

APPENDIX G
Review of Empirical Work
on the Relationship Between
Income, Health and Wealth

Review of Empirical Work on the Relationship Between Income, Health and Wealth

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EXECUTIVE SUMMARY

The goal of this report is:

1. to provide an overview of peer-reviewed research that has been conducted within Canada and internationally on the link between the income and/or wealth of an individual and health;
2. to examine the data on this association that are currently available for Newfoundland and Labrador, as well as recent or ongoing research on this association; and
3. to suggest additional data that could be collected and methodologies that could be employed in order to better estimate any improvements in individual health that may be associated with income increases.

Part 1

We focus on income rather than wealth due to the availability of good annual data. Income may be measured as individual or household income. When researchers use household income, they usually adjust for factors such as the size and structure of the household as well as for inflation. Household income rather than individual income has the advantage of giving a more complete picture of the total economic resources available to an individual. However, household income fluctuation does not necessarily imply commensurate changes in living standards, as accumulated wealth could be used sometimes to offset drops in income. Furthermore, social transfers in kind, such as publicly funded medical care, increase access to economic resources for individuals and therefore the quality of their lives.

In the studies we review, health is measured using a variety of indicators, either objective or subjective. Early research in this area used mortality rates to measure health; currently, subjective health indicators, such as self-assessed health status, are commonly employed. Self-assessed health status has the advantage of including both physical and mental health and is therefore closely related to the World Health Organization's definition of health, which is "a state of complete physical, mental and social well-being". Furthermore, researchers have shown that self-assessed health status generally correlates to objective mortality and morbidity measures. However, self-assessed health status can be influenced by shifts in the expectations that people have with regard to their health and factors that may change their awareness of health problems. Therefore, in situations where people may be sensitized to perceived health risks, objective health indicators should also be used.

A strong association between individual income and health has been demonstrated in many different countries, including Canada, using a variety of health indicators. In other words, it has been observed that people with higher incomes are more likely to have better health. However, the exact manner in which health varies with income (i.e., the health gradient) is likely to differ for different sections of the population, from country to country, and by health indicator. Poverty is widely accepted as one of the best predictors of ill health, but the correlation between income and health is observed throughout the income range. Nevertheless, in Canada the rate at which health changes with income seems to taper off at higher incomes, as illustrated using a number of health indicators. Therefore, when considering how a change in income may affect health, it's important to know where an individual sits in the income distribution. The impact of income on health also depends on age; in particular, socioeconomic status during early childhood plays a key role in shaping income and health at a later stage (Mikkonen and Raphael 2010).

Mechanisms linking income to health are thought to include material factors (e.g., quality of housing, nutrition, clothing), behavioural factors (e.g., quality of diet, extent of physical activity, smoking, alcohol use), and psychosocial factors (e.g., social status, autonomy, and the quality of social relations and their impact on health and well-being). There is a strong association between income and health, but the question of causality has been subject to discussion since plausible mechanisms may run in both directions. For example, abrupt losses in income may result in lower health status due to increased stress; on the other hand, health related issues might result in early retirement with a reduction in income and living standards. A more definitive understanding of which forces are more likely to occur in our Province and in local jurisdictions would require longitudinal studies in which data on income and health are gathered for the same subjects over a period of time.

On balance, our view is that income does have a positive effect on health; in general, increases in income will result in increases in health outcomes. This association may be particularly strong in terms of poverty and health and during the period of early childhood. However, we acknowledge that income is only one of a number of determinants of health, which are described in (Marmot, Allen, et al. 2010) as “the range of interacting factors that shape health and well-being. These include: material circumstances, the social environment, psychosocial factors, behaviours, and biological factors. In turn, these factors are influenced by social position, itself shaped by education, occupation, income, gender, ethnicity and race. All these influences are affected by the socio-political and cultural and social context in which they sit.”

A 2009 report of the Canadian Senate Subcommittee on Population Health (Keon and Pépin 2009) cites the key determinants of health as socioeconomic factors (50%), the healthcare system (25%), biology and genetics (15%), and the physical environment (10%). Socioeconomic factors include income and social status, as well as early childhood development, education, employment and working conditions, culture, gender, housing, social environment, and personal health practices. Many of these factors are interrelated – for example, income may influence social status, early childhood development, education, employment and working conditions, housing, and personal health practices. However, the mechanisms linking income to these factors, and ultimately their combined effect on health, depend on the cultural and social context, and so it is important to look at the available data on the association between income and health for Newfoundland and Labrador and the communities of interest. It is also important to consider how other determinants of health, in particular the physical environment, may be affected by resource development irrespective of changes to income, but that is beyond the scope of this report.

Part 2

In this section we follow the pathway set by the Organisation for Economic Co-operation and Development (OECD) in its current work in measuring well-being and social progress¹ in order to explore the association between income and health in Newfoundland and Labrador at the provincial and local levels and, if possible, for designated municipalities. At the provincial level, we use the OECD indicator “household disposable income per capita” as our income variable but this indicator is not adjusted for the receipt of social transfers in kind. For the health indicator, we use self-reported health status. Our general examination² of the association of these two variables over time at aggregate levels for the 10 Canadian provinces plus the country generally shows a positive relationship between these two indicators at any point in time and over time. Newfoundland and Labrador has experienced an absolute increase in both these indicators; that is, both average health status and inflation-adjusted household disposable income per capita have improved over time for our population, as has our relative ranking amongst the provinces. Due to oil development and the resultant income increases, primarily from wages and royalties, incomes have risen quite rapidly in real terms relative to other provinces.

We observe that while “aggregate” income data from administrative tax records are available at the municipal level, self-assessed health status data from national surveys are not available for individual municipalities³. Balancing this paucity of information on subjective health at the local level are objective, municipal-level morbidity data based on administrative hospital utilization records. Unfortunately, for our analysis, the administrative records of our public health care system do not collect income or other socioeconomic variables for patients. These morbidity data for individual patients at the municipal level appear, at first glance, to present morbidity levels that would not seem to be out of line with provincial averages. The self-reported health status data at the local area level seem to indicate slightly lower levels of health in certain middle categories in the Port au Port Peninsula/Stephenville area (Local Area

¹ Readers are encouraged to follow the proceedings in the OECD World Forum, *Transforming Policy, Changing Lives*, held in October 2015 in Guadalajara, Mexico.

² Through the use of charts.

³ There are too few survey respondents at the local level to provide estimates about the self-reported health status of various populations at the local level by age, income, education and gender.

37), but not for the local area around the Bay of Islands (Local Area 40). However, large variability associated with a small number of survey respondents at the local area level should be kept in mind when attaching to much significance to this finding.

The more scientific studies that used advanced statistical techniques consistently showed a statistically significant relationship between income and health using cross-sectional (individual respondent) data. These studies also demonstrated the importance of including a variety of other factors in addition to income, such as gender or employment status, in any attempt to understand an association with health. Work in progress using the most advanced statistical techniques available shows a nonlinear association in Newfoundland and Labrador between income and health. Increases in income seem to be associated with larger increases in health at lower income levels. In other words, any change in income is more likely to have a larger impact on the health of a poor person in comparison to someone who is rich.

Some of the reviews covered in Part 1 of our report, as well as one of the statistical works relating to Newfoundland and Labrador, reported on the health gradient, that is, the association between socioeconomic inequalities, generally focusing on income inequalities, and health inequalities. The single published report on the inequality issue for Newfoundland and Labrador, which used data up to 2001, reported relatively high levels of health inequalities for the province. The term "relative" was in reference to other Canadian provinces and the Canadian average, as well as many European countries. The report noted that the degree of health inequality for our province was approaching that existing in the United States. This result should be a concern. However, work in progress that has employed more advanced, and, in our opinion, more appropriate indexing procedures, as well as more recent data, produces almost the opposite results for the Canadian provinces. Newfoundland and Labrador has one of the lowest measures of health inequality.

Part 3

This part of our review deals with considerations to guide future research in the area of income, wealth and health.

At the base of any applied research pyramid are good data. In the case of understanding the impact of income changes and associated changes on the health of individuals and communities, we suggest that socioeconomic and health data be collected on those individuals to be most directly affected and prior to any economic event. These data would include all members of the household including children, since they are often the ones most indirectly affected by economic events and have the most to win or lose over a lifetime. Our suggestion for the collection of specific indicators is guided by our review outlined in Parts 1 and 2 of this report. Our ideal data set for individuals would be longitudinal in that we wish to track the variables of interest over as much of an individual's lifetime as is practically possible.

We believe that the methodologies employed in the work in progress of Hoskins and May are the most advanced ones currently available but we do acknowledge that statistical analytical methodologies are constantly evolving.

At the top of the research pyramid are hypotheses to be tested. We have suggested a couple to be considered. Our proposals may be somewhat easier to implement than at first appears, since the infrastructure, in terms of survey design and accounting practices within government and health care units, exists, as does the appropriate statistical methodology. The major constraints would be research dollars and applied researchers, as well as access to data for academic researchers.

A Final Note

The review focuses on the general association between income and health as revealed by the literature and other research work known to us. While hopefully of assistance to the panel considering the potential impacts of hydraulic fracturing in Western Newfoundland, our review on the association between income and health should be of interest to the general public and policy makers, since both areas are central to societal well-being. It is this wider interest in general well-being that appears to be the primary motivation of researchers in most of the studies we reviewed.

PART 1: REVIEW OF CANADIAN AND INTERNATIONAL RESEARCH

Introduction

In this report we summarize the results of numerous empirical studies that have been done within Canada and internationally on the link between the income and/or wealth of an individual (i.e., the economic resources at a person's disposal) and health. Although wealth is probably superior to income as an indicator of long-term health outcomes because it provides more complete information about a person's cumulative lifetime economic resources (Martikainen, et al. 2003), (Mikkonen and Raphael 2010), (Braveman, Egerter and Barclay 2011), we focus on income due to the fact that data on personal or household income are more readily available in the countries of interest. Since we are conducting the review in the context of possible spillover effects of resource development in Newfoundland, we look not only at the association between income and health, but the question of causality and the pathways that link income to health. In other words, is an increase in income likely to lead to improved health and how? These questions can be approached from two angles (J. W. Lynch, et al. 2000), (M. Marmot 2002), (Mikkonen and Raphael 2010), (Kawachi, Adler and Dow 2010): studying the relationship between 1) income and health; and 2) income inequality and health. This ties into what is often termed the "social gradient of health", or the fact that inequalities in population health status are related to inequalities in social status.

We also address briefly other socioeconomic factors that influence health. A challenge in studying the effect of income on health is the relation between income and other social determinants of health. Health is determined by a complex interaction of many factors, such as income, education, housing, social support networks, and working conditions, many of which are strongly affected by a person's economic and social status (Wilkinson and Marmot 2003), (Keon and Pépin 2009), (Marmot, Allen, et al. 2010), (Mikkonen and Raphael 2010).

Geographic Focus

In our review we look at data for Canada as well as studies that have been done in developed countries with similar welfare and health delivery systems to Canada, in particular the United Kingdom (UK) and other European countries. We also look at research that examines how health varies with income (or income inequality) between countries.

We give less emphasis to the United States (US)⁴, even though Canada and the US are in many respects alike. Nevertheless, Canada has somewhat better welfare measures (including a national/provincial health care delivery system) that may reduce the strength of the association between income and health. In a number of international studies looking at associations between income inequality and health across countries, excluding data from the US makes a big difference to the results (Ross, et al. 2000), (J. Lynch, G. D. Smith and M. Hillemeier, et al. 2001).

