.D .	0.045996	1.675	-0.02388	-0.59

COUNTRY OF BIRTH (BASE CATEGORY: BRITAIN)				
CANADA	0.082110	2.543	0.16360	5.046
UNITED STATES/EUROPE	0.034727	0.789	0.079967	1.985
ASIA/AFRICA	0.014621	0.312	0.095876	2.154
OTHER INCOME	-.000003	-1.44	-0.000001	-0.10
HEALTH INDEX	-0.05095	-0.85	-0.079178	-1.41
	MALE		**FEMALE**	
NUMBER OF OBSERVATION	3181		3623	
MADDALA R-SQUARE	0.1456		MADDALA R-SQUARE	0.1381
MCFADDEN R-SQUARE	0.15926		MCFADDEN R-SQUARE	0.1498

Table A.2.4 ***OLS regression to test the endogeneity of the caregiving variable***

	MALE			**FEMALE**		
VARIABLE NAME	ESTIMATED COEFF.	T-RATIO	P-VALUE	ESTIMATED COEFF.	T-RATIO	P-VALUE
CONSTANT	20.015	1.122	0.262	-32.805	-1.88	0.059
AGE	0.063224	4.130	0.000	0.087076	7.205	0.000
AGE SQUARE	-0.00003	-3.60	0.000	-0.000045	-6.49	0.000
MARITAL STATUS (BASE CATEGORY: SINGLE)						
MARRIED	3.5788	2.748	0.006	-1.7818	-1.72	0.085
DIVORCED	2.0464	1.655	0.098	2.4250	2.360	0.018

WIDOW	-0.61809	-0.22	0.853	-2.3193	-1.30	0.191
# OF 15+ HOUSE HOLD MEMBER (BASE: 1 MEMBER)						
# 2-4	-1.7940	-1.63	0.103	2.9328	2.155	0.031
# 5 AND MORE	-1.7850	-0.88	0.375	5.7385	2.276	0.023
PRESENCE OF CHILDREN	-0.90081	-1.21	0.226	-4.9468	-5.27	0.000
CEREGIVING	***-0.78549***	***-1.02***	***0.304***	***-1.8040***	***-2.95***	***0.003***
PHAT	***-4.2484***	***-0.59***	***0.544***	***-5.0414***	***-1.19***	***0.233***
EDUCATION (BASE CATEGORY: HIGH SCHOOL)						
ELEMENTARY-SCHOOL	0.13057	1.257	0.209	6.7418	1.080	0.280
SOMECOLLEGE/ UNIVERSITY	-0.81854	-0.72	0.469	3.6402	2.140	0.032
TRADE DIPLOMA	-1.5686	-1.30	0.193	7.1519	2.807	0.005
BACHELOR/MASTERS/PH.D .	0.86870	0.584	0.559	11.901	2.953	0.003
COUNTRY OF BIRTH (BASE CATEGORY: BRITAIN)						
CANADA	-2.3965	-0.71	0.474	7.3370	2.311	0.021
UNITED STATES/EUROPE	-3.6876	-1.12	0.263	6.5065	2.123	0.034
ASIA/AFRICA	-4.4453	-1.61	0.106	2.8583	1.106	0.269
OTHER INCOME	-.000008	-0.98	0.320	-0.000004	-3.97	0.000
HEALTH INDEX	0.005011	.0006	0.999	18.239	2.531	0.011
LAMBDA	-6.5915	-0.90	0.368	17.674	2.332	0.020
	MALE			**FEMALE**		
NUMBER OF OBSERVATION	2587			2489		

R-SQUARE	.1323			.1025		
ADJUSTED R-SQUARE	.1255			.0928		

Chapter 3

The Pattern of Care and its Impact on the Health of the Elderly in Canada

3.1 Introduction

The elderly population is increasing in Canada, as it is in many other developed countries. Statistics Canada projects that by 2031, approximately 20% of Canada's population will consist of senior citizens. This growing elderly population is of great concern for health care policy in Canada since health declines, and health care use increases, with age (Menec et al., 2002). In the 1950s, the Canadian Health Care authority developed a publicly funded institutional health care program to support the elderly. However, ever-rising health care costs has forced the governments to reevaluate policy on elderly health care. Following this reevaluation, the governments implemented a policy in the 1990s which served to shift the burden of elderly care from institutional care programs to community based care programs. Community-based care is made up of two components: formal home care and informal care. Health Canada data suggests that in 1998, 4.5% of total health care expenditures were spent on health care conducted in homes. However, for some Canadian provinces this expenditure on home care is smaller (see Table A.3.1 in the Appendix). Health Canada data also shows that in 1998, 25 persons per 1,000 inhabitants in Canada received formal home care (see Table A.3.2 in the Appendix). Most of the burden of community based elderly care is borne by close relatives and friends. Currently, between 80 and 90 % of all elderly care is provided by family members and friends (Keefe, 2002).

Few studies have been conducted on the impacts of formal home care and informal care on the health of the elderly population. However, a recent study by Coyte and Stabile (2002) found that self-reported health status was positively correlated with the increased availability of government-financed home care facilities. To my understanding, no study in Canada has ever attempted to identify the relative impacts of formal care and informal care to the health status of the elderly.

However, the proposed research has important policy implications since current Canadian policy aims at shifting the burden of elderly care from an institutional care system to a community-based care system. Should the government spend public money to encourage informal care? Is it beneficial to spend public money on a formal home care system? To answer these questions, policy makers must know the impacts of informal care, as well as formal home care upon the health of the elderly.

The prime objective of this paper is to examine the impact of care patterns on the health outcomes of elderly Canadians, aged 65 and over. This study will utilize data from the 1996-97 Canadian National Health Population Survey (NPHS) within a production function approach. The measure of health outcomes used in this research will be from data collected through methods of self-reporting. Self-reported health status is a subjective measure of health status, covering physical, psychological and emotional health.[4] Because of differences in health outcomes between males and females, this study will estimate separate health production functions for males and females. Moreover, since the majority of formal home care and informal care recipients belong to

[4] Despite its well-known limitations, this paper uses self-reported health status as a measure of health outcomes in order to allow comparison of our results with results of other Canadian studies using the same variable.

age group of 80 and over, this study will analyze this sub-group of the elderly population separately.

This paper proceeds as follows: an overview of formal home care and informal care in Canada is presented in section 3.2; the literature review of existing research on the impacts of home care and informal care is summarized in section 3.3; the methodology and empirical specifications of the study are outlined in section 3.4; the data used in the analysis is described in section 3.5; the findings of the analysis are presented in section 3.6; and section 3.7 concludes the study.

3.2 Home Care and Informal Care in Canada

In Canada, formal home care is generally defined as an array of services which enables clients, incapacitated in whole or in part, to live at home, often with the effect of preventing, delaying, or substituting for long-term care or acute care alternatives. Home care may address needs specifically associated with a medical diagnosis (e.g., diabetes therapy), and/or may compensate for functional deficits in the activities of daily living (e.g., bathing, cleaning, food preparation). Home care may be appropriate for people with minor health problems and disabilities, and for those who are acutely ill, and require intensive and sophisticated services and equipment.[5]

[5] Health Canada. *Report on Home Care* (prepared by the Federal/Provincial/Territorial Working Group on Home Care, a Working Group of the Federal/Provincial/Territorial Subcommittee on Long Term Care), 1990, p. 2.

Home care is included in the federal *Canada Health Act* as an extended health care service. However, formal home care services are not publicly insured in the same way as hospital and physician services. The jurisdictional responsibility of providing home care services rests with the provinces and territories. All provinces offer both acute and long term home care services, as well as a range of basic services: client assessment; case coordination; case management; nursing services; and home support (including personal care, homemaking, Meals-On-Wheels and respite services). Other services, such as rehabilitation services (e.g. physiotherapy, occupational therapy), oxygen therapy, respirology and specialized nursing services are becoming a part of home care in some provinces. There is a set of basic eligibility requirements for home care services across the provinces based upon: the possession of provincial or territorial health insurance; proof of residence in the jurisdiction; an assessment of unmet needs; safety considerations in the home; and consent of client.

The availability of professional services and models of service delivery vary across the provinces. Fewer professional services (i.e. nursing and therapy services) are offered in rural and isolated areas. Speech therapists, dieticians, and social workers are not as readily available in the home care program than are other professional services. Ontario's home care program offers the broadest range of professional services. Single entry functions (i.e. assessment, case management, discharge planning), professional services, and home support services are mainly delivered by public employees in Saskatchewan, Prince Edward Island, the Yukon Territory and the North West Territories. Single entry functions and all professional services are delivered by public employees in New Brunswick, Newfoundland, British Columbia and Alberta. In most

instances, however, home support services are contracted out. In Nova Scotia and Manitoba, single entry functions and some professional services and home services are delivered by public employees. However, in these two provinces some nursing services and home support services are contracted out within the province.

Informal care is defined as the tasks performed by family and friends without pay which help maintain or enhance independence of individuals (Kelly Cranswick, 1997). The 1996 General Social Survey (GSS) conducted by Statistics Canada gives a detailed description of informal caregiving in Canada. According to this survey, about 2.8 million Canadians provided help to someone with a long-term health problem or disability in 1996. The GSS survey data suggests that the bulk of informal care in Canada is provided by women between the ages of 45 and 64. A caregiver may be called upon to assist with instrumental tasks such as cooking, cleaning, providing transportation, banking; or with personal care such as bathing or dressing. According to the 1996 GSS survey, about half of the caregivers whom provided assistance with instrumental activities were the children of the elderly patient. About 24% of this type of care was provided by family friends. Again, the children of the elderly also provided about half of the help with personal care. Spouses and friends provided about 30% of assistance with personal care activities.

3.3 Literature Review

Only a few studies have examined the impact of formal home care and informal care on the health outcomes of the health care recipients. Coyte and Stabile (2002) published the only Canadian paper on the impact of publicly funded home care on the health status of individuals. Using 1994/96/98 NPHS data, the authors regressed a

variable measuring self-perceived health status on the generosity of home care programs and a set of demographic controls. The generosity of public home care programs were measured by public home care expenditures per capita in the population of elderly aged 65 and over. The study basically estimated two separate regressions. In the first regression, the authors used data for individuals who used home care services, as well data for individuals who did not use home care services. In the second regression, the authors considered only the data for individuals who used home care services. The results of the first regression suggested that a one hundred dollar increase in spending per individual correlates with a 1.7 percentage point increase in the probability of self-reporting good health or better. To take into account the problem of endogeneity between health status and the generosity of public home care, the authors used the instrumental variable approach (IV). The IV estimates of the effects of the generosity of public home care programs are large and significant. The second regression results also suggest that increases in the generosity of public home care are positively correlated with increases in the probability of self-reporting good health. The IV estimates remain positive, but the coefficient estimates decrease in magnitude.

In a U.S. study, Penrod, Kane, Finch, and Kane (1998) examined the effects of post-hospital Medicare home health and informal care on the functional status of 755 Medicare beneficiaries six weeks after hospital discharge for treatment of strokes, congestive heart failures, hip procedures and hip fractures. Data was collected by interviewing patients prior to hospital discharge and then six weeks later. Patient's functional status was measured using a weighted sum of seven functions: incontinence, bathing, dressing, toileting, transferring, feeding, and walking. The caregiver's self

report of the number of hours of care he/she provided in the first two weeks after hospital discharge was used as the measure of informal care. The amount of Medicare expenditures on home care for the patients during the six weeks after discharge was used as the home care variable in the US model. The results of the study suggest that variations in the amount of post-acute Medicare home health services had an insignificant effect on functional dependency six weeks after discharge. More informal care in the first two weeks after discharge was associated with an increase in functional impairment four weeks later. To explain the negative impact of informal care, the authors suggest that the informal caregivers did not encourage elders to walk or to carry out their own daily activities, such as bathing and cooking. As a result, the elderly individuals remain dependent on their caregivers.

In another U.S. study, Shaughnessy, Schlenker and Hittle (1994) used a random sample of 1,632 individuals to evaluate the impact of home care services on patients' status outcomes. Patient status outcomes refer to patients' activity of daily living (ADL) and instrumental activity of daily living (IADL) outcomes. The study compared patient status outcomes of selected individuals enrolled in Medicare HMO, who were provided with less home care services, to selected individuals using Medicare Fee For Service (FFS,) who received relatively more home care services. Overall, the results of the study suggest that case mixed adjusted outcomes for FFS patients are superior to those for HMO patients in most of the ADL and IADL categories. The study concludes that the superiority of outcomes for FFS patients is due to a higher utilization of home care services.