This is perhaps because the US has a high level of income inequality coupled with a low level of health outcomes despite being one of the richest countries in the world. Of the 20 member countries of the Organization for Economic Cooperation and Development (OECD), only Turkey and Mexico rank below the US in terms of inequality (OECD 2011), and the US ranks well below other much poorer nations regarding various measure of health status (Coburn 2004). As summarized by (J. Lynch, G. D. Smith and M. Hillemeier, et al. 2001): "It seems likely that the US is the exception, not the rule, and it is possible that evidence drawn from studies within the US has less direct applicability to other wealthy nations. Higher income inequality within the US is overwhelmingly associated with more unequal distribution of many powerful determinants of health. This may not be the case in other wealthy countries where there has been more widespread and more evenly distributed social investments in public health relevant goods and services."

⁴ For those interested, a good review of the relationships between income, wealth, and health in the US can be found in (Braveman, Egerter and Barclay 2011).

Even within Canada there are large differences in health across provinces and territories when we look at health indicators such as life expectancy (Keon and Pépin 2009), and therefore it is also important to look specifically at data for Newfoundland and Labrador and, ideally, data at the community level, which are included in Part 2. This is important because the physical and social characteristics of communities, and the degree to which they enable and promote healthy behaviours, also affect health (Marmot, Allen, et al. 2010).

Determinants of Health

The association between income and health should be considered in the broader context of the determinants of health. While the World Health Organization (WHO) describes the determinants of health as simply “things that make people healthy or not” (World Health Organization 2010), this seems to imply a causality relationship. It is perhaps more appropriate to think of a determinant as something that is correlated with health and can influence health. In (Marmot, Allen, et al. 2010) the determinants of health are defined as “the range of interacting factors that shape health and well-being. These include: material circumstances, the social environment, psychosocial factors, behaviours, and biological factors. In turn, these factors are influenced by social position, itself shaped by education, occupation, income, gender, ethnicity and race. All these influences are affected by the socio-political and cultural and social context in which they sit.”

Figure 1 illustrates the relative importance of the primary determinants of health according to a 2009 report of the Canadian Senate Subcommittee on Population Health (Keon and Pépin 2009); these include socioeconomic factors, the healthcare system, biology and genetics, and the physical environment. Socioeconomic factors, which together are estimated to account for 50% of health status and well-being, include factors like income and social status, education, and personal health practices (e.g., smoking, alcohol use). Note that the inclusion of “well-being” broadens the traditional definition of health: the Senate Subcommittee adopted the widely used WHO definition of health as “a state of complete physical, mental and social well-being” and “a resource for everyday life” (Keon and Pépin 2009, 4).

It is interesting to compare Figure 1 to similar breakdowns of the determinants of health in other countries. For example, in (McGinnis, Williams-Russo and Knickman 2002), the impacts of various factors on early deaths in the US are estimated. Figure 2 illustrates the resulting breakdown. In terms of the total impact of socioeconomic factors, the estimate from (McGinnis, Williams-Russo and Knickman 2002) is roughly in line with (Keon and Pépin 2009). This is because the socioeconomic factors in Figure 1 include both social circumstances and health behaviors (i.e., personal health practices), which together account for 55% of the determinants of health in Figure 2. However, (McGinnis, Williams-Russo and Knickman 2002) see health behaviours as the most important determinant (40%). When discussing social circumstances, they also make the following point: “For the [US] population as a whole, the most consistent predictor of the likelihood of death in any given year is level of education... Poverty, another strong influence, has been estimated to account for 6 percent of U.S. mortality.”

Likewise, (Prus 2011) compared the social determinants of another health measure (self-assessed health) in the US and Canada, and found that the association between education and health is stronger in the US than in Canada. He concluded that although sociodemographic and socioeconomic factors have substantial effects on health in both countries, the size of the effects tends to differ.

How much income influences health status relative to other determinants is a critical question that is explored further in subsequent sections, but the effect of income itself can be difficult to determine due to the complex interactions between factors. Nevertheless, income is often cited as one of the most important determinants of health in Canada, e.g., (Keon and Pépin 2009), (Mikkonen and Raphael 2010). However, as pointed out in (M. Marmot 2002), “It may not be income itself that matters, except insofar as it determines ability to participate in the way defined as acceptable by society. To put it more generally, income is an impoverished way of capturing the condition of life that gives rise to health differences.” That is, income may also be considered an indicator of socioeconomic status at a more general level, rather than a pure measure of economic resources.

Figure 1. Determinants of health status and well-being in Canada. Source: Adapted from Keon and Pépin 2009.

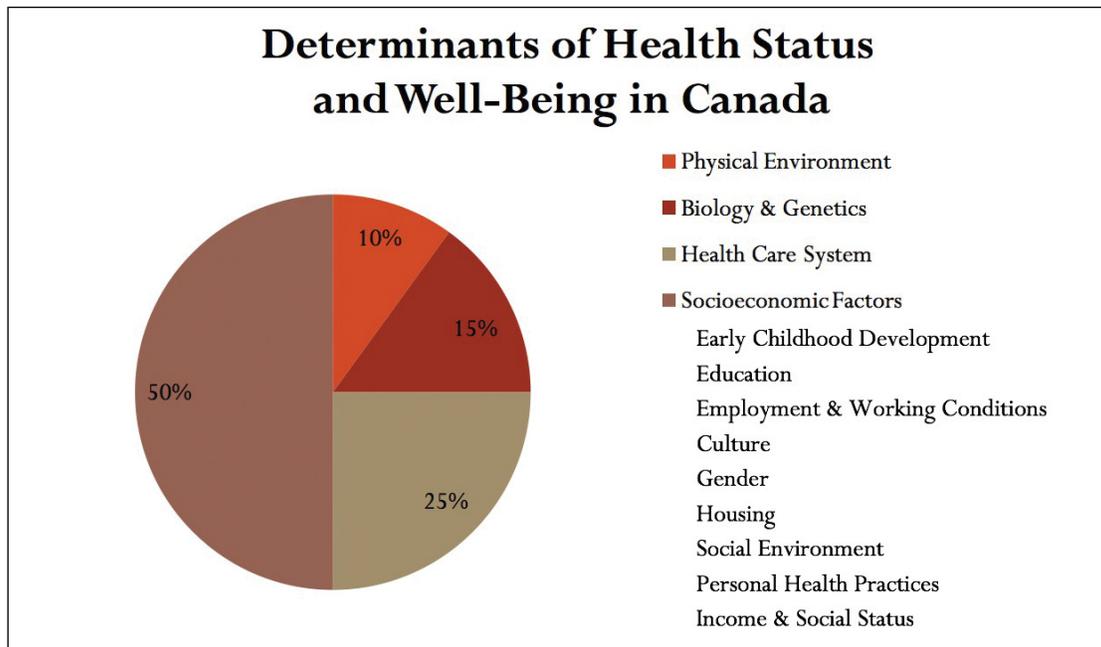
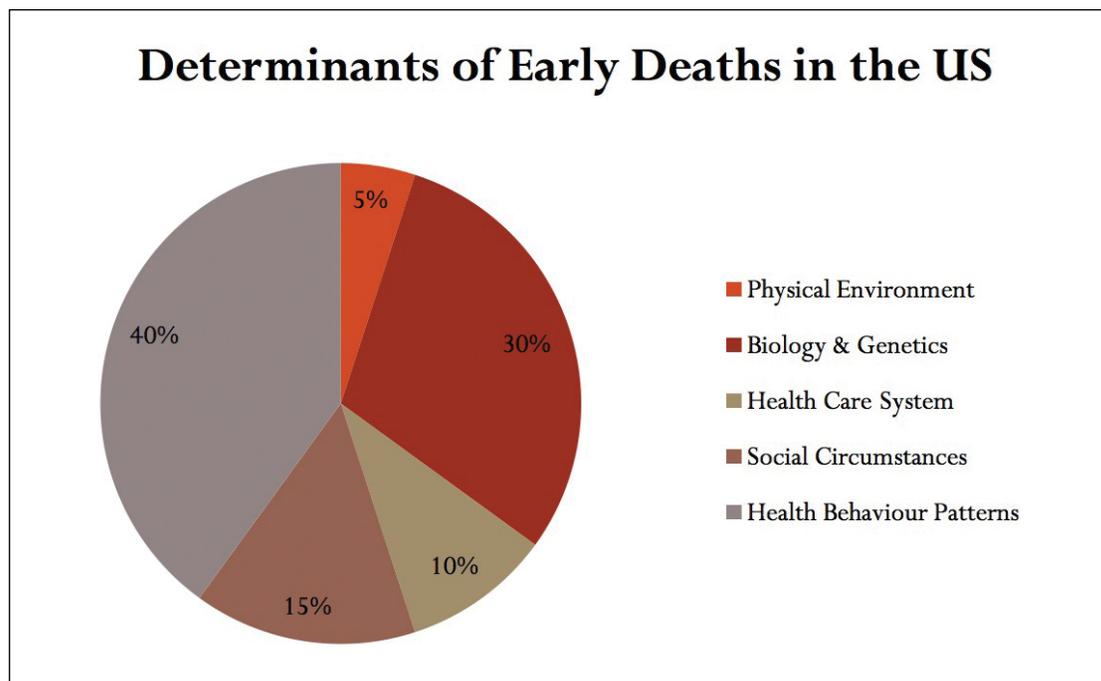


Figure 2. Determinants of early deaths in the US. Source: McGinnis, Williams-Russo and Knickman 2002.



Association between Income and Health

Income as a Measure of Economic Resources

In general, income has four main components (O'Donnell, et al. 2008): 1) wage income from labor services; 2) rental income from the supply of land, capital, or other assets (e.g., interest or dividends from investments); 3) self-employment income; and 4) current transfers from government or nongovernment agencies (e.g., income support or pension payments) or individuals / households.

Income may be measured as individual or household income. When researchers use household income, they usually adjust for factors such as the size and structure of the household. Household income has the advantage of giving a more complete picture of the economic resources available to an individual, particularly when looking at the association between income and health during childhood and adolescence.

Nevertheless, even household income can fluctuate significantly. However, household income fluctuation does not necessarily imply commensurate changes in living standards; for example, savings could be used to offset a temporary loss of income and therefore consumption might not change significantly. For this reason, household wealth, which measures income earned over decades and even across generations, is likely to be a better indicator of long-term health outcomes (Martikainen, et al. 2003), (Mikkonen and Raphael 2010), (Braveman, Egerter and Barclay 2011). Typically wealth is estimated as the difference between the cash value of assets owned by an individual or household and debts or liabilities. Some studies have also used markers like home ownership or access to a car as an indicator of wealth, e.g., (Goldblatt 1990). However, as mentioned earlier, our focus is on income rather than wealth due to the fact that data on income are more readily available in developed countries, particularly on an annual and individual basis. Moreover, income information is often collected as part of a general health survey, such as the Canadian Community Health Survey (CCHS), and therefore data on income and health can be linked for each respondent.

Health Indicators

If income is used to measure economic resources, how is health measured? The choice of health indicator is very important in studying the relationship between income and health.

Much of the early research on income and health used indicators related to mortality (death) because of the ready availability of data. An example indicator is mortality rate, which is the number of deaths (either in total or from a specific cause) during a given period of time, divided by the total population. However, morbidity (illness) indicators are becoming more common. Morbidity indicators measuring diseases are based on either incidence (the probability of being diagnosed with a disease during a given period of time) or prevalence (a person's likelihood of having a disease). Morbidity may be self-assessed rather than observed / measured.

Examples of common health indicators include: mortality rate, life expectancy at a specific age, disability-free life expectancy, self-assessed health status, measured incidence of diseases (e.g., cancer, coronary heart disease, stroke and diabetes), and physical factors such as obesity.

Self-assessed health status, in particular, is gaining popularity as an indicator. One reason is that the question used to collect this data often encompasses both physical and mental aspects of well-being and therefore relates closely to the WHO definition of health. Furthermore, information on self-assessed health status has been routinely collected in Canada since the mid-1980s, using a question that has remained largely unchanged. Therefore, in this country, it is more widely available and more consistent than many other indicators. Finally, although self-assessed health status is subjective, numerous studies have shown that it is associated with mortality (Rogers 2005). However, a limitation of self-assessed health status is that it does not directly measure objective health status, but instead relies on individuals to map their own health status to one of a number of possible categories, and how they do this can vary according to education,

economic status, age, gender, etc. This subjective mapping can complicate subsequent analysis (Rogers 2005). Furthermore, self-assessed health can be influenced by shifts in the expectations that people have with regard to their health, as well as factors that may change their awareness of health problems, such as improved detection of diseases (Kunst, et al. 2005).

Data on morbidity are often collected through the use of surveys, and design of these surveys is critical. For example, do the surveys monitor health behaviours (e.g., smoking) that may be associated with increased risk of the health indicator of interest (e.g., heart disease)? Surveys can be used to collect complementary data on the community, household and individual that aid in understanding the mechanisms that contribute to the health outcome.

The length of time over which health indicators are monitored is also important. For many health indicators, we would expect a time lag between any change in income and the effect on health status (Ecob and Smith 1999). A possible exception is infant mortality rate, which is likely to reflect contemporary conditions (Coburn 2004).

A good analysis of UK-based health indicators can be found in the framework for assessing performance improvement from the Marmot Review recommendations (Marmot, Allen, et al. 2010). However, the availability and limitations of specific health status data are very country specific.

Some Evidence of the Association between Income and Health

The strong association between income and health using a variety of mortality and morbidity indicators has been documented in numerous studies in the Canada, the US, and Europe. The following figures provide some examples.

Figure 3 shows that the prevalence of a particular illness, diabetes, decreases as we move up the income ladder in Canada. Those in the lowest income quintile are almost 3 times as likely to have diabetes as in the highest income quintile. This stepwise relationship between income and health, or the “health gradient”, has also been demonstrated using other types of health indicators. For example, Figure 4 shows that the life expectancy of both men and women in urban Canada increases with the average income of the neighbourhood in which they live. For males the difference in life expectancy between the poorest and richest neighbourhoods is 4 years, whereas for women it is slightly lower at 2 years.

The health gradient is seen over the entire income spectrum, indicating that the association between income and health is not just about poverty and the ability to meet basic needs for nutrition, housing and clothing. However, the “step” may be steeper at lower incomes, as seen in Figure 3 and Figure 4.

Other studies in Canada have looked at the association between income and other health indicators such as cardiovascular health (Lee, et al. 2009) and self-reported health status (Humphries and Doorslaer 2000), (McLeod, et al. 2003) and found similar health gradients.

The health gradient has been observed in many developed countries. Figure 5, for example, shows that within several European countries, as household equivalent income increases, the percentage of men considering themselves to have less than “good” health decreases; in other words, self-assessed health improves with income. Note, however, that the change in health associated with each step in income varies according to country.

Among industrialized nations the health gradient is steepest in countries such as the United States, and much less steep in countries like Norway and Sweden (Keon and Pépin 2009). The welfare and socio-political regimes within a country are a possible reason for this difference (Coburn 2004). “Social democratic” welfare states, such as Sweden, Norway and Finland, would be expected to have a shallower gradient than “liberal” welfare states such as Canada, the UK and US (which are the most market dependent). “Christian democratic” countries such as Belgium, Germany, Netherlands, France, Italy, and Switzerland lie within an intermediate group. Indeed, in Figure 5, the greatest difference between the poorest and richest groups is seen in the UK (where the difference in prevalence of “fair/poor” health is 25 percentage points), whereas Sweden has the lowest difference (18 percentage points).

Figure 3. Prevalence of diabetes by income quintile. Source: Reproduced from Keon and Pépin 2009.

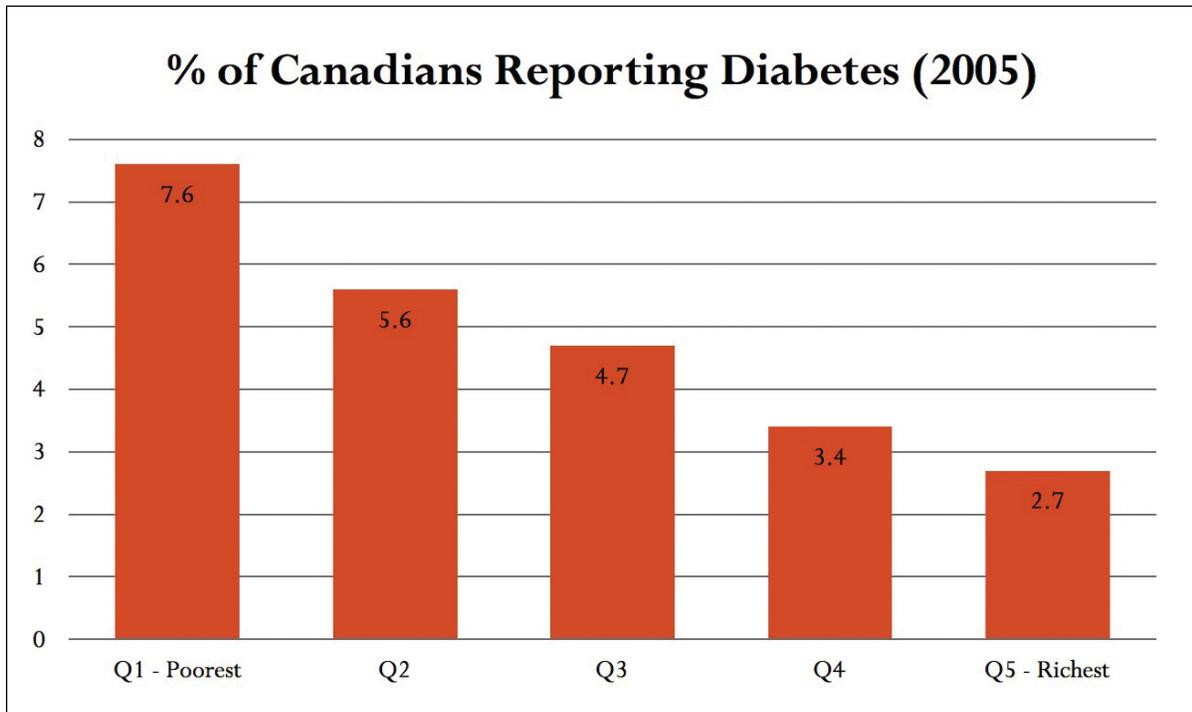
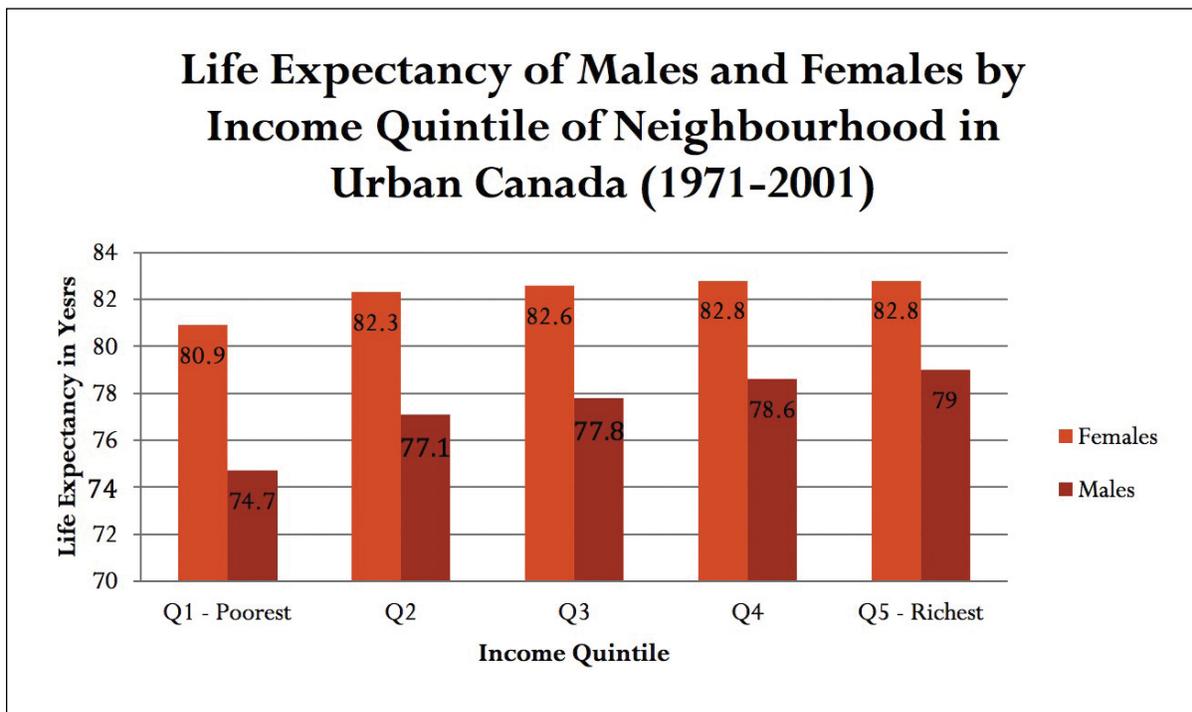
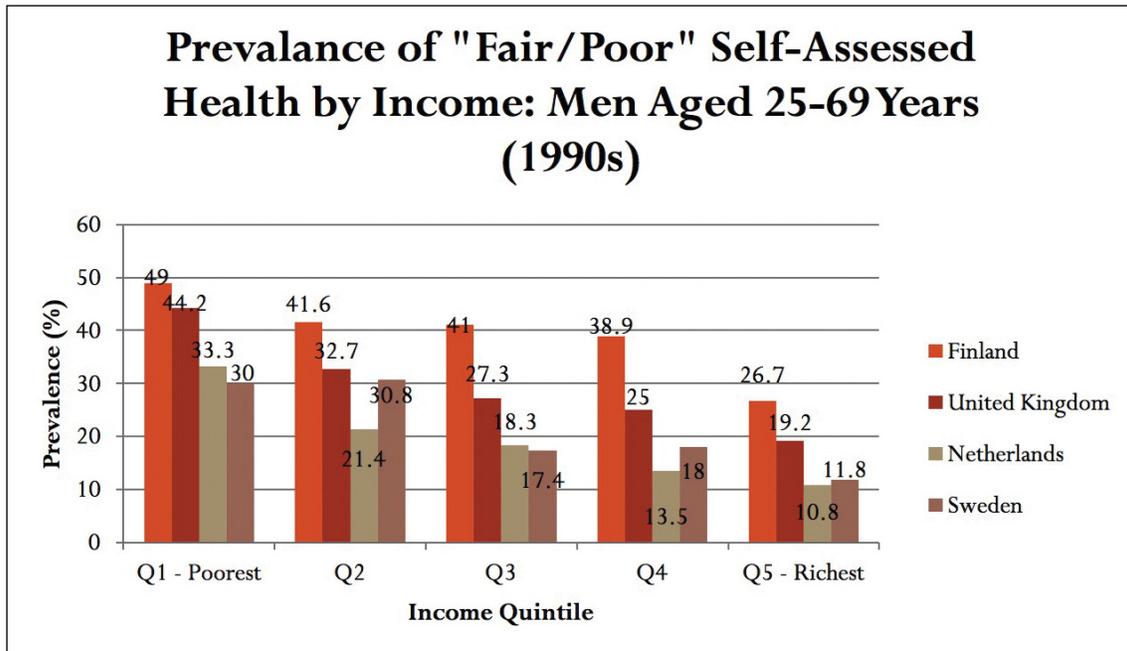


Figure 4. Life expectancy by income quintile of neighbourhood in urban Canada. Source: Reproduced from Wilkins 2007 in Mikkonen and Raphael 2010.



In a similar vein, (Humphries and Doorslaer 2000) found that income-related health inequality in Canada was significantly higher than that of seven European countries (Sweden, East Germany⁵, Finland, West Germany, The Netherlands, Switzerland, and Spain in ascending order of health inequality), but not significantly different from the health inequality measured for the UK or the US. This appears to be consistent with the theories presented in (Coburn 2004).