Kane, Finch, Chen, and Blewett (1994) examined whether home care services were associated with the improvement of functional outcomes of selected Medicare patients. In this study, a total of 2,865 Medicare patients in five diagnosis related groups (DRGs) were interviewed just prior to their discharge from the hospital and again six weeks, six months and one year after discharge from hospital. The outcome measure used in this study was self-reported functional status as measured by ADLs such as feeding, bathing, dressing, toileting, transferring, and walking. The functional outcome approach compares the functional score at the time of discharge from hospital with the reported score six weeks, six months, and one year after discharge. The study observed that in each of DRG cases, patients who received home care showed improvement in the six weeks following discharge from the hospital. In contrast, patients who did not receive home care showed improvements only in cases of hip procedures and simple hip fractures.

Kutty (2000) used Asset and Health Dynamics (AHEAD) data to estimate a production function of bathing functionality of elderly individuals. The study found that the use of assistive devices, nutritional intake, endowment variables, and chronic health conditions are significant factors in determining the level of bathing functionality. The use of informal care in the form of personal assistance did not appear to contribute to bathing functionality. Although the coefficient of the personal care variable was positive, it was not significant. The study also analyzed the bathing functionality production function of individuals over 80 years old, but the coefficient of the 'informal personal assistance' variable was not statistically significant either.

3.4 Methodology and Empirical Specifications

3.4.1 *Methodology of the study*

The study will be based on the concept of a health production function. In a broad sense, a health production function describes the relationship between combinations of medical and non-medical inputs and health outcomes (Smith, 1993). Following Rosenzweig and Schultz (1983), the general form of health production function is written as:

$$H = h\,(HC, X, \mu, e_1). \qquad (3.1)$$

In this model, the dependent variable H represents health status as measured by Self Perceived Health Status (SPHS). HC represents the different forms of care: formal home care, informal care, and self care/ no care. X represents a vector of various socio-economic and life style variables that affect health status directly. The socio-economic variables include income, wealth, and educational status; and the life style variables include exercise patterns and smoking behavior. Also included in the vector X are specific variables such as age and language ability, as well as provincial dummy variables. The unobserved individual-specific health endowments such as genetic traits are represented by μ. Individuals and their family members know more about the severity of illness or frailty of the individual than does the researcher working with the health production function (Rosenzweig and Schultz, 1983). The unobserved residual variation in health is represented by e_1. It is expected that the care pattern, HC, affects health status positively.

People with higher incomes tend to consume higher quality goods, and better housing. It has been observed that both household income and wealth are correlated with higher health status (Smith & Kington, 1997).

Education is expected to increase the efficiency of the production function (Grossman, 1972), thus schooling is used a proxy for long-term economic status. Compared to persons with low levels of education, those with high levels of education are more capable of taking preventive measures and more aware of harmful life styles.

Mullahy (1990) has observed negative impacts of smoking on health status. Study also observed detrimental effect of alcohol consumption on health (Figueredo, V.M., 1997). However, some studies found U-shaped relationship between drinking and cardiovascular function as well as longevity (Miyamae et al., 1997; Obisesan et al., 1998).

Age plays very significant role in determining health status especially for the elderly persons. Study found that functionality of elderly persons declined with age (Kutty, N.K., 2000).

Recent literature tends to emphasize the role that cultural factors play in the determination of health status. Several studies found that language barriers are largely responsible for racial and ethnic disparities in health care (Weech-Maldonado, R., et. al, 2001; Baker, D., 1999).

Provincial dummy variables will be included in the health status regression to account for differences among the provinces with respect to the availability of health care facilities, as well as the physical and socio-cultural environments.

3.4.2 *Estimation Strategy*

The dependent variable in this study is health status (HS), which is measured by a categorical health measure. In the categorical health-rating questionnaire, individuals rated their own current health status on a five-point scale: 1 = excellent health, 2 = very good health, 3 = good health, 4 = fair health and 5 = poor health. An appropriate tool for analyzing such ordered categorical data is the Ordered Probit model (Greene, 2000).

Before estimation of the model, the possibility of endogeneity problems needs to be resolved. The demand for formal care and informal care may be influenced by the individual specific unobserved traits captured in μ. For example, individuals who know they are particularly ill may presumably be the most persistent in seeking out health care services. This will result in a negative correlation between the demand for health care services and good health, rather than the anticipated positive relationship that would be expected to emerge if beneficial health services were randomly allocated to equally sick patients. In this situation, estimation of a health production function by single equation methods may produce biased results.

To test for the presence of endogeneity, following Reichman and Florio (1996), the Wu-Hausman test will be conducted. If the Wu-Hausman test suggests endogeneity, then a two-stage regression procedure will be adopted to purge the bias. In the first stage, a Probit regression will be run for home care and informal care use on all exogenous variables and instruments in the model. The predicted probabilities obtained through this procedure will then replace the actual values of home care and informal care in the second stage of the production function estimation.

Income is also suspected to be endogenous since healthy persons likely have higher labor force participation rates and command higher wages (Luft, 1975; Lee, 1982). In this study however, the data sources from individuals above 65 years old whose major source of income is retirement income, which is dependent on past working behavior. Prior health status will likely affect past working behavior. In this sense, current retirement income of the individuals is not correlated with current health status. A similar type of argument holds for the wealth variable, since wealth is the result of individuals' saving behavior during the working age.

Both current smoking patterns and alcohol consumption behavior may also be endogenous to current health status since individuals with poor health may reduce their smoking or alcohol consumption. To purge the endogeneity bias, the study will utilize data of prior smoking patterns and alcohol consumption behavior.

In this study, separate regressions will be estimated for males and females. Past studies have found gender differences in health outcomes (Smith and Kington, 1997; Verbrugge, 1989). Biological differences between genders and differences in the perception and reporting of health problems are suggested to explain the variation across genders (Kington, Lillard and Rogowski, 1997).

3.4.3 *Formulation of the Ordered Probit Model*

Let h* be a continuous, latent variable that could be interpreted as representing the health of an individual on a continuous scale. Following Greene (2000), a linear dependence is assumed between the latent variable h* and X_i, β and ε:

$h^* = \beta' X_i, + \varepsilon.$ (4.2)

h^* is unobserved, and can be thought of as the underlying tendency of an observed phenomenon. It is assumed that ε is normally distributed with zero mean. β' is a vector of unknown parameters; and X_i is a vector of respondents' specific individual characteristics, as well as socio-demographic characteristics. What we observe is that:

$h = 1$ if $h^* \leq 0$; (4.3a)

$h = 2$ if $0 < h^* \leq u_1$; (4.3b)

$h = 3$ if $u_1 < h^* \leq u_2$; (4.3c)

$h = 4$ if $u_2 < h^* \leq u_3$; and (4.3d)

$h = 5$ if $u_3 < h^*$, (4.3e)

where h is observed in five number-ordered categories. The u's are unknown threshold parameters to be estimated with β. With a normal distribution, the probability of obtaining an observation is given by the following general expression:

$$\text{Prob}\,(h = j) = \Phi(u_j - \beta'X_i) - \Phi(u_{j-1} - \beta'X_i); \quad (4.4)$$

where Φ (.) denotes a standardized cumulative normal distribution.

In this study, individuals' responses are classified as: excellent (h = 1); very good (h = 2); good (h = 3); fair (h = 4); and poor (h = 5). The resulting probabilities are written:

$$\text{Prob}\,(h=1) = \text{Prob}\,(h^* \leq 0) = \Phi(-\beta'X); \quad (4.5a)$$

$$\text{Prob}\,(h = 2) = \text{Prob}\,(0 < h^* \leq u_1) = \Phi(u_1 - \beta'X) - \Phi\,(-\beta'X); \quad (4.5b)$$

$$\text{Prob}\,(h = 3) = \text{Prob}\,(u_1 < h^* \leq u_2) = \Phi(u_2 - \beta'X) - \Phi(u_1 - \beta'X); \quad (4.5c)$$

$$\text{Prob}\,(h = 4) = \text{Prob}\,(u_2 < h^* \leq u_3) = \Phi(u_3 - \beta'X) - \Phi(u_2 - \beta'X); \quad (4.5d)$$

$$\text{Prob}\,(h = 5) = \text{Prob}\,(u_3 < h^*) = 1 - \Phi(u_3 - \beta'X). \quad (4.5e)$$

For the five probabilities the marginal effects of changes in the regressors are as follows:

$$\partial \text{ Prob } (h=1)/ \partial X = \varnothing(-\beta'X)\ \beta \quad (4.6a)$$

$$\partial \text{ Prob } (h=2)/ \partial X = [\varnothing(-\beta'X) - \varnothing\ (u_1 - \beta'X)]\ \beta \quad (4.6b)$$

$$\partial \text{ Prob } (h=3)/ \partial X = [\varnothing(u_1-\beta'X) - \varnothing\ (u_2 - \beta'X)]\ \beta \quad (4.6c)$$

$$\partial \text{ Prob } (h=4)/ \partial X = [\varnothing(u_2-\beta'X) - \varnothing\ (u_3 - \beta'X)]\ \beta \quad (4.6d)$$

$$\partial \text{ Prob } (h=5)/ \partial X = \varnothing\ (u_3 - \beta'X)\beta \quad (4.6e)$$

3.5 The Dataset

The dataset used in this study sources from the NPHS, 1996-1997.[6] The NPHS collects information related to the health of Canadians, as well as related socio-demographic information. The NPHS collected the first cycle of data in 1994, and will continue to collect similar data every second year over the next 20 years. Three components make up the NPHS dataset: a household survey, a health care institution survey, and the Northern Territories survey. The household component includes household residents in all provinces, with the exclusion of peoples living on Indian Reserves, Canadian Armed Forces bases, and in some remote areas of Quebec and Ontario. The health care institution survey component includes long-term residents living in health care facilities with four or more beds, in all Canadian provinces—excluding the Yukun Territory and the Northwest Territories. The Northern component includes household residents in both the Yukon Territory and the Northwest Territories, excluding persons living on Indian Reserves and Canadian Armed Forces bases.

The longitudinal sample for 1996 - 1997 consists of all the longitudinal respondents selected in cycle 1 who had completed at least the general component of the 1994 – 1995

[6] The study uses unweighted data and consequently the results will reflect sample characteristics.

questionnaires. A total of 17,276 persons participated in the 1996 – 1997 NPHS interview process. This paper will use the data collected regarding individuals aged 65 and over. The gender breakdown of the total sample is 5357 male respondents and 8006 female respondents.

Table 3.1 ***The Socio-economic characteristics of the individuals in the sample***

	MALE			**FEMALE**
Names of the Variables	**Frequency (percentage)**		**Names of the Variables**	**Frequency (percentage)**
Sample size	5357		**Sample size**	8006
Age Group			**Age Group**	
65-69 Years	1780 (33.2%)		65-69 Years	2213 (27.6%)
70-74 Years	1610 (30.1%)		70-74 Years	2177 (27.2%)
75-79 Years	1004 (18.7%)		75-79 Years	1715 (21.4%)
80Years or more	963(18%)		80Years or more	1901 (23.7%)
Marital Status			**Marital Status**	
Married	3634 (67.8%)		Married	2683 (33.5%)
Single	412(7.7%)		Single	451 (5.7%)
Widow/Divorced	1311(24.5%)		Widow/Divorced	4872 (60.8%)
Language of the Respondents			**Language of the Respondents**	
English only	3524 (65.8%)		English only	5567 (69.5%)
French only	120 (2.2%)		French only	211 (2.6%)
Eng & French only	389 (7.3%)		Eng & French only	591 (7.4%)
Other only	1324 (24.7%)		Other only	1637 (20.4%)
Level of Education			**Level of Education**	
No School/Some Secondary	2698 (50.4%)		No School/Some Secondary	4034 (50.4%)
Secondary Graduate	756 (14.1%)		Secondary Graduate	1313 (16.4%)
Post Sec./Diploma	1056 (19.7%)		Post Sec./Diploma	1775(22.1%)
Bachelor/MA/PhD	847 (15.8%)		Bachelor/MA/PhD	729(8.3%)
Income Level			**Income Level**	
No income	17 (.3%)		No income	27 (.3%)
Less than $5,000	4 (.1%)		Less than $5,000	14 (.2%)
$5000 to $14,999	704 (13.1%)		$5000 to $14,999	1942 (24.3%)
$15,000 to $29,999	3118 (58.3%)		$15,000 to $29,999	4650(58.1%)
$30,000 to $49,999	1026 (19.1%)		$30,000 to $49,999	978(12.2%)

$50,000 and above	488 (9.1%)		$50,000 and above	395(4.9%)
Home Ownership			**Home Ownership**	
Home owner	4370 (81.6%)		Home owner	5461 (68%)
No home owner	987 (18.4%)		No home owner	2545 (32%)

Figures in the parentheses show the percentage.

Table 3.1 above gives the socio-economic characteristics of the sample population. The males in the sample are slightly younger than the females in the sample—the average age of males is 72.5 years, and the average age of females is 73.5 years. The data in the table suggest, in percentage terms, more females than males belong in the 65 –74 age group. The majority of males are married, while the majority of females are either widowed or divorced. There is little difference between the male and female samples in terms of language and schooling. In percentage terms, more males than females belong to the upper income category of $30,000 and above. Similarly, more males own households than do females.

Table 3.2 shows the relationship between age and the use of formal and informal care services by males and females. In total, 486 males (or 9% of the male sample) and 1106 females (or 14% of the female sample) use home care services. On the other hand, 130 males (or 2.4% of the male sample) and 176 females (or 2.1% of the female sample) receive informal care services. The major users of home care services are males and females who are either very old or within the age group of 80 years old and above.

Table 3.2 ***The Relationship between age and formal care and informal care services***

	MALE		FEMALE	
Age Level	Receive Formal Care	Receive Informal Care	Receive Formal Care	Receive Informal Care
65-69 Years	65 (13.4%)	13 (20%)	114 (10.3%)	41(23.4%)
70-74 Years	121 (24.9%)	14 (21.5%)	185 (16.7%)	38 (21.7%)
75-79 Years	103 (21.2%)	14 (21.5%)	239 (21.6%)	38 (21.7%)
80Years or more	197 (40.5%)	24 (36.9%)	568 (51.4%)	58 (33.1%)

Figures in the parentheses show the percentages who receive home care and informal care services.

More than 50% of female home care users belong to the 80 and over age group. As in the use of formal care services, males and females in the age group of 80 years and over are the major recipients of informal care services.

3.6 Empirical Results

3.6.1 *Introduction*

The analyses of Table 3.2 indicate that all individuals aged 80 years and above are the main recipients of formal care and informal care. Consequently, it will be interesting to examine the health production function of individuals aged 80 years or above. This section will present the research findings of estimating the health production function of individuals aged 65 and over, and of the sub group aged 80 years and over.

3.6.2 *Analysis of the male sample*

Table 3.3 shows the parameter estimates of the health production function of males aged 65 and over. Before estimating the final Ordered Probit model, the Hausman test was conducted to determine whether or not home care and informal care are endogenous to health status. The variables used as instrument variables are living alone,

frequency of contracts with sons, frequency of contracts with daughters, and frequency of contracts with close friends. These instruments are found to be jointly significant in predicting the use of home care and informal care. The predicted probabilities obtained from the Probit estimation are included in the health production function regression along with the home care and informal care variables. The predicted probabilities are statistically insignificant, suggesting that home care and informal care are not endogenous to health status.[7] Consequently, the final Ordered Probit regression for male health status includes home care and informal care as independent variables.

Table-3.3

Ordered probit estimates of health production function for male aged 65 and over

Variable	Coefficient	P-value
Age (70-74)	.1240	.000
Age (75-79)	.2033	.000
Age (80-over)	.1999	.000
No-Income	.0283	.903
Income (5,000-15,000)	.1448	.001
Income (30,000-50,000)	-.1175	.002
Income (Over 50,000)	-.2575	.000
Own Dwelling	-.0134	.733
Secondary Graduate	-.2083	.000

[7] Using NPHS (1994-95) data, Rosenberg and Moore (1997) showed that many elderly people suffered from activity limitations, disabilities and chronic conditions. However, at the same time, an overwhelming majority of elderly persons perceived that their health was good to excellent. Rosenberg and Moore also found that utilization of health care increased after age 74, and those who utilized health care more frequently perceived that their health was good to excellent. Using Manitoba data, Menec et. al. (2002) found that approximately 80% of elderly persons aged 85 or over needed help with basic activities of daily living. However, about 70 to 80% of the elderly in the 85 and over age group perceived that their health was good to excellent. These evidences suggest that there may be a positive relationship between health care use and activity restriction, disability or chronic illness, but the relationship between perceived health and health care use is less obvious.

Post Secondary Diploma	-.0975	.010
Bachelor/MA/PhD	-.3439	.000
Only French Language	-.0318	.821
French and English only	.0153	.791
Other Language only	.0412	.233
Home Care	-.2796	.000
Informal Care	-.3736	.006
Total Smoking Years	.0032	.000
Exercise	-.2731	.000
Alcohol Consumption	-.2413	.000
Newfoundland	-.4918	.000
Nova Scotia	.0326	.782
PEI	-.0845	.537
New Brunswick	.0010	.994
Quebec	-.1404	.258
Manitoba	.0435	.262
Saskatchewan	.0742	.527
Alberta	.0576	.187
British Columbia	.0902	.383
_Cut 1	-1.5138	
_Cut 2	-.55923	
_Cut 3	.45802	
_Cut 4	1.2918	

LR chi 2 (28) = 509.55

Prob >chi 2 = 0.000

Because self-perceived health status, the dependent variable in this model, increases with bad health outcomes, a positive coefficient implies the likelihood of a worse outcome, but a negative coefficient indicates the likelihood of a better outcome. The regression results

suggest that both home care and informal care improve health status.[8] As expected, age has a significant negative effect on the health of the elderly population. Compared to the base category income ($15,000 - $30,000), increases in income positively impacts health status. Similarly, compared to no schooling, increases in the level of education significantly influences health status positively. Smoking year has significant negative effect while exercise has significant positive impact on health. Alcohol consumption has significant positive impacts on health. The NPHS data statistics on the drinking habit of individuals suggests that majority of them are moderate drinkers. Positive coefficient of alcohol consumption as found in this study thus supports the findings of other studies that moderate drinking is associated with positive health outcome.

The marginal effects of each variable can be assessed in two different ways. If the variable is a continuous variable, then marginal effect is calculated by taking partial derivative. If the variable is dummy variable, then the marginal effect can be calculated by computing the change in predicted probability given a unit change in X with the other variables are held at their sample means. The marginal effects are presented in the Table-3.4.

Table-3.4
Marginal effects of independent variables

Variable	Prob (h=1)	Prob (h=2)	Prob (h=3)	Prob (h=4)	Prob (h=5)
Age (70-74)	-.0221*	-.0249*	.0084*	.0234*	.0151*
Age (75-79)	-.0345*	-.0415*	.0111*	.0385*	.0264*
Age (80-over)	-.0339*	-.0408*	.0109*	.0378*	.0260*
No-Income	-.0051	-.0056	.0020	.0053	.0034
Income (5,000-15,000)	-.0249*	-.0295*	.0084*	.0274*	.0185*

[8] Statistical test failed to reject the null hypothesis of equal coefficients for the home care and informal care variables.

Income (30,000-50,000)	.0022*	.0227*	-.0103*	-.0219*	-.0130*
Income (Over 50,000)	.0538*	.0469*	-.0282*	-.0468*	-.0257*
Own Dwelling	.0024	.0026	-.0010	-.0025	-.0015
Secondary Graduate	.0420*	.0390*	-.0209*	-.0383*	-.0218*
Post Secondary Diploma	.0186*	.0189*	-.0084*	-.0182	-.0109
Bachelor/MA/PhD	.0736*	.0611*	-.0397*	-.0618*	-.0332*
Only French Language	.0059	.0062	-.0026	-.0059	-.0036
French and English only	-.0028	-.0030	.0011	.0029	.0018
Other Language only	-.0075	-.0082	.0030	.0077	.0049
Home Care	.0590*	.0504*	-.0314*	-.0506*	-.0275*
Informal Care	.0849	.0624*	-.0490*	-.0654*	-.0329*
Total Smoking Years	-.0006*	-.0006*	.0002*	.0006*	.0003*
Exercise	.0491*	.0544*	-.0189*	-.0513*	-.0333*
Alcohol Consumption	.0486*	.0486*	-.0152*	-.0455*	-.0302*
Newfoundland	.1186**	.1753*	-.0714	-.0831*	-.0395*
Nova Scotia	-.0058	-.0065	.0023	.0061	.0039
PEI	.0163	.0163	-.0076	-.0157	-.0093
New Brunswick	-.0001	-.0002	.00008	.0002	.0001
Quebec	.0280	.0265	-.0137	-.0259	-.0149
Manitoba	-.0078	-.0087	.0031	.0082	.0052
Saskatchewan	-.0130	-.0150	.0047	.0140	.0092
Alberta	-.0103	-.0115	.0040	.0108	.0070
British Columbia	-.0157	-.0183	.0055	.0171	.0113

* Sign implies that coefficient is significant at 1% level.

The results of Table-3.4 suggest that provision of home care will increase the probability of having excellent health (h=1) by .0590, and will decrease the probability of having worse health classification (h=5) by .0275. Both of these effects are significant. Informal care significantly decreases the probability of having worse health status by

.0329. Compared to base category age (60-64 years), increase in age will significantly reduce the probability of having excellent health status and will significantly increase the probability of having health with worst classification. Similarly increase in schooling from base category (no schooling) significantly increases probability of having excellent health outcome and decreases the probability of having worst health outcome. Similar result holds for the increase in income from base category level of more than 15,000 and less than 30,000. The results of also suggest that with one-year increase in smoking year, the probability of having excellent health decreases by .0006 and probability of having worst health outcome increases by .003. These effects are statistically significant.

In this paper, the health production function was also estimated for males aged 80 years old and over. The results of the Ordered Probit estimation are given in Table 3.5. The Hausman endogeneity test shows that formal care and informal care variables are not endogenous to self-perceived health status. Consequently, the final Ordered Probit model includes actual values of both formal care and informal care variables.

Table-3.5

Ordered probit estimates of health production function for male aged 80 and over

Variable	Coefficient	P-value
No Income	.4635	.532
Income (5,000-15,000)	.1423	.120
Income (30,000-50,000)	.0497	.631
Income (Over 50,000)	.0577	.629
Own Dwelling	.0272	.735
Secondary Graduate	-.2068	.055
Post Secondary Diploma	.0992	.920

Bachelor/MA/PhD	-.3151	.014
French Only	-.1457	.652
French and English	.1616	.278
Other Language only	.2118	.011
Home Care	-.2368	.006
Informal Care	-.1286	.583
Total Smoking Years	.0021	.129
Exercise	-.3155	.000
Alcohol Consumption	-.2279	.002
Newfoundland	-.2306	.425
Nova Scotia	.3472	.143
PEI	-.0015	.996
New Brunswick	.0521	.857
Quebec	-.1707	.545
Manitoba	-.0367	.672
Saskatchewan	-.0330	.897
Alberta	-.0072	.947
British Columbia	-.0418	.864
_ Cut 1	-1.626	
_ Cut 2	-.6743	
_Cut 3	.3571	
_Cut 4	1.169	

LR chi 2 (25) = 74.30 Prob >chi 2 = 0.000

The results suggest that formal home care positively impacts the health status of Canadians aged 80 years old and over. The impact of informal care, however, is not significant to health status. Exercise and alcohol consumption also significantly impact the health of very old persons positively.

Table-3.6
Marginal effects of independent variables

Variable	Prob (h=1)	Prob (h=2)	Prob (h=3)	Prob (h=4)	Prob (h=5)
No Income	-.0490	-.0964	-.0273	.07799	.0948
Income (5,000-15,000)	-.0198	-.0302	.0008	.0262	.0229
Income (30,000-50,000)	-.0071	-.0105	.0007	.0092	.0077
Income (Over 50,000)	-.0082	-.0122	.0007	.0107	.0091
Own Dwelling	-.0040	-.0057	.0006	.0050	.0041
Secondary Graduate	.0341	.0426	-.0101	-.0383	-.0282
Post Secondary Diploma	.0014	.0020	-.0002	-.0018	-.0015
Bachelor/MA/PhD	.0556	.0631***	-.0208	-.0578	-.0399*
Other Language only	-.0291***	-.0450	.0005	.0389	.0347*
Home Care	.0387	.0488**	-.0109	-.0438**	-.0326*
Informal Care	.0207	.0266	-.0055	-.0239	-.0179
Total Smoking Years	-.0003	-.0004	.00004	.0003	.0032
Exercise	.0478*	.0659*	-.0083	-.0582*	-.0472*
Alcohol Consumption	.0335*	.0480*	-.0045	-.0421*	-.0349*
Newfoundland	.0398	.0467	-.0140	-.0426	-.0299
Nova Scotia	-.0404	-.0733	-.0129	.0610	.0657
PEI	.0002	.0003	-.0003	-.0002	-.0002
New Brunswick	-.0074	-.0110	.0006	.0096	.0082
Quebec	.0282	.0351	-.0086	-.0316	-.0231
Manitoba	.0055	.0077	-.0009	-.0068	-.0055
Saskatchewan	.0050	.0069	-.0009	-.0061	-.0049
Alberta	.0010	.0015	-.0001	-.0013	-.0010+
British Columbia	.0063	.0087	-.0012	-.0077	-.0061

* Sign implies that coefficient is significant at 1% level.

The marginal effect analysis shows that formal care decreases significantly the probability of reporting worst health outcome. Other factors such as having Bachelor/MA/PhD, exercise and alcohol consumption decrease the probability of

reporting excellent health outcome. On the other hand, knowing only 'other language' increases the likelihood of reporting worst health status.