Figure 5. Prevalence of "fair/poor" self-assessed health by income in Europe. Source: Kunst, et al. 2005.



Figures 3 to 5 tell us is that within many developed countries, such as Canada, health is observed to vary as income varies. However, they do not allow us to conclude that an increase (decrease) in income is likely to lead to better (or poorer) health. Nor do they address the mechanisms linking income to health, which allow us to develop models for the relationship between the two. These issues will be addressed in the following sections.

Variation of Health with Income between Countries

In the previous section, we touched on how health varies with income within different countries. It is also interesting to look at between-country variations of health with income. For example, a World Bank report examined the relationship between life expectancy and income per capita in more than 100 countries from about 1900 to 1990 (World Bank 1993). In (Marmot and Wilkinson 2001) two important findings from the report are highlighted. Firstly, a small increase in income per capita corresponds to a large increase in life expectancy at low levels of income per capita. However, above around \$5,000 per capita (in 1991 international dollars⁶), the relationship levels off and there is a shallow gradient between life expectancy and income per capita. Secondly, for a given level of income per capital, life expectancy increased dramatically during the twentieth century. This indicates that other determinants of health besides income play a significant role.

⁵ Data from 1997, prior to German reunification, was used in the study.

⁶ International dollars are derived from national currencies by assessment of purchasing power rather than exchange rates. The effect is to raise the relative incomes of poorer countries.

One of the challenges in interpreting the results of between-country comparisons is that aggregation and averaging have a way of hiding the characteristics that are associated with health status. Even though we might try to conclude from the World Bank data that above a minimum level of income, an increase in income is associated with only a small increase in health, data presented earlier from within-country studies show that this is not the case (c.f. Figure 3 to Figure 5). The shallow gradient at higher national incomes may reflect that we are not really comparing “like for like” on all the determinants of health, and these unaccounted for differences may have a greater influence on health than absolute income above a certain income threshold. For example, it has been proposed (somewhat controversially) that the distribution of income within a population (i.e., income inequality) could be an important determinant of health, and this could explain the shallow gradient. (See (Wilkinson and Pickett 2006) for a review and discussion of the opposing views.) This leads us into an overview of some of the mechanisms thought to link income to health.

Mechanisms Linking Income to Health

Explanations for why income may affect health (J. W. Lynch, et al. 2000), (Marmot and Wilkinson 2001), (Kawachi, Adler and Dow 2010), (Mikkonen and Raphael 2010) can be grouped into roughly three categories:

- **Material effects:** income determines an individual’s ability to purchase good nutrition and adequate housing and clothing. This could be used to explain why, for example, there is such a steep gradient in life expectancy at of low levels of income per capita in (World Bank 1993);
- **Behavioural effects:** income affects health-related behaviours such as quality of diet, extent of physical activity, smoking, and excessive alcohol use;
- **Psychosocial effects:** income is associated with factors such as social status, autonomy, and the quality of social relations which in turn impact well-being through mechanisms such as stress and anxiety (Marmot and Wilkinson 2001), (M. Marmot 2002). For example, European workplace studies have shown that health suffers when people have little opportunity to use their skills and low decision-making authority, which tends to be associated with lower paying jobs (and hence lower income), e.g., (Bosma, et al. 1997), (Marmot and Theorell 1988).

Models for Individual Income and Health

The above mechanisms have been tied to different models of the relationship between income and health at an individual level, which are outlined in (Kawachi, Adler and Dow 2010).

In the absolute income model, the health and well-being of an individual is a function of the person’s own income. As income increases, so does health, but the rate of increase tapers off with increasing income. This sort of curvilinear relationship has been found in studies such as (Ecob and Smith 1999). The absolute income model is typically associated with material factors being the primary mechanism linking income and health. The rationale is that above the level where basic needs are met, added income has fewer health benefits.

In the relative income model, health is a function of the relative gap between an individual’s income and the income of some reference group, which could be co-workers, neighbors, or the national population. In this case, there is a linear relationship between health and the income gap, since a combination of psychosocial, behavioural and material factors are seen to be at work. In (Kunst, et al. 2005), for example, the authors observed that the association between income and self-assessed health is generally linear within the European countries studied, with the exception of the UK. For European countries other than the UK, this would be consistent with the reference group being the national population in a relative income model.

A variation of the relative income model is the relative deprivation model, which focuses on the gap between an individual’s income and the incomes of those richer than the person, and ignores information about the incomes of those poorer.

Finally, the relative rank model assumes that an individual's level of health is determined by the relative position within a hierarchy that a given income confers on that individual. The rationale behind this model is studies in nonhuman primates, which link health to social status even when resources are abundant and therefore material factors like access to food can be ruled out. Instead, stress associated with inferior rank is seen as the explanation for physiological effects (Sapolsky 2005). This model is supported by the well-known Whitehall studies of British civil servants, which showed that for most major categories of disease (cancer, coronary heart disease, stroke, etc.), health increased with employment rank (Marmot, Shipley and Rose 1984), (Marmot, Stansfeld, et al. 1991).

It is likely that the shape of the curve and the degree to which it depends on absolute vs. relative income varies in different sections of the population, from country to country, and by health indicator.

Income Inequality and the Health of a Population

At a population level, many studies have looked at the relationship between income inequality and the health of a population. These studies, which are reviewed in (J. Lynch, G. D. Smith and S. Harper, et al. 2004), (Subramanian and Kawachi 2004), and (Wilkinson and Pickett 2006), tie into the relative models proposed at the individual level.

According to the income inequality hypothesis, unequal distribution of income in a society poses an additional hazard to the health of individuals living in that society, and this leads to poorer overall health. Studies on the association between income inequality and health have looked at how health varies between countries using a country-level inequality measure, as well as how health varies between areas within countries using an area-level inequality measure. These studies commonly use the Gini coefficient⁷ to measure income inequality, but other measures are also used.

It is interesting that in studies within Canada, an association between income inequality and health status has not been found once other factors, such as absolute income, have been taken into account (Ross, et al. 2000), (McLeod, et al. 2003), (Vafaei, Rosenberg and Pickett 2010). In (McLeod, et al. 2003), the authors conclude: "Household income, but not income inequality, appears to explain some of the differences in health status among Canadians." That is, in Canada studies suggest that the absolute income model holds. However, a negative relationship between income inequality and area-level health has been found in other countries, notably the UK, e.g., (Ben-Shlomo, White and Marmot 1996), and the US, e.g., (Ross, et al. 2000), (Lynch, et al. 1998). In (Ross, et al. 2000), which compared data from Canada and the US, differences in social and political context were suggested as a possible explanation.

Regression Analysis

How well these models are able to explain the variation of health with income can be tested using regression analysis. Regression analysis also allows us to gauge how important income is relative to other socioeconomic factors such as education.

In Figure 3 to Figure 5 presented previously, individuals have been grouped together in equally sized groups according to where their income falls relative to the rest of the population, e.g., the bottom quintile refers to the lowest 20% of income earners. The figure then plots the average value of the health indicator for each group. This approach helps us to visualize the overall trend (i.e., the existence of a health gradient) but it doesn't provide any information about the underlying observations. However, in analyzing the strength of the relationship between income and health, factors like the number of observations made and how samples are drawn from the population are important. Furthermore, differences in age, sex, and any other factors that may influence the observed health outcomes must be carefully controlled for.

⁷ If incomes in a population are distributed completely equally, the Gini coefficient is 0, and if one person has all the income (maximum inequality), the value is 1.0.

In regression analysis, a particular model of the relationship between income and health is assumed, and then researchers test how well that model explains the observed health data. Researchers can add other socioeconomic factors as variables to the model and see if income still explains some of the observed variation in the health data. If it does, we say that the income is still “statistically significant”.

Why might the effect of income disappear when other variables are introduced to the model, even if there appears to be a strong association between income and health when only income is considered? This can happen if income is simply acting as a marker for the effects of these other variables.

A good example of this comes from the Whitehall studies mentioned previously. Ten years into the 25-year Whitehall II study, measures of personal and household income and household wealth were introduced to the study. In (Martikainen, et al. 2003), the association between these variables and two health indicators – self-perceived health and symptoms of depression – was examined. It was found that the higher the income, the more likely people were to report themselves in good health and the less likely to report depression. The same was found to be true for the relationship between household wealth and the two health indicators. However, when adjustments were made for pre-existing health conditions and additional socioeconomic factors (notably employment grade and education), income was no longer statistically significant.

An interesting side note is that household wealth was still strongly associated with both health indicators even after the adjustments were made. According to (Martikainen, et al. 2003), the independent association between household wealth and these morbidity measures is likely to be related to a set of early and current material and psychosocial benefits.

Other studies which control for other socioeconomic variables such as occupation and education have shown that income still has an independent effect on health, e.g., (Duncan 1996), (Ecob and Smith 1999). Nevertheless, controlling for these variables may reduce the effect of income on health.

Causal Analysis

As discussed in the previous section, the association between individual income and health is well established. That is, we know that within countries higher individual income is associated with better health (as measured by mortality and morbidity indicators) even after controlling for various factors such as age, sex, etc.

However, this does not necessarily imply direct and independent causality. That is, just because income and health are correlated, we cannot conclude that an increase in income is always likely to result in an increase in health. Getting to the bottom of this question is extremely important when making policy decisions, but the potential complex interaction of a number of factors, including age, gender, genetics, lifestyle, and employment status along with income, makes estimating the strength and nature of the relationships difficult.

Why isn't evidence of a strong association between income and health sufficient for establishing causality? Firstly, the correlation between income and health could be explained by “reverse causation”, i.e., poor health leads to lower earnings rather than lower earnings lead to poor health. Secondly, income and health may not be directly related to each other, but they may both be determined by another independent factor that hasn't been considered, such as genetic endowments (e.g., intelligence, height), parental income, or social background. That said, studies that have looked at whether intelligence, for example, could be used to explain the apparent association between income and health have found evidence that this is not likely to be the case, e.g., (Link, et al. 2008).

There are three main strategies that researchers use to investigate causality (Kawachi, Adler and Dow 2010). Firstly, they can conduct controlled experiments in which the income of a group is changed and then observe the direct effects. An example is (Forget 2011), which looks at the long-term health outcomes for MINCOME, a Canadian

Guaranteed Annual Income (GAI) field experiment that ran in the province of Manitoba between 1974 and 1979. The research focuses on income security – the guarantee that all participants can expect a basic annual income whether or not they work – rather than income itself. Forget found that overall hospitalizations, and specifically hospitalizations for accidents and injuries and mental health diagnoses, declined for MINCOME subjects relative to a comparison group. Physician contacts for mental health diagnoses also fell for subjects relative to comparators.

Generally, these sorts of experiments focus on the relationship between income and health at the lower end of the income spectrum, that is, poverty as a predictor of poor health. This is simply because it is not feasible to conduct controlled experiments over a wide income range in order to determine if there is a causal relationship between income and health for the rich as well as the poor. Even in the MINCOME experiment described in (Forget 2011), inadequate budgeting of the program severely limited the data that were collected and analyzed.

Instead of controlled experiments, researchers often rely on “**quasi-experiments**”, in which a change in income happens due to external factors, and then observe the results. An often-cited example is (Lindahl 2005), which examined the effects of lottery payments on health status in Sweden. The results suggested that each 10% increase in income was associated with a statistically significant increase in life expectancy of between 5 and 8 weeks.

Another example of a quasi-experiment is (Frijters, Haisken-DeNew and Shields 2005), which used the natural experiment created by the reunification of Germany in 1990, as a way of establishing the causal effect of income changes on health satisfaction. German reunification resulted in a widespread positive income shock in East Germany, but not in West Germany. The authors looked at data from the German Socio-Economic Panel for the period between 1990 and 2002 in East Germany, with comparative data from West Germany between 1984 and 2002. They found some evidence that increased income leads to improved health satisfaction. However, the quantitative size of this effect was small. Interestingly, they found that health satisfaction in both East and West Germany followed a similar downward trend from 1990 to 2002 despite very different income profiles, with large increases in real household income between 1990 and 1993 in East Germany only. Increased household income did partially off-set this downward trend, but accounted for less than 5% of the change in average health satisfaction.

There are other examples of “quasi-experiments”, including (Case 2004), but (Frijters, Haisken-DeNew and Shields 2005), point out that more research utilising random variations in income is needed to further address the issue of the existence of a causal link between income and adult health.

Thirdly, researchers can investigate causality using longitudinal studies in which data are gathered for the same subjects repeatedly over a period of time. A longitudinal study is a type of “observational study”, that is, researchers record information about their subjects without manipulating the study environment. The advantage of a longitudinal study over a cross-sectional study (another type of observational study in which data are collected at a single point in time) is that it provides more information about cause and effect relationships. For example, a longitudinal study allows researchers to control for prior health status. Furthermore, it permits researchers to look at how health changes over time in response to a temporary or permanent income change. By comparison, a cross-sectional study only gives us a “snapshot”; it does not consider what happens before or after the snapshot is taken. The Whitehall studies mentioned earlier are good examples of a longitudinal study extending over many years (Marmot, Shipley and Rose 1984), (Marmot, Stansfeld, et al. 1991), (Martikainen, et al. 2003).

Various longitudinal studies have shown that socioeconomic status in early childhood plays a key role in shaping income and health at a later stage, but exactly what role income plays is hard to assess. For example, (Currie and Stabile 2003) examined the way that the relationship between socioeconomic status and health changes with age among a panel of Canadian children. They found that the health of low socioeconomic status children worsens with age, not because they lack the resources to respond to health shocks (e.g., accidental injuries, chronic conditions such as asthma, and diseases requiring hospitalization), but because they are subject to more shocks. The authors demonstrated that health shocks in childhood are likely to affect future socioeconomic status through both their

direct effects on future health and by lowering academic performance (measured by math and reading scores). In other words, the relationship goes both ways – low socioeconomic status in childhood (which is measured by household income) is more likely to lead to poor health which in turn has an impact on future earnings. An example of a UK study is (Propper, Rigg and Burgess 2007), which looked at the mechanisms by which higher household income might translate into better childhood health, such as parental behaviours and parental health, including mental health. It found that after controlling for these factors, there is almost no direct impact of income, but the mother's own health, particularly her mental health, plays a significant role in determining childhood health.

Areas for Research on Income and Health

As mentioned earlier, the association between income and health is well established, but demonstrating causality has been a greater challenge. However, there is some evidence from experiments, quasi-experiments and longitudinal studies that income has an effect on health. Areas for further research on income and health that are important for policy-making include the following (Kawachi, Adler and Dow 2010):

- **What are the differences in how health changes in response to a short-term increase in income vs. a permanent increase in income?**

For example, (Ruhm 2007) showed that in the US, transitory upturns, particularly those involving more intensive use of existing labor and changes in environmental conditions, may be associated with increased mortality from heart attacks. In other words, short-term increases in income may not improve the overall health of the population. Likewise, (Granados 2005) demonstrated that economic expansions in the US are associated with increased mortality. He suggested a number of possible mechanisms: expansion of traffic and industrial activity directly raising injury-related mortality; decreased immunity levels (owing to rising stress and reduction of sleep time, social interaction and social support); and increased consumption of tobacco, alcohol and saturated fats.

- **At what stage in life does income have the greatest influence on health?**

Many studies talk about the importance of family income during early childhood as a determinant of health in later life, e.g., (Currie and Stabile 2003), but there appears to be a weaker impact of adult income on adult health, particularly as people near retirement.

- **Does income matter more in particular social contexts?**

Research such as (Ross, et al. 2000), (Coburn 2004), and (Prus 2011) suggests that this is the case, but further study is needed to confirm the underlying mechanisms. For example, to what extent do differences in the way that health care and high quality education are distributed in Canada and the US (which relies more on the marketplace for distribution) explain differences in the health gradients?

Considerations for Resource Development in Newfoundland

The complexity of the relationship between income and health leads to some important questions when looking at the potential implications of resource development in Newfoundland. Some factors which should be taken into consideration are outlined below.

Recipients

There is evidence that within Canada the increase in health status associated with an increase in income tapers off at higher incomes.

Who would receive the income from new jobs created? Where would they come from, what were they earning previously, and how much would their income increase?

Work Status

Health is associated with work status as well as income. For example, (Rueda, et al. 2012) conducted a systematic review of the literature on the impact of returning to work on health among working-aged adults and found that most (but not quite all) of the studies that met their inclusion criteria revealed a beneficial effect of returning to work on health.

What is the work status of the anticipated job recipients prior to development? Are they unemployed or employed?

Working Environment

Working environment also impacts health. As pointed out in (Marmot, Allen, et al. 2010), "Work is good – and unemployment bad – for physical and mental health, but the quality of work matters... Insecure and poor quality employment is also associated with increased risks of poor physical and mental health. There is a graded relationship between a person's status at work and how much control and support they have there. These factors, in turn, have biological effects and are related to increased risk of ill-health."

What sorts of jobs would be created? What health impacts might be expected due to this type of work?

Physical Environment

Environmental factors like safe water and clean air are also determinants of health (Keon and Pépin 2009), (World Health Organization 2010). In a recent review of research on the negative environmental impacts of hydraulic fracturing of shale, such as air and water pollution, that could possibly influence public health (Shonkoff, Hays and Finkel 2014), the authors concluded that existing scientific data suggest there are potential health risks but more research is needed to clarify the magnitude of these risks.

What are the environmental risks, such as wastewater contamination and increased concentrations of pollutants in ambient air, associated with this particular development? How would they be likely to impact health?

Age Distribution

The impact of income on health also seems to depend on age; in particular, socioeconomic status in early childhood plays a key role in shaping income and health at a later stage.

How old are the people in the households of those to be employed?

Duration

Permanent increases in income may have different health impacts than short-term increases.

Would resource development improve long-term job prospects?

Summary and Conclusions

In Part 1 of this report, we have looked at peer-reviewed Canadian and international research on the association between income, wealth and health, with a focus on income and health due to data availability. A strong association between income and health in Canada has been demonstrated using a variety of health indicators. It appears that income, rather than income inequality, explains some of the differences in health status among Canadians; in other words, in Canada health seems to be related to absolute rather than relative income. Furthermore, the increase in health status associated with an increase in income seems to taper off at higher incomes in this country.

On balance, our view is that income does have an effect on health, particularly in terms of poverty and health. However, income is only one of a number of determinants of health, which include socioeconomic factors, the healthcare system, biology and genetics, and the physical environment. Many of these socioeconomic factors are interrelated – for example, income may influence social status, early childhood development, education, employment and working conditions, housing, and personal health practices. However, the mechanisms linking income to these factors and ultimately their combined effect on health depend on the cultural and social context, and so it is important to look at the available data for Newfoundland and Labrador and the communities of interest. It is also important to consider how other determinants of health, in particular the physical environment, may be affected by resource development irrespective of changes to income, but that is beyond the scope of this report.

In Part 2 of the report, we probe some of these issues further by looking at data specifically for Newfoundland and Labrador.

PART 2: EVIDENCE FOR NEWFOUNDLAND AND LABRADOR

The Canadian and Our Provincial Context

The general associations discussed in our review sections will now be investigated by using indicators that were gathered by (Hoskins and May 2014a)⁸ on a project funded by Collaborative Applied Research in Economics (CARE), Memorial University. This project adopted the domain and indicator approach chosen by the Organisation for Economic Co-operation and Development (OECD) as part of its framework for individual well-being and sustainable development as shown in Figure 6.

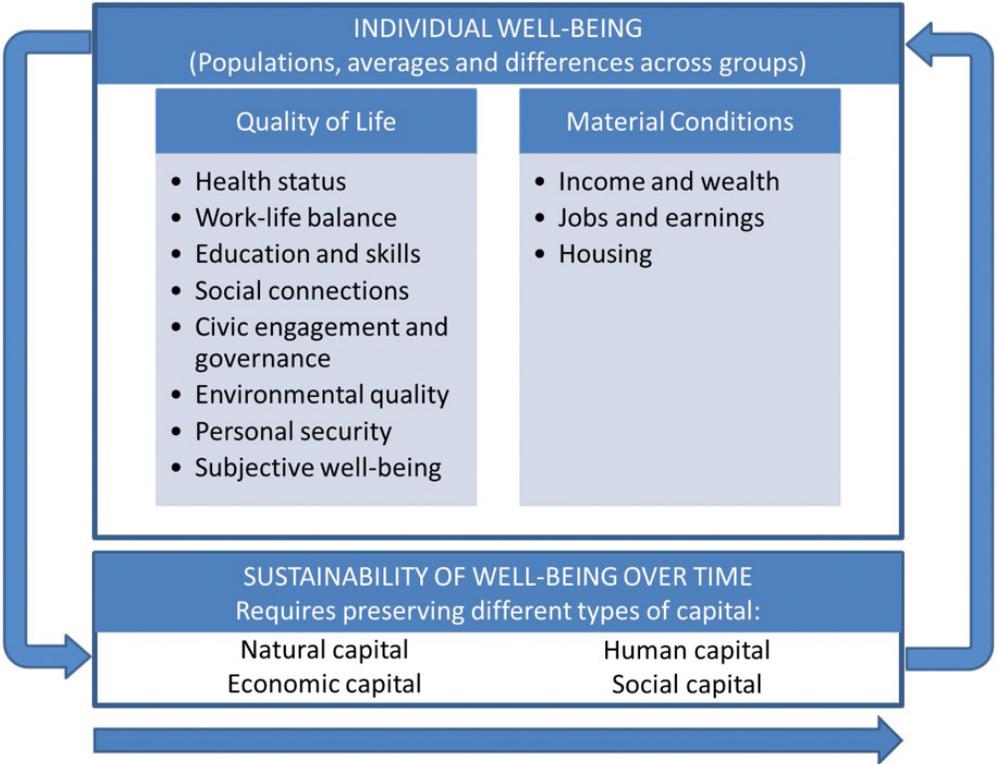


Figure 6. OECD framework for measuring well-being and progress. Source: OECD 2013.

⁸ See www.mun.ca/care/topics/BLI_paper_Final_2014.pdf.

While the OECD framework covers many of the factors already discussed in Part 1 of this report, our interest lies in the domains of income and wealth and health. One of the strengths of adopting the OECD approach in (Hoskins and May 2014a) is that it permits readers to make interprovincial and also international comparisons⁹.

To investigate the association between income and health by province, we choose self-reported health status as a health indicator. Many studies have chosen this variable as an outcome indicator of health, and (Doorslaer and Jones 2003) showed that inequalities in this variable are equivalent to inequalities in mortality. (Decker and Rentier 2004) noted the connection between self-assessed health status and functional health. Household disposable income in inflation-adjusted (2002) dollars is used as an “associative” variable or as a traditional “determinant” in the World Health Organization’s “population-health” model. Figure 7 presents the results for the year 2000 using Google’s Motion charts for all 10 provinces. The size of each circle represents the relative population size of each province.