Comparing the results of estimating the health status production function for males aged 65 and over to the sub sector of oldest males (aged 80 and over), shows many similarities and differences. In the group including all elderly men, it is estimated that both formal home care and informal care positively impact health status significantly. Yet, the estimation results for the sub group of those aged 80 and over show that only formal home care positively affects health status significantly. In both groups, exercise and alcohol consumption are found to positively impact health status with statistical significance. All the education variable coefficients are significant in the group which includes all males, but none of the education variables is significant in the oldest sub group. Income is not statistically significant predictors of health status in the oldest sub group.

3.6.3 *Analysis of the female sample*

The health production function was also estimated separately for the sample of Canadian females. According to the Hausman test results for this sample both formal and informal care are exogenous to health status. The Ordered Probit regression of self-perceived health includes the actual values of the formal care and informal care variables. The results presented in Table 3.7 show that both formal care and informal care have significant positive impacts on the health status of females aged 65 and over.[9] Other

[9] The Statistical test did not reject the null hypothesis of equal coefficients of Home Care and Informal Care variables.

factors that positively affect health status are own dwelling, level of schooling, exercise and alcohol consumption. Language barriers and number of smoking years appear to negatively impact health outcomes for females aged 65 and over.

Table-3.7

Ordered probit estimates of health production function for female aged 65 and over

Variable	Coefficient	P-value
Age (70-74)	.0382	.232
Age (75-79)	.0737	.033
Age (80-over)	.1217	.001
No-Income	.2387	.147
Income (5,000-15,000)	.1520	.000
Income (30,000-50,000)	.0279	.463
Income (Over 50,000)	-.0391	.490
Own Dwelling	-.1017	.000
Secondary Graduate	-.1971	.000
Post Secondary Diploma	-.2028	.000
Bachelor/MA/PhD	-.3602	.000
Only French Language	-.0529	.631
French and English only	.0185	.692
Other Language only	.2628	.000
Home Care	-.1804	.000
Informal Care	-.2303	.007
Total Smoking Years	.0033	.000
Exercise	-.4138	.000
Alcohol Consumption	-.2640	.000
Newfoundland	-.2738	.026
Nova Scotia	.0712	.499
PEI	-.2184	.034

New Brunswick	.1357	.186
Quebec	.0567	.599
Manitoba	-.0473	.138
Saskatchewan	.2145	.014
Alberta	.0823	.024
British Columbia	-.0137	.870
_Cut 1	-1.673	
_ Cut 2	-.6259	
_Cut 3	.3765	
_Cut 4	1.386	

LR chi 2 (19) = 939.81

Prob >chi 2 = 0.000

Table-3.8
Marginal effects of independent variables

Variable	Prob (h=1)	Prob (h=2)	Prob (h=3)	Prob (h=4)	Prob (h=5)
Age (70-74)	-.00676	-.00814	.00347	.0078	.0035
Age (75-79)	-.01273	-.01580	.00640	.0151	.0069
Age (80-over)	-.02072*	-.02623*	.01013*	.0250*	.0117*
No-Income	-.03624	-.05333	.01295*	.0500	.0265
Income (5,000-15,000)	-.02564*	-.03287*	.01228*	.0313*	.0148*
Income (30,000-50,000)	-.00488	.00595	.00252	.0057	.0025
Income (Over 50,000)	.00710	.00819	-.00388	-.0079	-.0034
Own Dwelling	.01761*	.02174*	-.00890*	-.0208*	-.0095*
Secondary Graduate	.03797*	.03956*	-.02238*	-.0390*	-.0160*
Post Secondary Diploma	.03860*	.04101*	-.02242*	-.0403*	-.0168*
Bachelor/MA/PhD	.07632*	.06619*	-.04874*	-.0682*	-.0255*
Only French Language	.00967	.01099	-.00536	-.0106	-.0046
French and English only	.00331	.00389	-.00177	-.0037	-.0016
Other Language only	-.0421*	-.05769*	.01779*	.0546*	.0274*
Home Care	.03470*	.03625*	-.02045*	-.0357*	-.0147*

Informal Care	.04673	.04434*	-.02905	-.0446*	-.0173*
Total Smoking Years	-.0006*	-.0007*	.00031*	.00068*	.00031*
Exercise	.06984*	.08836*	-.0341*	-.0846*	-.0410*
Alcohol Consumption	.04687*	.05551*	-.0239*	-.0536*	-.0242*
Newfoundland	.05713	.051311	-.03629	-.0523	-.0197
Nova Scotia	.04410	-.01539	.00587	.01470	.0068
PEI	-.0120	.042222	-.02731	-.0424	-.0165
New Brunswick	-.0220	-.02976	.00977	.02822	.0138
Quebec	-.0097	-.01219	.00481	.01167	.0054
Manitoba	.0085	.0099	-.00463	-.0096	-.0042
Saskatchewan	-.0332	-.0476	.01274*	.04488	.0233
Alberta	-.0140	-.0177	.00695	.01695	.0078
British Columbia	.0024	.0028	-.00131	-.0027	-.0012

* Sign implies that coefficient is significant at 1% level.

The marginal effect analysis shows that formal home care significantly increases the likelihood of reporting excellent health status and significantly reduces likelihood of reporting worst health outcome. The informal care also significantly decreases the likelihood of reporting worst health status. All levels of schooling, exercise and alcohol consumption significantly increase the probability of reporting excellent health. On the other hand, number of smoking years and knowledge of only 'other language' significantly reduce the probability of reporting excellent health.

For the sample of females aged 80 years and above, the Hausman test suggests that formal care and informal care are not endogenous to health status. Table 3.9 presents the results of the Ordered Probit estimation for this age group. The results of the analysis suggest, with statistical significance, that both formal care and informal care positively

affects the health of very old females.[10] Schooling levels and exercise positively impact health status, while the characteristic 'other language' was estimated as negatively impacting health status.

Table-3.9

Ordered Probit estimates of health production function for female aged 80 and over

Variable	Coefficient	P-value
No-Income	-.0747	.807
Income (5,000-15,000)	.1526	.006
Income (30,000-50,000)	.0730	.455
Income (Over 50,000)	-.0806	.591
Own Dwelling	-.1039	.040
Secondary Graduate	-.1840	.012
Post Secondary Diploma	-.2066	.002
Bachelor/MA/PhD	-.3474	.000
Only French Language	-.4226	.092
French and English only	-.0926	.400
Other Language only	.2267	.000
Home Care	-.2564	.000
Informal Care	-.4200	.006
Total Smoking Years	.0001	.914
Exercise	-.4291	.000
Alcohol Consumption	-.2334	.000
Newfoundland	-.6379	.014
Nova Scotia	.0583	.826
PEI	-.2042	.240
New Brunswick	.0870	.675

[10] Statistical test did not reject the null hypothesis that Home Care and Informal Care have equal impacts.

Quebec	.5226	.054
Manitoba	-.0258	.686
Saskatchewan	.1484	.351
Alberta	.1036	.182
British Columbia	-.1759	.283
_Cut 1	-1.800	
_Cut 2	-.7883	
_Cut 3	.1564	
_Cut 4	1.0983	

LR chi 2 (19) = 895.99

Prob >chi 2 = 0.000

The marginal effect of the independent variables, as shown in the Table-3.10 suggests that provision of formal care increases the likelihood of having excellent health status (h=1) by .0438 while it decreases the likelihood of having worst health outcome by .0288. Informal care significantly decreases the likelihood of reporting worst health outcome by .0374.

Table-3.10

Marginal effects of independent variables

Variable	Prob (h=1)	Prob (h=2)	Prob (h=3)	Prob (h=4)	Prob (h=5)
No-Income	.0124	.0159	-.0040	-.0157	-.0085
Income (5,000-15,000)	-.0233**	-.0332**	.0049**	.0322**	.0193
Income (30,000-50,000)	-.0111	-.0159	.0023	.0154	.0093
Income (Over 50,000)	.0134	.0171	-.0044	-.0169	-.0092
Own Dwelling	.0163	.0225	-.0041	-.0219	-.0127
Secondary Graduate	.0319	.0384	-.0116	-.0385	-.0202**

Post Secondary Diploma	.0358*	.0432*	-.0130	-.0432*	-.0227*
Bachelor/MA/PhD	.0664*	.0685*	-.0299	-.0711*	-.0338*
Only French Language	.0869	.0078	-.0438	-.0844	-.0373
French and English only	.0155	.0196	-.0051	-.0195	-.0105
Other Language only	-.0329*	-.0498*	.0044	.0477*	.0305*
Home Care	.0438*	.0538*	-.0151*	-.0537*	-.0288*
Informal Care	.0858	.0786*	-.0428	-.0841*	-.0374*
Total Smoking Years	-.0002	-.0003	.0006	.0003	.0001
Exercise	.0695*	.0909*	-.0191*	-.0895*	-.0518*
Alcohol Consumption	.0386*	.0496*	-.0119*	-.0491*	-.0272*
Newfoundland	.1479*	.1021*	-.0829*	-.1197*	-.0473*
Nova Scotia	-.0089	-.0127	.0019	.0123	.0074
PEI	.3695	.0418	-.0150	-.0425	-.0212
New Brunswick	-.0130	-.0190	.0024	.0184	.0112
Quebec	-.0581	-.1145	-.0216	.1028	.0914
Manitoba	.0041	.0055	-.0011	-.0054	-.0031
Saskatchewan	-.0213	-.0326	.0027	.0312	.0200
Alberta	-.0156	-.0226	.0031	.0219	.0133
British Columbia	.0312	.0364	-.0121	-.0367	-.0187

* Sign implies that coefficient is significant at 1% level.

The schooling level and exercise significantly increase the probability of having excellent health. On the other hand, the variable 'other language only' significantly reduces the probability of reporting excellent health outcome.

A comparison between the results found for the group of all females and the results for the sub group of only those 80 and over showed very little variation. However, the comparison between the two genders showed that for females, the

variables—own dwelling and other language—were significant predictors of health outcomes. Yet, these variables are not significant in the regression for males. However, in both the regression for males and the regression for females, the schooling variable coefficients are significant.

3.7 Summaries and Conclusion

The prime objective of this paper was to examine the impact of care patterns on the health outcomes of elderly individuals aged 65 and over. Self-reported health status was used in this study as a measure of health outcome. This study applied the production function approach to utilize data from the 1996-97 Canadian National Health Population Survey. Because of differences in health outcomes between males and females, the study estimates separate production functions for males and females. Moreover, since the majority of formal home care and informal care recipients belong to the age group of 80 and over, the study analyzed this sub group of population separately as well.

The Ordered Probit model estimates suggest that when compared to individuals with no care or self-care, individuals with formal home care generally experience better health outcomes. This observed result is consistent for both males and females, in both the 65 and over age group and the 80 and over age group. These results of the study are in line with the results of previous studies conducted on this topic. The study also suggests that informal care positively affects the health of all Canadian seniors, with statistical significance, except for males aged 80 and over.

Other statistically significant results of this study show that age and number of smoking years negatively impact health status; and level of schooling, income, and exercise positively impact health status.

Regression results also show some variations between the entire male sample and the sub group of those aged 80 and over. For the sub group, income and education are not significant predictors of health status. The variations between the results found for the two groups of females were minimal.

Comparing results across the genders, suggests that for females, the variables—own house and other language—are significant predictors of health outcomes. On the other hand, these variables are not significant predictors of health outcomes for males. For males, all levels of income influence health outcomes significantly, yet for females, only income level ($5,000 - $15,000) has significant effects on health.

This study also demonstrates the effectiveness of formal care in improving the health status of elderly people. It suggests that informal caregivers are effectively meeting the needs of Canada's elderly. This result reinforces the concluding argument of my previous paper: informal caregivers ought to be given proper support—including the appropriate training to deal with the challenges in caring for the elderly. Since the empirical results have found that formal care is effective, this paper also argues that the Canadian government should put more emphasize on the formal home care system.

The NPHS provides no information about the intensity and quality of formal home care, nor any information about the total hours provided under the umbrella of informal care. Consequently, this study was limited to representing both formal home care and informal care by dichotomous variables. Any future impact study may benefit

by using data on the quantity and quality of formal and informal care. Similarly, future studies may wish to disaggregate the home care sector into separate sub sectors (such as nursing care, personal care, and respite care) to analyze the impact of these individual sub sectors on elderly health outcomes.

Another possible area for future research may be the investigation of the impact of formal care and informal care on the number of hospital days or the number of consultations with physicians. It would be interesting to research whether formal care or informal care reduces the number hospital days or the number of consultations with physicians, as an indicator of reduction in total health care expenditures.

3.8 References

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Table A.3.1 *Public Home Care expenditures in percentage of Public Health Care expenditures by provinces and territories*

Province/Territory	Province/Territory 1996/97	Province/Territory 1997/1998
British Columbia	8	8.2
Alberta	3.2	3.6
Saskatchewan	4.1	4.1
Manitoba	6.9	7.5
Ontario	5.3	6.1
Quebec	3.3	3.4
New Brunswick	5.8	6.2
Nova Scotia	4.4	4.3
Prince Edward Island	2.4	2.6
Canada	4.1	4.5

Source: Provincial and Territorial Home Care Programs: A Synthesis for Canada, published by Health Canada.

Table A.3.2 *Rate of utilization: the number of home care clients per 1000 inhabitants*

Province/Territory	Province/Territory 1996/97	Province/Territory 1997/1998
British Columbia	31	31
Alberta	23	24
Saskatchewan	28	28
Manitoba	24	26
Ontario	29	32
Quebec	46	47
New Brunswick	40	43
Nova Scotia	19	19
Prince Edward Island	16	16
Canada	25	25

Source: Provincial and Territorial Home Care Programs: A Synthesis for Canada, published by Health Canada.

Chapter-4

The Labor Market Impact of Chronic Illness In Canada

4.1 Introduction

The relationship between health and labor supply is a widely investigated issue in economic literature (Sammartino, 1987, Quinn and Burkhauser, 1990 and Weaver, 1994). Health status, in nearly all of these studies, is measured by some form of subjective measurement such as self-reporting (Butler et al. 1987). Only a few studies focus on specific diseases as a measure of health (Bartel and Taubman, 1979; Inman 1987; Mitchel, 1990; and Wilson, 2001). However, a disease-specific measure of health status has some advantages from a policy point of view, as well as from an econometric point of view. Policy makers are interested to know the economic burden of poor health that is best described in disease specific terms. The economic burden of poor health differs among various types of diseases. For policy intervention purposes it is important to identify the relative economic burden of various diseases, since the government allocates public investment between the prevention and treatment of diseases. Knowledge about relative economic costs enables governments to focus on those diseases that create relatively more economic burden. Econometric analysis on health issues are concerned with the problem of reporting bias associated with the subjective measure of self-reported health (Currie and Madrian, 1999). Those who prefer to stay in the labor force may understate these health problems (Bound 1991, Dwyer and Mitchell 1991). On the other

hand, those who want to take an early retirement or want to work fewer hours may overstate their health problems to justify their action. In such cases, one would find presence of an inverse relationship between self reported health status and labor force participation. When health status is measured by clinically diagnosed conditions to objectively report specific illnesses, there is less leaway to overstate or understate individual's health status, which leaves less room for reporting bias than may be realized with self-reporting.

The aim of this study is to analyze the impact of various chronic diseases on individual labor market behavior using Canadian data. Only a limited number of studies have investigated the relationship between health and labor market behavior using Canadian data. However, Canadian studies primarily focus on disability issues (Hum and Simpson, 1996, 2001, and Harkness, 1993).

The proposed study also aims to improve on other studies that have dealt with disease specific measures of health. In 1979, Bartel and Taubman estimated the impact of various diseases on individual earnings, wages, and working hours. This study did not, however, analyze the impact of diseases over the life cycle. Inman (1987) and Mitchel (1990) narrowly focused on a single specific disease and thus could not find the relative impact of different chronic diseases.

The study will take into account that the impact of disease differs over the life cycle, and will estimate separate regressions for different age groups to model these variations. Unlike the studies of Inman (1987) and Mitchel (1990), this study will analyze the relative impact of various diseases. It will also consider the problem of endogeneity surrounding income and health. The endogeneity problem arises because

health may influence income, while at the same time, income may influence the health of the individual. The endogeneity problem will result in a biased estimate of the coefficient of the health status variable in both the employment and income equations. For this reason, we need to purge this bias before estimating these equations.

Because of data limitations this study will focus on only five major chronic illnesses: Arthritis, High Blood pressure, Heart Disease, Diabetes, and Cancer. To test the endogeneity problem, as well as to purge the endogeneity bias, will require finding variables which influence health status but do not influence labor market outcomes. In the National Population Health Survey (NPHS) data, these variables, or instruments, are found only for arthritis, high blood pressure, heart disease, diabetes, and cancer. Consequently, this study will analyze the labor market impact of only these five chronic conditions. According to the NPHS (1998-99), the prevalence of most of these chronic conditions increases with age. There is also a gender difference in the prevalence of various chronic conditions. This paper will investigate the impacts of these chronic conditions on individuals' probability to work, number of work hours, and total earnings over their life cycle.

The paper is divided into seven sections. Section 4.2 provides a brief literature review. Methodological issues are discussed in Section 4.3. Section 4.4 describes the extent of chronic illness in Canada. Section 4.5 discusses the issues relating to the source of data and characteristics of the data sample. The estimation results are presented in Section 4.6. Section 4.7 provides the summary and conclusion of the study.

4.2. Brief Literature Review

Bartel and Taubman (1979) used 1974 National Academy of Science-National Research Council data to explore the effects of certain diseases on earnings and labor force behavior. For estimation purposes, the study created a series of dummy variables for each of the eight aggregated disease categories. The study identified five-time period of disease diagnoses: pre-1948; 1948-1954; 1955-1961; 1962-1967; and 1968-1973. It regressed 1973 earnings on the data of individuals who were diagnosed in each of these five periods, which produced five estimated earning functions. The result suggests that more recent diagnoses have much stronger effects than do earlier ones. The study further investigated the impact of 1962-1967 diagnoses on individual wage, weekly work hour, probability of being out of labor force, and probability of being unemployed. The results of these regressions show that diagnoses of psychoses/neoroses and bronchitis significantly reduced usual work hours in 1973. Furthermore, individuals with phychoses /neoroses or arthritis were significantly more likely to be out of the labor force during the survey week. Chronic illnesses such as bronchitis, emphysema, and asthma significantly increased the probability of unemployment.

Inman (1987) used the 1976 National Sample of Multiple Sclerosis patients to estimate the impact of Multiple Sclerosis (MS) related illness limitation upon the earnings of unmarried and married patients. The study estimated a single equation Tobit earning model for unmarried patients and a simultaneous equations earnings model for married couples. The overall result suggests that MS has large and statistically significant negative effects on the potential earnings of a typical MS household. Losses rise with the severity of the illness.

Mitchell (1990) explored the effect of the onset of chronic arthritis on the work behavior over the life cycle. The data for this study came from the 1978 Survey of Disability and Work. The study used a Dynamic Hazard Model to estimate the duration of employment upon the onset of chronic illness. The resulting estimations suggest that an individual who develops arthritis continues to work about 9 years after the onset of the Chronic illness. The mean age of a man with Arthritis in the study sample was 43 years. The model predicted that he would continue to work until he reaches age 52 years of age. Thus if the average healthy man works until age 65, then a man with arthritis may lose 13 years from his working career.

Wilson (2001) used a data set of over 14 000 households from the state of New Jersey in the USA to estimate the impact of specific chronic health conditions on the probability of employment. The chronic disease indicators used in this study were binary indicators of physician-diagnosed conditions. The estimations of models for individual level analysis suggest that chronic disease explains very little of the overall variation in employment probability for the given sample. However, the magnitudes of the disease coefficients showed strong negative impacts for some highly disabling conditions such as Central Nervous System Trauma and the diseases of the Musculoskeletal System. On the other hand, a disease like hypertension which is not typically debilitating has little effect on employment. The aggregate level analysis of the impact of chronic illness on employment probability was modest. The aggregate level estimates showed that if all chronic diseases occurring after age 25 are removed from the analysis on the population aged 35-74, the predicted probability of employment will rise by 5.5% for women and 3% for men.

4.3 Methodology:

4.3.1. Analytical Framework:

Following Mete and Schultz (2002) the model constructed in this study will assume that an individual's single period utility (U) depends on leisure (L), consumption of marketed goods (C), and health status (S):

$U = U(L, C, S)$..... (4.1)

An individual also faces two constraints: a time constraint (T) and a budget constraint (C). These are modeled such that:

Time constraint: $T = H_t + L + H_S$..... (4.2)

Where T is total time, H_t is time devoted to work, L is leisure, and H_S is the sick period when the individual cannot work; and

Budget Constraint: $C = W*H_t + V$..... (4.3)

Where W is the wage rate and V is other income. For simplicity it is assumed that workers are not receiving any compensation during the period of illness. The wage rate (W) depends on education (ED), age (A), health status (S) and error term (e_1).

$W = W(ED, A, S, e_1)$..... (4.4)

Both education and age are expected to have a positive impact on the wage rate since Education enhances the worker productivity and age reflects the work experience. Health status may influence the wage rate negatively if chronic illness reduces worker's productivity.

The basic idea behind labor supply model is that in deciding whether to work individuals compare market wage rate with the non-market or shadow wage rate. An individual will not work if market wage rate is less than the shadow (reservation) wage at

zero hours, i.e. the opportunity cost of not working. The labor supply decision equation can be written as:

$H^* = W - r$..... (4.5a)

where H^* denotes the desired number of work hours and r is the reservation wage or non-market wage at zero hours. Individuals will not work if the number of desired work hour is negative. Individuals will work only if the desired number of work hours is equal or more than zero.

$H=0$ if $H^* < 0$..... (4.5b)

$H=H^*$ if $H^* \geq 0$..... (4.5c)

The labor supply model can be used to identify channels through which the health status as represented by the presence of chronic illness can influence labor market behavior. Chronic illness can influence labor supply most directly through the time constraint. Sick time reduces time available for work which reduces total labor supply as well as total earnings. Chronic illness may also influence wages if productivity of workers is affected by disability. Labor supply may be affected if chronic illness changes disutility of wage work relative to non-wage activities. Individuals who are ill find it more painful to perform wage work than non wage work which may serve to reduce the labor supply.

4.3.2. Empirical Specification:

Following Killingsworth (1983) the empirical labor supply model is specified such that:

$H^* = b + b_1ED + b_2A + b_3S + b_4Z + \varepsilon$..... (4.6a)

Where ε denotes the error term (a mean zero random variable reflecting impact of unmeasured variables). The series of dummy variables indicating such diseases as arthritis, high blood pressure, heart disease, diabetes, and migraines is denoted by S and Z represents different exogenous variables such as race, marital status, and presence of children that affect employment decision.

Work=1 if $H^* \geq 0$..... (4.6b)

Work=0 if $H^* < 0$..... (4.6c)

Work Hour (H) = Desired Work Hour (H*) if Work=1... (4.6d)

The labor supply equation (4.6.a) will be estimated using maximum likelihood probit method.

To estimate the probability to work as a part timer or work as a full timer, Ordered probit method will be utilized. Following Greene (2000) the ordered probit model can be specified as follows:

$H^* = \beta' X_i + \varepsilon$..... (4.7a)

Where H* is unobserved and may be thought of as the underlying tendency of an observed phenomenon. It is assumed that ε is normally distributed with a mean of zero. Individual characteristics are represented by Xi.

What we observe is

$H=0$ if $H^* \leq 0$..... (4.7b)

$H=1$ if $0 < H^* \leq \mu_1$..... (4.7c)

$H=2$ if $\mu_1 < H^* \leq \mu_2$..... (4.7d)

Where H is observed in 3 categories: not employed (H=0), part timer (H=1) and full timer (H=2). The μ is unknown threshold parameter. Working with the assumption of a normal distribution, the probabilities of having no job, part time employments, and full time employments are given by the following:

$$\text{Prob}(H=0) = \Phi(-\beta' X) \quad (4.8a)$$

$$\text{Prob}(H=1) = \Phi(\mu_1-\beta' X) - \Phi(-\beta' X) \quad (4.8b)$$

$$\text{Prob}(H=2) = \Phi(\mu_2-\beta' X) - \Phi(\mu_1-\beta' X) \quad (4.8c)$$

Another measure of labor market outcome is total earning. Following Bartel and Taubman (1979), an earnings function can be constructed as:

$$Y_t = \alpha + \alpha_1 ED + \alpha_2 A + \alpha_3 S + \alpha_4 Z + \varepsilon \quad (4.9)$$

where ED represents education level, A represents age in years, Z represents exogenous variables such as race, marital status and so forth. Health status as measured by various diseases is denoted by S. The error term is represented by ε.

Earning functions will be estimated only for those individuals who work. To correct for the resulting selectivity bias, a two-step procedure developed by Heckman (1979) will be adopted. In the first step, on the basis of equation (6), a labor force participation equation will be estimated using the Probit method. The selection term lambda (λ) obtained in the first equation will then be used as a variable in the second stage OLS estimation of earning function.