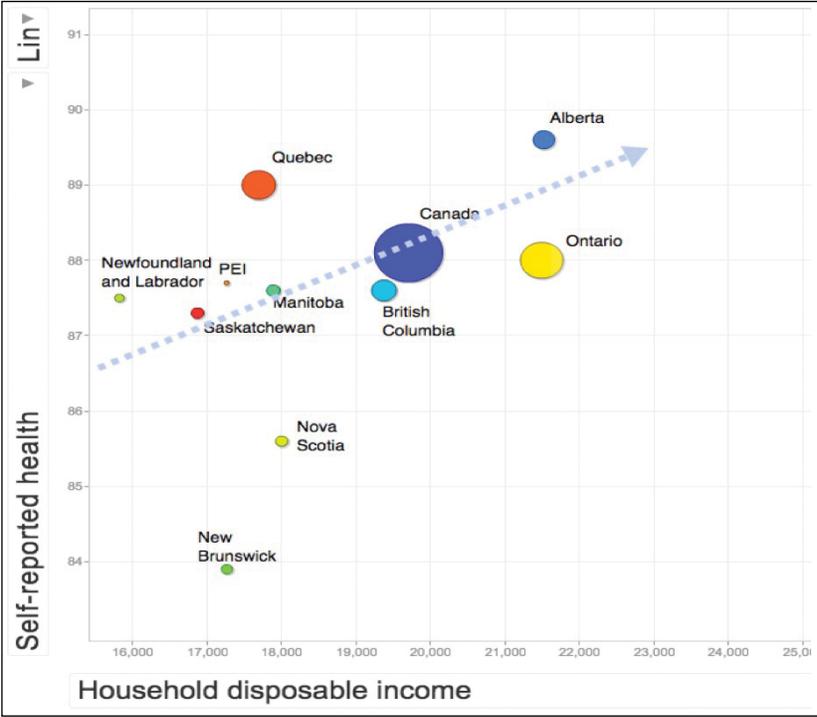


Figure 7. The association between income and health in Canadian provinces, 2000. Source: Newfoundland and Labrador Community Accounts 2015.

Considering the 10 Canadian provinces in 2000, Newfoundland and Labrador seems to be in the lower half (7th) with respect to self-reported health status and is definitely at the bottom of the pack when it comes to constant dollar¹⁰ household disposable income per capita (income after direct taxes have been taken out and government transfers added in¹¹). We have drawn a dashed blue arrow to show what seems to be a general association between health status and take-home income. It appears that as income increases so does average self-reported health status: a higher number means that a higher percentage of the provincial population surveyed reports “Excellent”, “Very Good” or “Good” health. For example, in 2000 it was estimated by Statistics Canada’s Canada Community Health Survey (CCHS) that 87.5% of Newfoundland and Labrador’s population would report their health status as

⁹ Readers are directed to (Hoskins and May 2014a), which outlines the methodology and the source of the data used in the paper.

¹⁰ In 2002 dollars, in order to adjust for price changes (inflation) over time.

¹¹ The OECD also adjusts for social transfers in kind, that is, they add average health and education expenditures to average household disposable income. This is not possible for Canada but is the correct procedure.

“Excellent”, “Very Good” or “Good”, and that the average household disposable income was \$14,825. New Brunswick had the lowest self-reported health status while Alberta had the highest. Some commentators might be tempted to conclude that the relationship is a causal one, with higher incomes leading to better health. However, as our review discusses, one has to be careful about making such general statements since causality might go either way. Individuals who, for whatever reason, suffer from poorer functional mental or physical health may experience lower incomes. Furthermore, income and health may not be directly related to each other, but they may both be determined by another independent factor that hasn’t been considered.

Tracking progress over time is also important as Figure 8 below demonstrates for Newfoundland and Labrador through the use of a green track, with each dot on this track representing a different year. Between 2000 and 2013, both income and health rose for all provinces except for Alberta. Figure 8 also shows that the improvement in health status associated with an increase in income varies by province, and so the relative rankings of the provinces changed over the period. Newfoundland and Labrador experienced the most rapid growth in household disposable income presumably due to the economic benefits, including royalties and income taxes, which were associated with oil production development and exploitation. Health benefits in Newfoundland and Labrador also rose between 2000 and 2013. In terms of our ranking amongst the provinces, we were last (10th) in terms of household disposable income per capita in 2000 and had moved up to 4th position in 2013. In terms of health, our ranking also rose from 7th to 3rd over the period. The association is more complex than income being the sole determinant of health. Clearly other factors, such as levels of education and expenditures on health care, are playing a role.

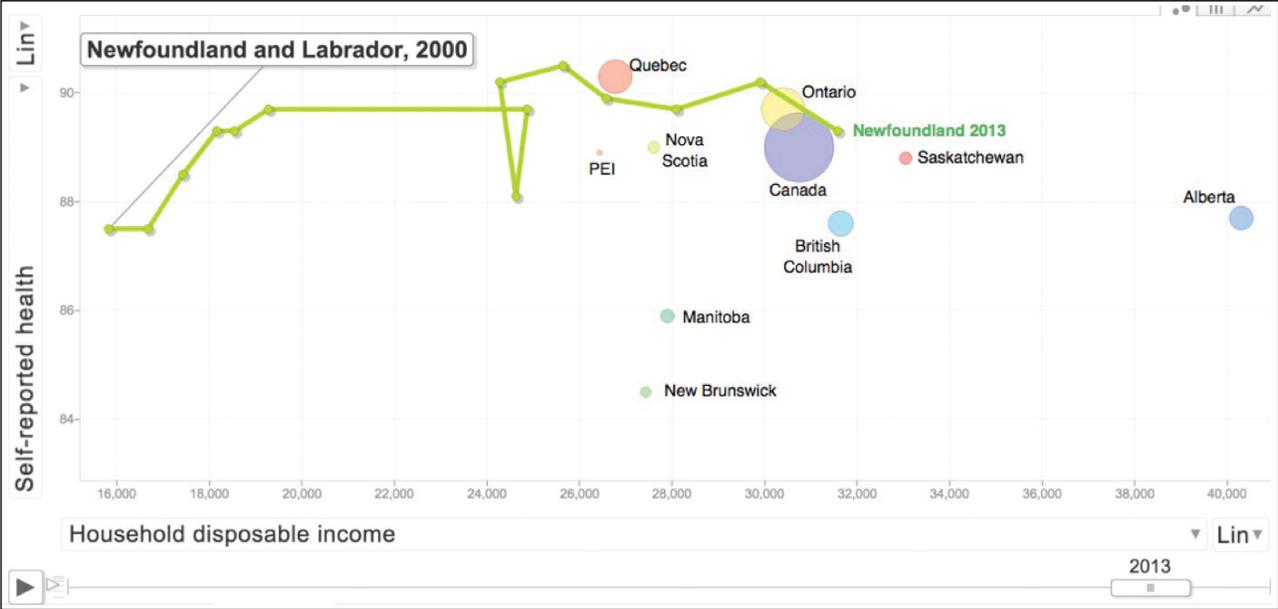


Figure 8. Tracking the association between income and health for Newfoundland and Labrador, 2000-2013¹². Source: Newfoundland and Labrador Community Accounts 2015.

¹² Data for the other provinces are for 2013 only.

Figure 9 replaces household disposable income per capita with adjusted household income in 2011 dollars after tax and direct transfers¹³. Households are adjusted for the size of the household, and it is these adjustments, which are used to measure income inequalities throughout OECD countries, that are provoking a great deal of discussion. Once again we observe the general trend that as income increases so does the self-reported health status of individuals. But once again we observe that, as income rises in some instances, health status falls¹⁴, as has recently been the case in Newfoundland and Labrador during the 2009-2011 period as shown by Figure 8.

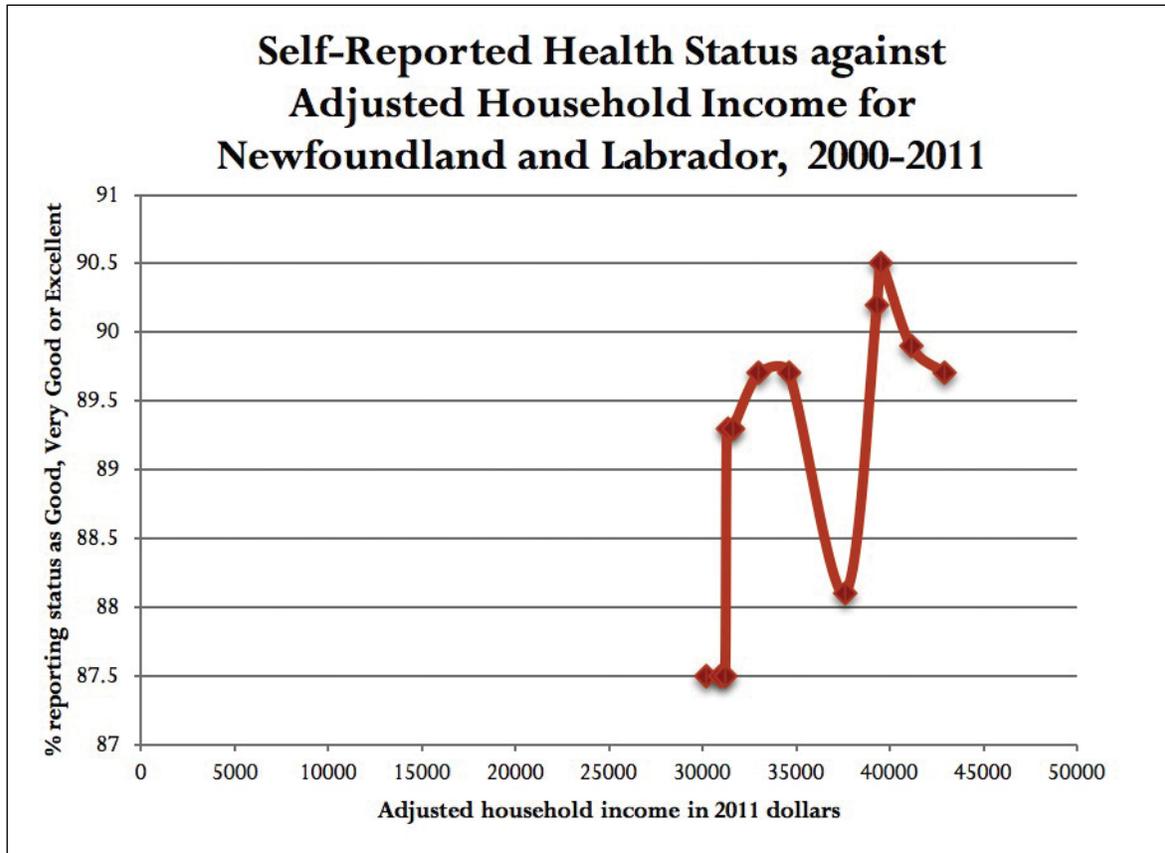


Figure 9. Self-reported health status against adjusted household income for Newfoundland and Labrador, 2000-2011. Source: Statistics Canada, CANSIM Table 202-0707.

The literature on income, wealth and health often refers to a “social gradient”, that is, inequalities in income are connected to inequalities in health. Recently, (Locke, et al. 2015)¹⁵ reviewed income inequalities in this province as part of a wider discussion on possible reforms to the personal income tax system to make the system fairer. As the paper explains in depth, income inequality is generally measured using a Gini coefficient based on adjusted (equalized)

¹³ “Adjusted” in the sense used by Statistics Canada means converted to “equivalent” incomes per capita. Note that these incomes are also expressed in constant dollars. This adjustment is the one used in discussions concerning income growth and aggregate measures of income inequalities.

¹⁴ When discussing indicator estimates at the more disaggregated geographic levels, you have to be careful in interpreting trends when these estimates are based on surveys, as is the case with our self-reported health status. Provincial or regional estimates involve smaller survey samples and are therefore subject to greater sampling variability. Trends may be reported that are due to sampling variability rather than “true” movements in the indicator at the population level. Note that our income data are based on large samples of administrative data and are therefore more reliable.

¹⁵ See www.mun.ca/care/papers/PIT_REVIEW_final_report_June_1_2015.pdf.

after-tax family or household income data. Estimates of these Gini coefficients for Canada and Newfoundland and Labrador over almost 35 years between 1977 and 2011 demonstrate that income inequality in Canada is much less pronounced than in the United States^{16,17}. It has increased very slightly over the 35 years but by far less than in the United States (US) or the United Kingdom (UK). In Newfoundland and Labrador income inequality has been slightly lower than the Canadian average. While we do rank higher than most of the other provinces, Newfoundland and Labrador has lower income inequality than Alberta, British Columbia, and Ontario, where inequality is more pronounced and growing. Recent evidence in our Province would indicate a slight decline in income inequality while inflation-adjusted real disposable incomes are increasing.