A widely discussed topic in health economics is the issue of the endogeneity of health status in labor market outcome analysis. Grossman (1972) argues that employment, earning, and health are simultaneously determined. The Hausman-Wu test will be used to test for the endogeneity of five different disease variables. This technique requires new variables, called instruments, that influence health status but do not directly influence labor supply or earnings. The NPHS data set includes variables indicating whether or not the parents and siblings of the subjects had chronic illness and whether or

not the parents of the subjects are alive. These variables are good candidates to be used as instruments. Ettner (1997) used these variables as instruments in her study on the labor market impact of various mental conditions. If the hypothesis of endogeneity is validated by the Hausman-Wu test then a two-stage instrumental variable approach will be used to purge such endogeneity bias. In the first stage, probit model for each of the categorical disease variables will be run on the exogenous variables of the model as well as on the instruments. The predicted probability estimated in the first stage will replace the actual values in the second stage of the regression.

To account for the possibility that disease effects differ across age groups, the study, following Wilson (2001), will estimate models for the age groups: Age 35-54, age 55-64, and age 65-74.

4.4 Chronic Illness in Canada:

The 1998 National Population Health Survey of Canada collects information about the prevalence of chronic illness in Canada. Table-4.1, using NPHS-1998 data, provides detailed information about chronic illness situation in Canada.

The NPHS survey found that Arthritis is the most common chronic disease in Canada. About 17% of surveyed population suffers from this disease. High blood pressure is the second most prevalent disease in Canada: affecting 12% of those surveyed.

Table 4.1 ***The Incidence of Chronic Illness in Canada by Age and Gender***

Chronic Illness	Age 12 - 24	Age 25 - 34	Age 35 - 54	Age 55 - 64	Age 65 & over	Total
Arthritis						
Overall	1.1%	4.1%	26.2%	21.1%	47.5%	16.6%
Male	.9%	4.5%	28.5%	22.4%	43.7%	11.8%
Female	1.2%	3.9%	25.4%	20.5%	49%	20.8%
High Blood Pressure						
Overall	.7%	2.9%	23.4%	21.2%	51.8%	11.8%
Male	.1%	3.5%	27.8%	27.4%	41.2%	9.3%
Female	.9%	2.5%	20.9%	18.8%	56.9%	14.1%
Diabetes	1.7%	2.9%	22.4%	20.4%	52.6%	3.6%
Overall	1.3%	2.3%	24.8%	22.8%	48.8%	3.8%
Male	1.9%	3.4%	20.3%	19%	55.4%	3.4%
Female						
Heart Disease						
Overall	2.2%	3.1%	12.4%	19.2%	63.4%	4.6%
Male	1.3%	1.8%	13%	25.5%	58.4%	4.8%
Female	.9%	4.2%	11.8%	13.7%	69.4%	4.4%
Cancer						
Overall	1.2%	2%	23.3%	18.6%	54.7%	1.5%
Male	1.8%	.9%	14.2%	19.9%	63.2%	1.3%
Female	1.3%	2.7%	29.6%	20.4%	46%	1.6%

Source: NPHS 1998

As Table-4.1 shows, a larger percentage of females than males aged 12 or older suffer from arthritis. In percentage terms, more females than males suffer from arthritis, high blood pressure and cancer. On the other hand, relatively more males suffer from diabetes and heart disease. Chronic conditions are generally more prevalent among middle aged and elderly than among the younger population. The NPHS data suggests that relatively less people in the age group 12-34 suffer from chronic illnesses. The majority of the people affected by chronic illnesses belong in the group aged 65 and over. However, significant numbers of chronically ill people belong in the working age groups 35-54 and 55-64.

The NPHS data also points to an interesting fact that relatively more males than females between the ages of 25 and 64 age groups are diagnosed with chronic conditions. The only exception to this observation is cancer which is more prevalent in females than males aged 25-64. One possible explanation of this observation is the prevalence of breast cancer among relatively young females.

4.5. The Data Source:

The study will use Canadian data from NPHS, Cycle-3 (1998-1999). The NPHS is composed of three components: a household survey, a health care institution survey, and the Northern Territories survey. NPHS collects general health information from all household members and in each household, a person, randomly selected answers a more in-depth interview on health questions. Approximately 49,000 respondents answered general part of the questionnaire and 17,244 answered the more detailed portion of the questionnaire in Cycle 3 of NPHS.

Table-4.2 provides the socio-economic characteristics of the sample population.

Table 4.2 ***The Socio-economic characteristics of the sample***

	Male	**Female**
Sample Size	8024	9220
Age Structure		
Up to 24 years	28.2 %	24.7 %
25 to 34 years	15.2 %	15.6 %
35 to 54 years	32.5 %	31.2 %
55 to 64 years	10.2 %	9.8 %
65 to 74 years	8.0 %	9.6 %
74 years and above	5.7 %	9.1 %
Marital Status		
Single	39.5 %	32.5 %

Married	50.5 %	45.2 %
Widow	10.0 %	22.3 %
Education Level		
Less than Secondary	40.7 %	37.1 %
Secondary Graduate	11.8 %	12.8 %
Other Post Secondary	20.4 %	22.9 %
College or University	27.1 %	27.2 %
Total Personal Income		
Up to $ 9,999	11.8 %	25.5 %
$10,000 to $29,999	29.5 %	38.2 %
$ 30,000 to $49,999	22.0 %	13.2 %
$50,000 and over	15.9 %	4.6 %
Working Status		
Worked in the last 12 months	55.4 %	44.4 %
Not worked in the last 12 months	45.6 %	55.6 %
Residential Status		
Urban	75.8 %	78.4 %
Rural	24.2 %	21.6 %
Race of Respondents		
White	90.7 %	91.2 %
Non-white	9.3 %	8.8 %

Source: NPHS 1998

The majority of individuals in the sample, both males and females, belongs to (25-64) age group. There are not major variations between genders with respect to marital status, education level, residential status or race. However, more males than females are in the labor force and a significantly greater percentage are in the upper income brackets than are the females of the same ages.

4.6 Estimation Results[11]

4.61. *Probit Analysis*

4.6.1.1 Estimation of All Ages

Probit method was used to estimate equation 4.6, the employment probability equation. Table-4.3 shows the results of this estimation using overall data for males and females.

Before running the Probit regression, the Hausman-Wu test was employed to check whether or not the chronic illness variables are endogenous to employment. The specific instruments used in the test are: whether or not mother is deceased; whether or not the father is deceased; whether or not the mother had a particular chronic illness, whether or not the father had particular chronic illness; whether or not the sibling had a particular chronic illness. The Hausman-Wu tests rejected the null hypotheses that the chronic illness variable arthritis is exogenous to employment for the male sample. Consequently, in the probit regression the predicted probability of arthritis replaced the actual values. For the female sample, the Hausman-Wu test suggests that high blood pressure is endogenous to the dependent variable. Thus in the probit regression the predicted probability of high blood pressure replaced the actual values.

Table-4.3 Probit estimation of employment equation (all age groups)

Name of Variables	Coefficient estimates for males	Name of Variables	Coefficient estimates for females
Constant	1.2459* (0.091507)	Constant	1.0665* (0.18869)

[11] The study uses unweighted data and consequently the results of the study will reflect sample characteristics.

Predicted Probability of Arthritis	-0.28479* (0.62287)	Arthritis	-0.18695* (0.049986)
Blood Pressure	-0.21906* (0.067830)	Predicted Probability Blood pressure	-0.73617* (0.25885)
Diabetes	-0.31287* (0.10186)	Diabetes	-0.22240* (0.10750)
Heart Disease	-0.40041* (0.095659)	Heart Disease	-0.32545* (0.10751)
Cancer	-0.24971 (0.18043)	Cancer	-0.17940 (0.14544)
Children below age 6	-0.093075 (0.097337)	Children below age 6	-0.36887* (0.14241)
Urban-Rural	-0.087647* (0.045113)	Urban-Rural	-0.087567* (0.039207)
Race	0.27725* (0.094917)	Race	0.12058* (0.064012)
Age 35-54	0.0091121 (0.10827)	Age 35-54	-0.083863 (0.055689)
Age (55-64)	-0.25870 (0.29085)	Age (55-64)	-1.0830* (0.88309)
Age (65-74)	-1.0841* (0.40244)	Age (65-74)	-2.0313* (0.11952)
Married	0.66409* (0.072319)	Married	0.54528* (0.052671)
Widow	0.34403* (0.12934)	Widow	-0.0029297 (0.062830)
Less than secondary	-0.19885* (0.060401)	Less than secondary	-0.29553* (0.05090)
Secondary	-0.023718 (0.075735)	Secondary	-0.032598 (0.060810)
College-Univ.	0.015046 (0.065739)	College-Univ.	0.26923* (0.050811)

Notes: The dependent variable in this model is Work=1, No Work=0.
The standard error is denoted in parentheses
* denotes that the coefficient is significant at the 1% level.

With the exception of cancer, all the chronic disease variables have significant negative impacts on the probability of employment for both males and females. Cancer also has a negative effect on the dependent variable but it is not significant in either equation. The sample population may have less severe form of cancer and consequently cancer does not

lessen employment. Because of data limitation, the study analyzed only five chronic illnesses. Consequently, the base category includes not only healthy individuals but also individuals suffering from illnesses other than five diseases analyzed in the essay. Some of these chronic conditions may be more work limiting than cancer. Consequently, the cancer coefficient may underestimate the impact of cancer on work probability.

The presence of children below 6 years old has no effect on the employment of males, yet this variable has a significant negative impact on the employment probability of females. Compared to individuals in the age group of 15-34, males aged 65-74 have a significantly lower probability to have employment. Similarly, females within the age groups 55-64 and 65-74 have significantly lower probability of employment compared to females between the ages of 15 and 34. Compared to single individuals, both married males and females are observed to have a higher probability to work. The probability to work is lower for both males and females who have less than secondary education than individuals with other post secondary education.

4.6.1.2 Estimation of Ages 35-54

Results of the probit regression for males and females within the age group between 35 and 54 are given in the Table-4.4. The Hausman-Wu test suggests that for both the male and female sample, the arthritis variable failed the exogeneity test. The predicted probability of arthritis replaced actual dummy variables for arthritis in both male and female probit equations.

Table-4.4 Probit estimation of employment equation (age group 35-54)

Name of Variables	Coefficient estimates for males	Name of Variables	Coefficient estimates for females
Constant	1.1556* (0.17861)	Constant	1.0773* (0.19969)
Predicted probability of Arthritis	-0.41728* (0.10577)	Predicted Probability Arthritis	-3.3041* (1.0518)
Blood pressure	-0.18785 (0.12359)	Blood pressure	-0.24532* (0.10438)
Diabetes	-0.25003 (0.19013)	Diabetes	-0.23378 (0.19315)
Heart Disease	-0.38173* (0.21539)	Heart Disease	-0.66983* (0.21034)
Cancer	0.081400 (0.52697)	Cancer	-0.22837 (0.24068)
Children below age 6	-0.24625 (0.16829)	Children below age 6	-0.35787* (0.15241)
Urban-Rural	0.012813 (0.076053)	Urban-Rural	-0.029473 (0.070500)
Race	0.72002* (0.16792)	Race	0.27022* (0.11522)
Married	0.94354* (0.10657)	Married	0.91384* (0.096561)
Widow	0.52670* (0.15457)	Widow	0.30517* (0.15061)
Less than secondary	0.088303 (0.11801)	Less than secondary	-0.30204* (0.11164)
Secondary	0.084955 (0.12851)	Secondary	-0.10982 (0.11854)
College-Univ.	0.065498 (0.10136)	College-Univ.	0.27424* (0.10500)

Notes: The dependent variable in this model is Work=1, No Work=0.
The standard error is denoted in the parentheses
* denotes that the coefficient is significant at the 1% level

The result suggests that arthritis and heart disease have significantly reduced the probability to work for both males and females. Blood pressure, diabetes and cancer decrease males' employment probability. However, the coefficients are not significant.

For females, arthritis, heart disease, and blood pressure are estimated to have significant negative effects on the employment probability. Diabetes and cancer also reduce employment but are not statistically significant. Gender variations in the impact of diseases may be explained by the fact that males and females work in different types of jobs, some of which are more accommodating to particular diseases than others. For example, high blood pressure has a significant negative effect on females' employment probability, but it is not significant for males. A possible explanation is that high blood pressure creates no problem for males to work in the jobs they choose while blood pressure creates problems in the jobs that females usually do.

Compared to singles, both married males and married females have a significantly higher probability to work. For females, the presence of children has a significant negative impact on employment. Also females with college education are more likely to work than females with other post secondary education.

4.6.1.3 Estimation of ages 55-64

Table 4.5 reports the results for employment regression for the ages 55-64. The sample for this age group has relatively less persons of both genders than does the age group between 35 and 54 years of age. The Hausman-Wu test failed to reject the null hypotheses that disease variables are exogenous in the employment equation for the female sample. The Hausman-Wu test did however find that the heart disease variable is endogenous in the model for the male sample.

As in the above regression, cancer is again not found to have significant impact on employment. For males, arthritis, high blood pressure and heart disease have significant

negative effects on the probability to work. For females, diabetes and heart disease are the diseases that significantly lessen employment probability.

Table-4.5 Probit estimation of employment equation (age group 55-64)

Name of Variables	Coefficient estimates for males	Name of Variables	Coefficient estimates for females
Constant	0.52408* (0.26968)	Constant	0.46018 (0.27079)
Arthritis	-0.35060* (0.10489)	Arthritis	-0.59260E-01 (0.88546E-01)
Blood pressure	-0.27842* (0.10927)	Blood pressure	-0.13789 (0.99369E-01)
Diabetes	-0.19664 (0.16483)	Diabetes	-0.46603* (0.19014)
Predicted probability Heart Disease	-1.6503* (0.69990)	Heart Disease	-0.40801* (0.19109)
Cancer	-0.40623 (0.28558)	Cancer	-0.21736 (0.24799)
Children below age 6	0.71303 (0.60574)	Children below age 6	1.3455* (0.40966)
Urban-Rural	-0.12799 (0.092720)	Urban-Rural	-0.10116 (0.86646E-01)
Race	-0.13299 (0.19588)	Race	-0.40002 (0.19118)
Married	0.57057* (0.17606)	Married	0.13569 (0.20364)
Widow	0.13567 (0.20707)	Widow	-0.15043 (0.21163)
Less than secondary	-0.11064 (0.12654)	Less than secondary	-0.20858* (0.11138)

Secondary	0.024135 (0.17026)	Secondary	0.11425 (0.14617)
College-Univ.	-0.088184 (0.13209)	College-Univ.	-0.41008E-01 (0.12096)

Notes: The dependent variable in this model is Work =1, No Work=0.
Notes: The standard error is denoted in parentheses
* denotes that the coefficient is significant at the 1% level

Married males have significantly higher probability to work than non-married males. Females with less than secondary education have a significantly lower probability to work than do females with other post secondary education.

In sum, using over all data for males and females, it is found that arthritis, high blood pressure, diabetes and heart disease significantly reduce the employment probability of both genders. When sample for age group (35-54) were considered, arthritis, heart disease are found to have significant negative effect on males' employment probability. For female case, arthritis, high blood pressure and heart disease have significant negative impact on employment probability. In the third regression of age group 55-64, the estimation of male sample showed that arthritis, high blood pressure and heart disease have significant negative impacts on their employment probability. Diabetes and heart disease are found to have significant negative coefficients in the female sample of this age group.

4.6.2. Ordered Probit Analysis:

4.6.2.1 Estimation of all ages

The Ordered Probit approach is used to estimate the impact of various chronic illnesses on the probability to work full time or part time.

The estimation results for this analysis for both males and females of all age groups are shown in Table- 4.6. Before estimating the equations, the Hausman-Wu test for endogeneity bias was conducted. The predicted probability replaces the actual value of any disease that was found endogenous to employment patterns. Arthritis, heart disease and blood pressure are the diseases that significantly reduce the probability of full time work for males. In the male sample, individuals aged 35-54 and 55-64 have a greater probability of having full time job than individuals aged 15-34. Both married and widows have a higher probability to work full time than single persons. Less than secondary education is found to significantly reduce the probability of having full time employment.

Table-4.6: Ordered Probit result for employment pattern (all age group)

Variable	Coefficient Estimates (Males)	Variable	Coefficient Estimates (Females)
Threshold values	-.184* (.087) .520* (.087)	Threshold values	-.217* (.072) .784* (.072)
Predicted Probability - Arthritis	-.558* (.058)	Predicted probability of Arthritis	-.680* (.044)
Blood Pressure	-.438* (.062)	Blood Pressure	-.402* (.048
Diabetes	-.484 (.093)	Diabetes	-.484* (.096)
Heart Disease	-.154* (.038)	Predicted probability of Heart Disease	-.228* (.028)
Predicted probability of Cancer	-9.919E-02 (.043)	Cancer	-.437* (.124)
Children below age 6	.548E-02 (.080)	Children below age 6	-.642* (.056)
Urban location		Urban location	-2.170E-02 (.041)
Race	.523* (.068)	Race	353* (.054)
Age 35-54	.580* (.055)	Age 35-54	.293* (.039)
Age (55-64)	.670* (.074)	Age (55-64)	.480* (.066)
Married	.752* (.061)	Married	.329* (.052)

Widow	.502* (.088)	Widow	.778* (.081)
> Than secondary	-.387* (.051)	> Than secondary	-.224* (.046)
Secondary	-6.22E-02 (.064)	Secondary	-.279* (.047
College-Univ.	1.759E-02 (.053)	College-Univ.	6.657E-02 (.039)

Notes: The standard error is denoted in parentheses.
* denotes that the coefficient is significant at 1% level

In the female sample, all the disease variables have significant negative impacts on the probability of having full time employment. Both married females and widowers are more likely to have a full time job. On the other hand, having children below age of six, holding only secondary and less than secondary educational qualification are estimated to be negatively associated with full time employment.

4.6.2.2 Estimation of ages 35-54

Table 4.7 below reports the results of the Ordered Probit estimation of the age group between the ages of 35-54. In this age group, arthritis, blood pressure, and heart disease are negatively associated with full time work in the male sample.

Table-4.7: Ordered Probit result for employment pattern (age group 35-54)

Variable	Coefficient estimates (males)	Variable	Coefficient estimates (females)
Threshold values	-.318* (.248) - 9.33E-02 (.248)	Threshold values	-.850 (.118) - .278 (.118)
Arthritis	-.593* (.093)	Arthritis	--.392* (.062)
Blood Pressure	-.188** (.111)	Blood Pressure	--.201 (.082)
Diabetes	-.168 (.173)	Diabetes	-.305* (.155)
Heart Disease	-.650* (.193)	Heart Disease	-.452** (.175)
Cancer	-1.607E-02 (.430)	Cancer	-.138 (.181)
Children below age 6	--.169 (.161)	Children below age 6	-.713* (.103)
Urban location	-2.55E-02 (.084)	Urban location	-5.85E-02 (.051)
Race	.552 (.217)	Race	.309* (.104)
Married	.562* (.113)	Married	-4.95E-02

			(.086)
Widow	.486 (.193)	Widow	-.228* (.130)
> Than secondary	.134 (.131)	> Than secondary	-.321* (.093)
Secondary	.118 (.141)	Secondary	-.241* (.088)
College-Univ.	2.186E-02 (.115)	College-Univ.	.9.023E-02 (.075)

Notes: The standard error is denoted in parentheses.
* denotes that the coefficient is significant at the 1% level

Although diabetes and cancer have the expected negative impact, these coefficients are not significant. Married males are more likely to work full time than single males. For females in this age group, arthritis, diabetes, and heart disease have significant negative effects on the probability of full time employment. The Presence of children below six years old also reduces the probability of having full time job.

The estimated gender differences of specific diseases' impact on the probability to work full time may be explained by the differences in the nature of jobs that male and females perform. Another possible explanation is that males in this age group may suffer from less severe type of diabetes and cancer while females may have less severe form of cancer and blood pressure. As a consequence diabetes and cancer do not have significant coefficients in the estimation of the male sample. Similarly high blood pressure and cancer do not significantly influence females' probability of full time employment.

Table-4.8: Ordered Probit result for employment pattern (Age group 55-64)

Variable	Coefficient estimates (males)	Variable	Coefficient estimates (females)
Threshold	-.325 (.280) - .143 (.280)	Threshold	-4.78E-02 (.310) .338 (.311)
Arthritis	-.322 * (.104)	Arthritis	-6.34E-02 (.086)
Blood Pressure	-.314* (.111)	Blood Pressure	-9.018E-02 (.099)
Diabetes	-.218 (.175)	Diabetes	-.810* (.204)
Heart Disease	-.555* (.175)	Heart Disease	-.485 (.200)

Cancer	-.479 (.275)	Cancer	-.442 * (.258)
Children below age 6	-.343 (.466)	Children below age 6	-.497 (.550)
Urban location	-.127 (.055)	Urban location	.171 (.153)
Race	-.316 (.214)	Race	-2.27E-02 (.223)
Married	.391* (.202)	Married	-.617* (.302)
Widow	.416* (.224)	Widow	-.234 (.232)
Less than secondary	-.104 (.130)	Less than secondary	.486 (.361)
Secondary	-.403* (.204)	Secondary	.252 (.198)
College-Univ.	-8.46E-02 (.164)	College-Univ.	.351* (.175)

Notes: The standard error is denoted in parentheses.
* denotes that the coefficient is significant at the 1% level

In the case of male sample of age group (55-64), arthritis, high blood pressure, and heart disease are negatively associated with full time job. The coefficients of these variables are significant. For female sample, diabetes and cancer are the diseases that reduce the probability of having full time job.

In sum, in male sample, for both age groups (35-54) and (55-64) arthritis, blood pressure and heart disease significantly reduce the probability to work as full timer. The impact of blood pressure becomes more pronounced in the case of age group (55-64). For female sample, diabetes is the common variable that affect both (35-54) and (55-64) age groups. Cancer becomes a significant factor influencing probability of full time employment for (55-64) age group. The negative influences of arthritis and heart disease are more pronounced in the case of female in (35-54) age group.

4.6.3 Earning Model Estimation

Personal earnings are a measure of labor market outcomes. This study examines the impact of various diseases on the earnings of employed individuals. Since, the earnings data of only employed individuals are used, it is expected that the results will suffer from selectivity bias. To test and correct the selectivity bias, a procedure known as the Heckman Two Stage estimation will be utilized here. Hausman-Wu tests are also used to test the exogeneity of the disease variables with respect to total earnings. In the case where a particular disease is found to be endogenous, the predicted probability of the disease is used instead of the actual values.

The estimation results of the earnings function using data for males and females are shown below in Table 4.9.[12] The selection variable, lambda, has significant positive coefficients in both the male and female equations, which suggests that the errors (unobserved effects) in the wage and labor supply equations are positively correlated. Arthritis, heart disease, and blood pressure have significant negative impacts on the earnings of males. The other disease variables also have negative effects on earnings, but the effects are not significant.

Table-4.9: Income regression for all age group

Variable	Coefficient estimates (males)	Variable	Coefficient estimates (females)
Constant	0.60855E+06* (0.4389E+05)	Constant	0.55536E+06* (0.5553E+05)
Arthritis	-84326* (0.2891E+05)	Predicted Probability of Arthritis	-0.12979E+07* (0.4002E+06)
Predicted Value of	-0.33733E+06*	Predicted	-0.17835E+06

[12] The results of the first stage probit estimations are already given in the Table-4.3, Table-4.4, and Table-4.5.

Blood Pressure	(0.1540E+06)	probability of Blood Pressure	(0.1654E+06)
Diabetes	-79533 (0.5737E+05)	Diabetes	-0.21056E+06* (0.6147E+05)
Heart Disease	-0.25450E+06* (0.6790E+05)	Heart Disease	-0.10478E+06 (0.7017E+05)
Cancer	3095.7 (0.6640E+05)	Cancer	-.13341E+06** (0.7751E+05)
Children below age 6	83574* (0.2073E+05)	Children below age 6	-.28793E+06* (0.4231E+05)
Urban location	-11010 (0.1526E+05)	Urban location	12092 (0.1705E+05)
Race	0.17816E+06* (0.2721E+05)	Race	0.15308E+06* (0.2862E+05)
Age 35-54	0.26227E+06* (0.2215E+05)	Age 35-54	0.34733E+06* (0.4763E+05)
Age (55-64)	0.18735E+06* (0.7238E+05)	Age (55-64)	0.37978E+06* (0.1495E+06)
Age (65-74)	-82177 (0.1947E+06)	Age (65-74)	0.11426E+06 (0.2369E+06)
Married	0.36434E+06* (0.3106E+05)	Married	0.11743E+06* (0.3355E+05)
Widow	0.29769E+06* (0.3178E+05)	Widow	0.32904E+06* (0.3722E+05)
Less than secondary	-0.24739E+06* (0.2459E+05)	Less than secondary	-0.38608E+06* (0.2930E+05)
Secondary	12486 (0.2326E+05)	Secondary	-0.19181E+06* (0.2717E+05)
College-Univ.	0.20631E+06* (0.1908E+05)	College-Univ.	0.18099E+06* (0.2501E+05)
Part-time	-0.37789E+06* (0.2534E+05)	Part-time	-0.28807E+06* (0.1735E+05)
Lambda	0.34606E+06* (0.1582E+06)	Lambda	0.34942E+06* (0.1491E+06)

Notes: * denotes coefficient is significant at 1% level
** denotes that coefficient is significant at the 5% level

In the sample of males, the presence of children below six years old is associated with higher earnings. Both married males and widows earn more than single males. Compared to males in the 15 - 34 age group, individuals in the age groups of 35 - 54, and 55 - 64 earn relatively more income. Part time employees earn less than full time

employees. College and university graduates earn more than males who have other post secondary qualifications.