When health inequalities are discussed the “evidence” is usually anecdotal rather than based on data. An exception is unpublished work of Hoskins in 2014 on health inequalities for MayMetrics Analysis¹⁸ using CCHS data collected on individuals in this Province using the methodology of (Naga and Yalcin 2008).

There does seem to be a modest increase recently in the health inequalities index. However, from the perspective of health equality, this Province has consistently had one of the highest levels of health equality amongst the provinces and now ranks first along with Prince Edward Island.

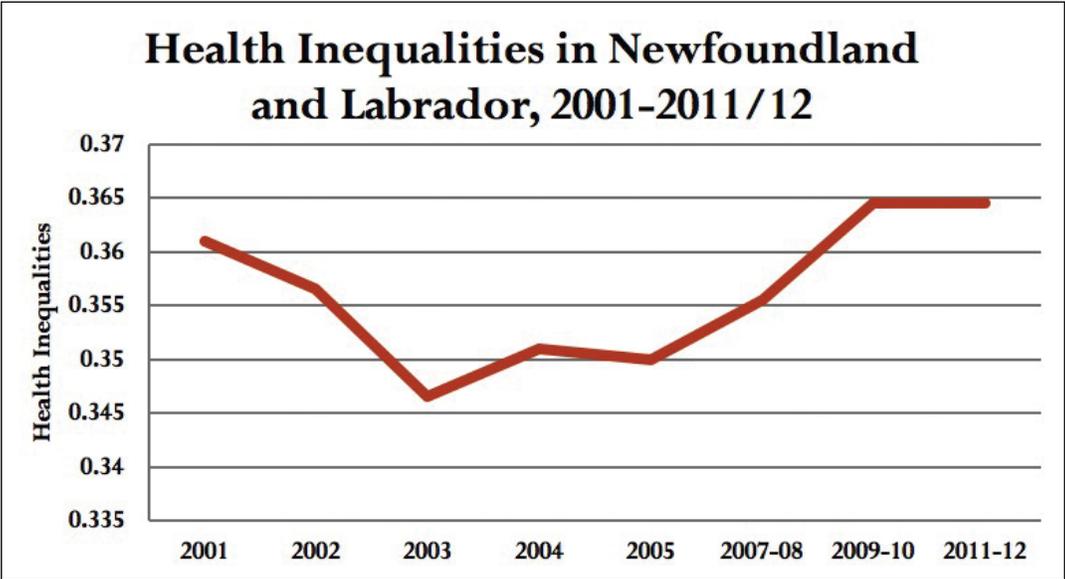


Figure 10. Health inequalities in Newfoundland and Labrador, 2001-2011/12.

The Regional and Local Context

Most published research has concentrated on income and wealth as a determinant of health at the national level and uses aggregate data. However, if changes in income are at the regional and/or local level and conditions vary across the nation/state, then local and regional conditions should be examined. Newfoundland and Labrador’s own System of Community Accounts does this. The system mirrors that of the OECD’s framework illustrated in Figure 6. This is no accident since the OECD’s developers built its framework with an in-depth knowledge of the Community Accounts¹⁹.

¹⁶ Readers are directed to the discussion around Figures 1-3 in (Locke, et al. 2015).
¹⁷ The OECD data used to make the international comparisons covered the period from 1985-2008.
¹⁸ The project was carried out in partnership with the Newfoundland and Labrador Statistics Agency.
¹⁹ See (Hollett, May and Giles 2008).

We have selected two local areas that are roughly associated with the potential hydraulic fracturing development and the panel's geographic areas of interest. These two areas are Local Area 37²⁰, the Port au Port Peninsula and Stephenville, and Local Area 40²¹, the Bay of Islands.

Local Area 37²², which includes the Port au Port Peninsula and Stephenville, had a population of 15,920 reported in the 2011 Census. Figure 11 shows the gender and age breakdown of the population. What it does not show is that this population is rapidly aging. The existence of a "waist" in our population pyramid is caused by large outmigration starting at age 20 and continuing up to the early 30s. The demographic profile for the 3,245 residents of Local Area 40²³, the Bay of Islands, in 2011 is somewhat similar, with an aging population that is shrinking due to deaths, fewer births and outmigration. These changing profiles will partially explain the changes in health and income profiles to be discussed.

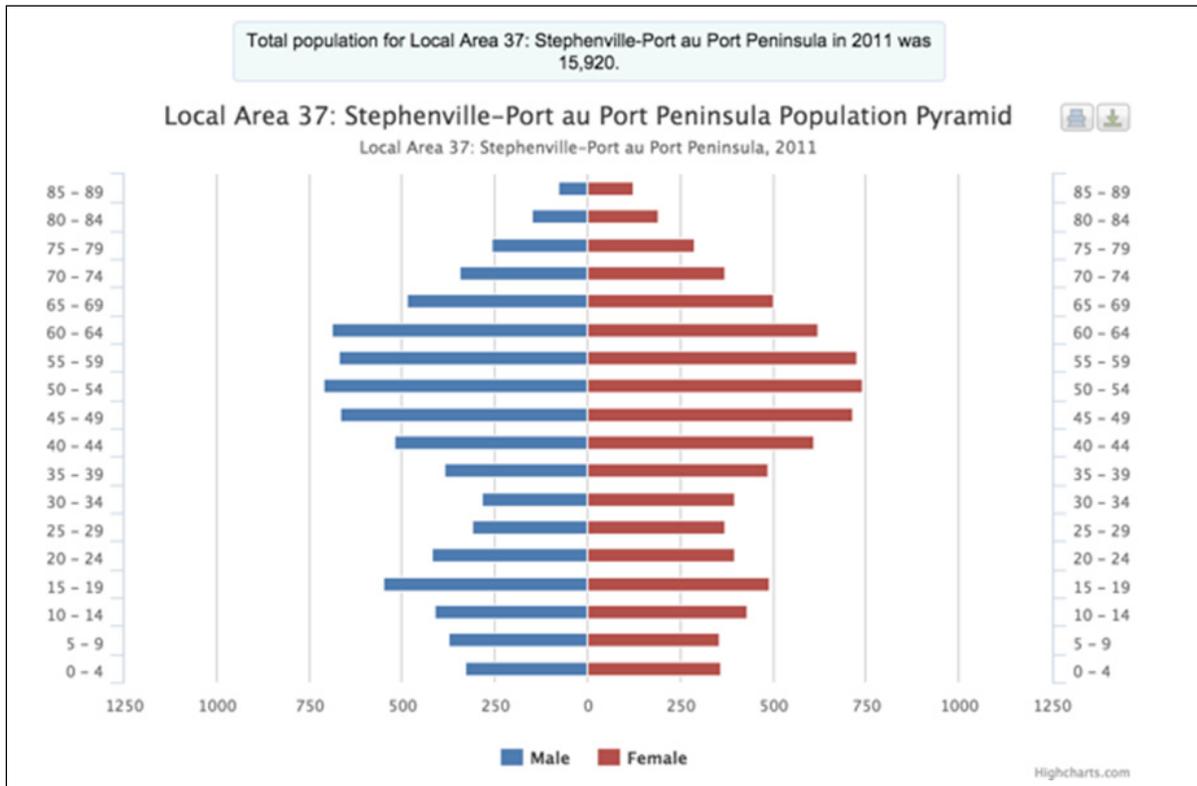


Figure 11. Gender and age breakdown of Local Area 37, Stephenville and Port au Port Peninsula. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

²⁰ The Community Accounts states: "Includes Black Duck, Cold Brook, Fox Island River-Point au Mal, Gallants, Georges Lake, Kippens, Mattis Point, Noels Pond, Port au Port East, Spruce Brook, Stephenville, Stephenville Crossing and the Port au Port Peninsula. This geography is similar to Statistic's Canada CCS's 4D and 4E, however 4D and 4E does not contain Mattis Point."

²¹ The Community Accounts states: "Includes Cox's Cove, Humber Arm South, Lark Harbour and York Harbour. This geography is similar to Statistic's Canada CCS 5D, however 5D also contains Mclver's."

²² See the Appendix for a map of this Local Area.

²³ See the Appendix for a map of this Local Area.

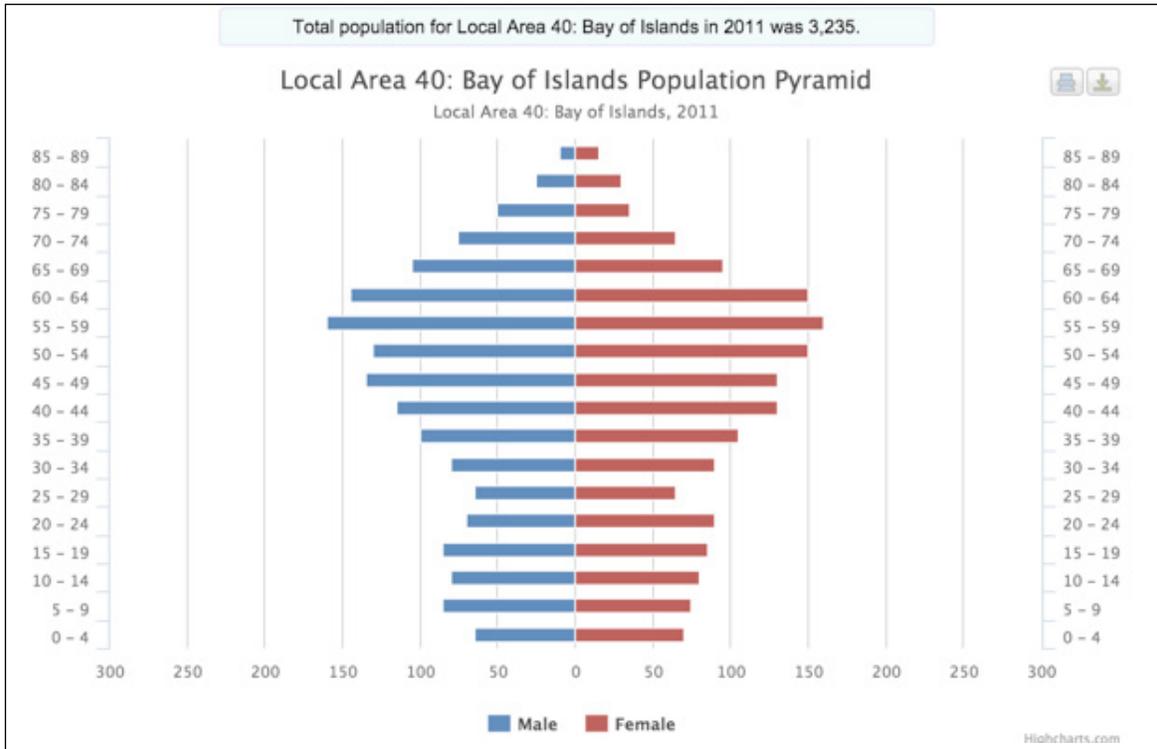


Figure 12. Gender and age breakdown of Local Area 40, Bay of Islands. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

With respect to self-reported health status data are reported at the local area level in the Community Accounts using CCHS data.