In the female sample, arthritis, diabetes and cancer have significant negative impacts on earnings. The presence of children below six years old has a significant negative impact on female earnings. Females in the age groups 35 - 54, and 55 - 54 earn more than those who are in age group between 15 - 34 years old. Married females and widowers earn more than the single females. White females earn more than the non-white females; and college and university educated women earn more than those who have other post secondary education.

The earnings functions estimated for male and females between the ages of 35 and 54 are given in Table 4.10. For males, arthritis and blood pressure and heart disease have a significant negative impact on earnings. Both married males and widows earn significantly more than single males. Males with a college or university education earn significantly more than those who have other post secondary education. And males with other post secondary education earn significantly more than those with less than secondary education. Not surprisingly, those employed part time earn much less than those employed full time.

Table-4.10: Earning regression for Age group (35-54)

Variable	Coefficient estimates (males)	Variable	Coefficient estimates (females)
Constant	0.12399E+07* (0.9745E+05)	Constant	0.12051E+07* (0.9079E+05)
Arthritis	-88910* (0.3845E+05)	Predicted Probability of Arthritis	-0.95805E+06* (0.4355E+06)
Blood Pressure	-72034** (0.4332E+05)	Blood Pressure	-52404 (0.4347E+05)

Diabetes	-13380 (0.6847E+05)	Diabetes	-0.18898E+06* (0.7782E+05)
Heart Disease	-0.12662E+07* (0.6919E+06)	Predicted Probability of Heart Disease	-0.18448E+07* (0.6630E+06)
Cancer	-16035 (0.1004E+06)	Cancer	-16188 (0.8972E+05)
Children below age 6	-14583 (0.2804E+05)	Children below age 6	-0.23793E+06* (0.5431E+05)
Urban location	26278 (0.2085E+05)	Urban location	27398 (0.2412E+05)
Race	0.11842E+06* (0.4125E+05)	Race	0.16359E+06* (0.4779E+05)
Married	0.10167E+06* (0.6059E+05)	Married	-0.15676E+06* (0.6203E+05)
Widow	0.15232E+06* (0.4324E+05)	Widow	0.11174E+06* (0.5593E+05)
Less than secondary	-0.13151E+06* (0.3473E+05)	Less than secondary	-0.35766E+06* (0.4349E+05)
Secondary	-17488 (0.3402E+05)	Secondary	-0.24418E+06* (0.4088E+05)
College-Univ.	0.13734E+06* (0.2742E+05)	College-Univ.	86086* (0.3681E+05)
Part-time	-0.30306E+06* (0.6130E+05)	Part-time	-0.32800E+06 (0.2762E+05)
Lambda	-0.28529E+06 (0.2456E+06)	Lambda	0.14624E+06 (0.1945E+06)

Notes: * denotes coefficient is significant at 1% level

In the female earnings function, arthritis, diabetes, and heart disease have significant negative coefficients. The other disease variables also have negative coefficients, but they are not significant. The presence of children below 6 years old is estimated to reduce female earnings. Married females earn less than single females, while widows earn more than single females. Females with either a college or a university education earn significantly more than females with other post secondary education. On the other hand, those who have completed secondary education, or less than secondary education, earn comparatively less than females with some form of post-

secondary education. Compared to full time employees, part time employees earn significantly less. Further, white females earn more than non-white females.

The earnings functions estimated for male and females between the ages of 55 and 64 are given in Table 4.11. In the male sample, the disease variables measuring arthritis and heart disease turn out to have significant negative impacts on earnings. Part-time employment and less than secondary education qualifications also have significant negative effects on income earnings. On the other hand, both married males and widowers earn significantly more than single males.

Table-4.11: Earning regression for Age group (54-65)

Variable	Coefficient estimates (males)	Variable	Coefficient estimates (females)
Constant	0.80051E+06* (0.2397E+06)	Constant	0.19850E+07* (0.4670E+06)
Arthritis	-0.15684E+06* (0.8207E+05)	Arthritis	-44460 (0.7254E+05)
Predicted Probability of Blood Pressure	-0.27016E+06 (0.2547E+06)	Blood Pressure	-0.18707E+06 (0.1445E+06)
Diabetes	-0.12652E+06 (0.1111E+06)	Diabetes	-0.32616E+06 (0.3050E+06)
Heart Disease	-0.19222E+06* (0.1042E+06)	Heart Disease	-0.28888E+06 (0.2210E+06)
Cancer	0.12923E+07 (0.1780E+07)	Cancer	-14495 (0.2235E+06)
Children below age 6	52745 (0.2812E+06)	Children below age 6	-0.12571E+07* (0.4512E+06)
Urban location	-58542 (0.5126E+05)	Urban location	47742 (0.7617E+05)
Race	0.14364E+06 (0.1224E+06)	Race	0.26425E+06 (0.1824E+06)
Married	0.38112E+06* (0.1510E+06)	Married	-0.39992E+06* (0.1530E+06)
Widow	0.29827E+06* (0.1562E+06)	Widow	0.18038E+06 (0.1688E+06)
Less than secondary	-0.20208E+06*	Less than	-87710

	(0.6834E+05)	secondary	(0.1263E+06)
Secondary	-32378 (0.1091E+06)	Secondary	- 0.19611E+06** (0.1134E+06)
College-Univ.	95843 (0.8683E+05)	College-Univ.	0.24270E+06* (0.8260E+05)
Part-time	-0.34580E+06* (0.1225E+06)	Part-time	-66119 (0.6777E+05)
Lambda	0.35712E+06 (0.2602E+06)	Lambda	-0.15624E+07* (0.7818E+06)

Notes: * denotes that the coefficient is significant at the 1% level
** denotes that coefficient is significant at the 5% level

In the female sample, none of the disease variables were estimated to significantly reduce personal earnings. In this equation only two variables come out significant in explaining the dependent variable. The presence of children below six years old decreases female earnings; and the impact of holding a college or a university degree is significantly positive.

In sum, the common illnesses that significantly affect the earnings of males in both the 35 – 54, and the 55 - 64 age group are arthritis and heart disease. On the other hand, arthritis, diabetes, and heart disease have significant negative impacts on the personal earnings of females between the ages of 35 and 54. However, none of the five chronic illnesses were found to have any significant impacts on the earnings of females aged 55 – 64.

In this study, the results should be interpreted with caution. None of the models used in this study accounted for the severity of the illnesses under consideration. Simpson and Hum (1996) found that the labor market impact of disabilities depend on the severity of the disability. Unfortunately, NPHS does not collect data on illness severity. The

results of this study could have been explained better if the data on severity of illness had been available.

Due to data limitations, this paper estimates the labor market impact of only five specific chronic illnesses. The NPHS data set also includes a small number of individuals who suffer from chronic illnesses other than the ones used here. However, the data required to remedy the endogeneity problem were only available for the five specified chronic diseases. Consequently, this study was restricted to the analysis of these specific diseases. As a result, the comparison group, or base category does not only include healthy individuals, but also those individuals who suffer from illnesses not included in the five chronic illnesses analyzed in this study. This problem in classification underestimates the cost of chronic illnesses.

4.7 Summary and conclusion

The research presented in this paper utilized data from the Canadian National Health Population Survey (1998) to analyze the impacts of various chronic illnesses on labor market outcomes. The five chronic illnesses analyzed in this study included arthritis, high blood pressure, diabetes, heart disease, and cancer. The NPHS data revealed that the incidence of chronic diseases in Canadians vary between genders and across age groups. The Probit method was used to estimate the employment probability equation, and the Ordered Probit method was used to estimate the impact of chronic illness on the probability of having full time, part time or no employment. The two-step procedure proposed by Heckman was used in this study to estimate the earning function.

This procedure was used to test and correct for any selectivity bias due to using earnings data for employed individuals exclusively.

In the Probit employment equation, using overall data for male and females, arthritis, high blood pressure, diabetes, and heart disease had significant negative impacts on the employment probability of both males and females. When the sample of Canadian males aged 35 - 54 was estimated, arthritis, and heart disease were the illnesses that showed significant negative effects on males' employment probability. In the sample of females in the same age group, arthritis, high blood pressure, and heart disease had significant negative effects on the probability of employment. The probability of employment for males aged 55 – 64 was estimated as being negatively impacted by arthritis, high blood pressure, and heart disease. In the case of females in the same age group, the variables measuring diabetes and heart disease had significant negative coefficients.

The study also utilized the Ordered Probit approach to find the impact of diseases on the probability of having full time, part time, or no employment. In the estimation of the male sample, arthritis, high blood pressure, and heart disease turned out to be the variables that significantly reduced the probability of full time employment for all age groups. In the female sample, all the disease variables had significant negative impacts on the probability to work full time. Arthritis, blood pressure, and heart disease significantly reduced the probability of full time work in the sample of males aged 35 – 54, while arthritis, diabetes, and heart disease had significant negative impacts on the probability of females aged 35 – 54 to work full time. The estimation of the sample of males in the 55 - 64 age group showed that arthritis, high blood pressure, and heart

disease significantly reduced the probability to work full time. In the female sample, cancer and diabetes were the chronic conditions that had significant negative impacts on the probability to work full time. In the male sample, the impact of blood pressure becomes more pronounced in those between the ages of 55 and 64. Diabetes was the common variable that affected both female age groups. Cancer became a significant factor influencing the probability of full time employment in the group of 55 - 64 year old females. The negative influences of arthritis and heart disease were more pronounced in the case of females between the ages of 35 and 54.

The analysis of the earning functions suggests that arthritis, heart disease, and high blood pressure significantly reduce the personal earnings of Canadian males of all ages. Arthritis, high blood pressure, and cancer significantly reduce the earnings of females overall. The estimation of the data on males aged 35 – 54 found that arthritis, blood pressure, and heart disease were the chronic conditions that had significant negative effects on wage earnings. Arthritis, diabetes, and heart disease also had significant negative impacts on the personal earnings of females aged 35 - 54. For males in the 55 - 64 age group, arthritis and heart disease significantly reduced personal wage earnings. However, none of chronic illnesses had any significant impact on the earnings of females between the ages of 55 and 64.

The findings of this study have some policy implications. The study found that chronic illnesses have significant negative impacts on labor market outcomes. Chronic illnesses not only reduce the probability to work, but also reduce the earnings of those who do work. Health policy makers ought to consider the substantial economic burden caused by chronic illnesses. However, any policy intervention should set priority based

on the comparative impact of various diseases. This study also found that arthritis, heart disease and high blood pressure are the diseases that are the major sources of economic burden for both males and females. Thus, policy makers should allocate more resources to the treatment and prevention of these three chronic illnesses. To ease the financial burden of the increased spending, the government could offer tax credits to individuals suffering from chronic illnesses. Currently, the Canadian government is assisting disabled individuals with disability tax credits, and such programs may be extended to cover individuals suffering from severe chronic illnesses.

There are several ways for doing further studies on the impact of chronic illness on labor market outcomes. Future study may use work hours, as well as wage data to find the impact of diseases on work hours and market wage. If data were available, the impact of the severity of illness on labor market behavior could also be analyzed. Another modification would be to use work absenteeism as a labor market outcome to estimate the impact of illnesses on absenteeism.

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Chapter 5

Conclusion

The major objective of this dissertation is to empirically analyze some important issues relating health and aging in Canada. The dissertation consists of three papers: the first paper deals with the issue of informal caregiving to elderly people; the second paper examines the impact of informal and formal care on the health status of elderly people; and the third paper estimates the impact of various chronic illness on individuals' labour market outcomes over the life cycle.

The estimation results in the first paper suggest that informal caregiving has significantly reduced the number of work hours for female caregivers. It is found that due to caregiving, female caregivers work 2.3 hours less per week than non-caregivers. As a result, female caregivers face financial losses, in terms of reduced current income and employment related benefits. A recent study suggests that financial loss and conflicts between job and caregiving duties create stress among employed caregivers. Such stress has negative influences on the quality of informal caregiving. This paper argues that policy makers should not consider community-based care as a less costly form of elderly care, without also considering the employment-related costs borne by caregivers. The paper also suggests that private employers may support caregivers by providing them the option of flexible work hours.

The second paper of this dissertation finds that formal home care has significant positive impacts on the health of the elderly population. It is also found that informal

caregiving has significant positive impacts on the health of the elderly. The paper argues that informal caregivers ought to be supported to a greater extent, since they are so effective in the health system. It is also suggested that informal caregivers should be provided with training to better equip them to care for the elderly. At the same time, the government should expand the publicly funded formal care system because the formal care system is also working effectively.

The third paper finds that the incidence of chronic illnesses increases with age. The estimation results suggest that chronic illnesses not only reduce the probability to work but also reduce the earnings of those who work. The study concludes that arthritis, heart disease and high blood pressure are the three chronic illnesses that cause the greatest economic burden for both males and females. The paper argues that policy makers should allocate more funds to the treatment and prevention of these chronic illnesses.