Table 1. Self-reported general health status in selected areas, 2001-2011. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

		GENERAL HEALTH					
		% Excellent + Very Good	% Excellent	% Very Good	% Good	% Fair	% Poor
2011	Canada	59.9	20.7	39.2	28.8	8.6	2.7
	Newfoundland and Labrador	60.1	17.6	42.5	27.2	9.7	2.9
	Port au Port Peninsula & Stephenville	44.8	23.5	21.3	34		
	Bay of Islands	68.6					
2007-2008	Canada	59.3	21.7	37.5	29.3	8.5	2.9
	Newfoundland and Labrador	61.8	18.1	43.7	26.2	8.7	3.3
	Port au Port Peninsula & Stephenville	50.6	20.7	29.8	27.7		
	Bay of Islands	63.6	18.7	45	24.9		
2007-2008	Canada	59.3	21.7	37.5	29.3	8.5	2.9
	Newfoundland and Labrador	61.8	18.1	43.7	26.2	8.7	3.3
	Economic Zone 09 (Stephenville-Burgeo)	52.4	18.3	34	19.3	15.6	5.7
	Economic Zone 08 (Corner Brook-White Bay)	63.2	20.4	42.9	26.5	7	3.2
2005	Canada	60.2	21.9	38.3	28.6	8.4	2.7
	Newfoundland and Labrador	64.5	18.8	45.7	23.6	8.5	3.5
	Economic Zone 09 (Stephenville-Burgeo)	59.4	18.3	41.1	19.2	16.6	4.8
	Economic Zone 08 (Corner Brook-White Bay)	60.9	16.3	44.6	25.8	10	3.3
2003	Canada	58.8	22.3	36.3	30.1	8.7	2.5
	Newfoundland and Labrador	66.5	21.1	45.4	22.5	7.5	3.4
	Economic Zone 09 (Stephenville-Burgeo)	64.2	32.2	32	17.8	13.9	4.2
	Economic Zone 08 (Corner Brook-White Bay)	64.6	25.9	38.7	25.8	7.8	1.9
2001	Canada	58.6	22.3	36.3	30.1	8.7	2.5
	Newfoundland and Labrador	66.4	22.6	43.8	21.1	9.3	3.1
	Economic Zone 09 (Stephenville-Burgeo)	42.6	11.9	31.7	38	16	2.4
	Economic Zone 08 (Corner Brook-White Bay)	67.9	24.5	43.4	20.3	9.2	2.6

Table 1 compares the self-reported general health status of these two Local Areas with the reported results for Canada and Newfoundland and Labrador for two time periods. Recall that the OECD indicator for health status combines the three health states of "Excellent", "Very Good" and "Good". Keeping in mind that there may be some sampling variation, and this can be relatively large given smaller sample sizes as we move to smaller geographies, we observe that the Port au Port/Stephenville local area seems to have a larger portion of its population reporting "Good" rather than "Very Good" health while the number reporting "Excellent" health seems slightly higher. Meanwhile, the Bay of Islands local area seems to have slightly more people reporting "Very Good" health. Given the small sample size, one cannot conclude that there are major differences between these local areas and the Canadian and Provincial results. There may be some minor differences just noted but the evidence is suggestive rather than definitive.

For earlier periods, the Community Accounts only reports by Economic Zone and these geographies are somewhat larger than the local areas. Economic Zone 09²⁴ (Stephenville-Burgeo) not only incorporates Local Area 37 but also the area around Burgeo. Zone 08 (Corner Brook-White Bay) includes Local Area 40 as well as Corner Brook and Deer Lake. Data from these earlier surveys indicate that the self-reported health status for the Province and for Zone 08²⁵ (Corner Brook-White Bay) are slightly better than that for Canada, while Zone 09 (Stephenville-Burgeo) seems to exhibit trends similar to those reported for Local Area 37. What may be of concern is the relatively high percentage of individuals reporting "Fair" health in Zone 09 (Stephenville-Burgeo). Readers should remember that this area is larger than Local Area 37 and comparable data for the same period are not available.

The self-reported health status data for the two local areas of interest for 1995 as reported in Table 2 are not from the CCHS but from an Adult Health Survey conducted by the Division of Community Health in the Faculty of Medicine at Memorial University. This was a much larger survey than the CCHS and involved around 12,000 respondents. We note that there are no significant differences amongst the two local areas and the Province.

Table 2. Self-reported general health status in selected areas, 1995. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

	% EXCELLENT + GOOD*
Newfoundland and Labrador	79
Port au Port Peninsula & Stephenville	77
Bay of Islands	77

*Equivalent to "Excellent + Very Good + Good" in previous tables since "Very Good" was not a choice in this survey.

While overall health is important, so too is mental health and the CCHS also reports on this health aspect using the same categorical breakdown for states outlined in Table 1 from "Excellent" to "Poor". Interestingly, the patterns noted previously regarding "Very Good" and "Good" general self-reported health status for Local Area 37 seem to be occurring here in mental health status. However, the percentage reporting "Excellent" mental health for the Bay of Islands and for Economic Zone 08 (Corner Brook-White Bay) and then for Economic Zone 09 (Stephenville-Burgeo) in the 2005 and 2003 period seems to be higher than the percentage for Canada or the Province.

²⁴ See the Appendix for a map of this zone.

²⁵ See the Appendix for a map of this zone.

Table 3. Self-reported mental health status in selected areas, 2003-2011. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

		MENTAL HEALTH				
		% Excellent	% Very Good	% Good	% Fair	% Poor
2011	Canada	35	37.2	22.1	4.6	1.1
	Newfoundland and Labrador	36.1	37.3	22.1	3.8	0.7
	Port au Port Pen & Stephenville	34.3	28	32.9		
	Bay of Islands		40.9	27.5		
2007-2008	Canada	39.1	35.5	20.5	4	0.9
	Newfoundland and Labrador	40.8	36.7	18.2	3.6	0.7
	Port au Port Pen & Stephenville	40.2	26.7	26.3		
	Bay of Islands	50.6	25.7	16		
2007-2008	Canada	39.1	35.5	20.5	4	0.9
	Newfoundland and Labrador	40.8	36.7	18.2	3.6	0.7
	Economic Zone 09 (Stephenville-Burgeo)	42.2	31.4	21.7	0.5	4.6
	Economic Zone 08 (Corner Brook-White Bay)	49	33.6	14.3		
2005	Canada	38	36.5	20.6	3.9	0.9
	Newfoundland and Labrador	39.7	37.4	19.3	2.8	0.8
	Economic Zone 09 (Stephenville-Burgeo)	43.7	33.3	17.3	3.2	2.5
	Economic Zone 08 (Corner Brook-White Bay)	44.4	31.5	23.4	0.7	
2003	Canada	38.6	35.1	21.7	3.8	0.8
	Newfoundland and Labrador	40	36.5	20.3	2.6	0.6
	Economic Zone 09 (Stephenville-Burgeo)	48.3	32.1	14.5	3.3	1.7
	Economic Zone 08 (Corner Brook-White Bay)	45.8	31.8	19.2	2.5	0.8

Administrative data can provide reliable information on the nature of the causes of health care treatments by municipality. Table 4 does this for the fiscal year 2008-09 for municipalities within the two selected local areas and presents the latest data available on these indicators in the Community Accounts. The number of cases as reported in the second column can refer to the same patient. The evidence presented in Table 4 indicates that the incidence of certain diseases is the same or somewhat lower than the provincial average. Other data indicate that over time those patients in hospital are getting older, and that female patients tend to be younger than their males counterparts by 8-10 years and somewhat more numerous. Moreover, as the population shrinks so does the number of patients even though the population is aging.

Table 4. Causes of health care treatments for selected municipalities²⁶ in relation to province²⁷, 2008-2009.

	TOTAL HOSPITAL MORBIDITY	RATIO TO PROVINCE: DISEASES OF THE CIRCULATORY SYSTEM	RATIO TO PROVINCE: DISEASES OF THE DIGESTIVE SYSTEM	RATIO TO PROVINCE: DISEASES OF THE RESPIRATORY SYSTEM	RATIO TO PROVINCE: DISEASES OF THE GENITOURINARY SYSTEM	RATIO TO PROVINCE: INJURY AND POISONING	RATIO TO PROVINCE: NEOPLASMS (CANCER)
Cape St. George (37)	170	0.93	0.3	0.97	1	0.45	0.43
Kippens (37)	390	1	1	1	1	0.79	0.95
Stephenville (37)	1705	1	0.93	0.71	0.91	0.94	0.99
Stephenville Crossing (37)	540	1	0.66	0.92	1	0.99	0.41
Cox's Cove (40)	230	1	0.89	1	0.75	1	0.96
Humber Arm South (40)	420	0.94	0.97	1	1	1	1
Lark Harbour (40)	195	0.81	0.79	1	1	0.79	1

Having discussed health indicators at the local level and for major communities within those areas we now turn our attention to the local area labour markets and real (2011\$) disposable incomes per capita. Figure 13 below shows the labour force using tax filer data for the two local areas under review. The Stephenville labour force shrank during the 1990s and around 2004 but is now growing²⁸. The Bay of Islands labour force has remained constant over time. At some point in the not too distant future, members of the current labour force will retire in increasing numbers.

²⁶ Maps locating these municipalities and indicating their approximate populations may be found in the Appendix

²⁷ This table was produced using data from the Government of Newfoundland and Labrador's Community Accounts. More detailed data are available as are rates per 1000 population.

²⁸ The 2011 data are the latest that are available in the Community Accounts.

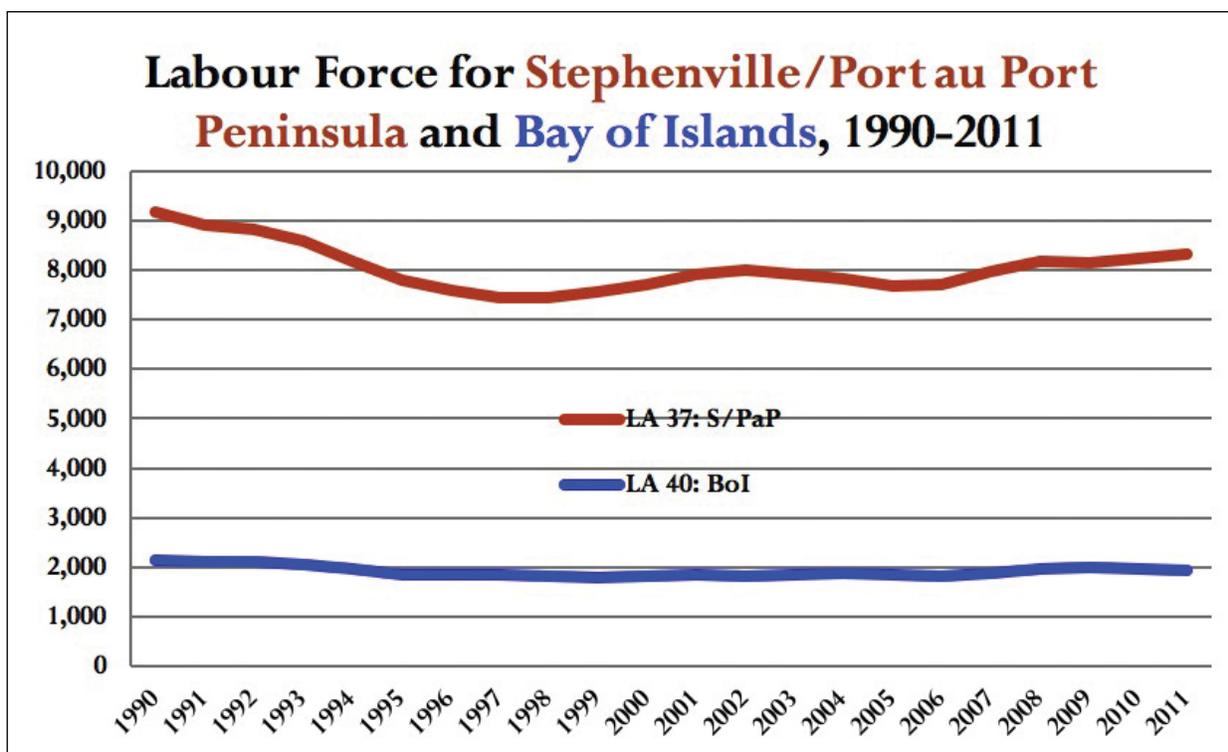


Figure 13. Labour force estimates for Stephenville/Port au Port Peninsula and Bay of Islands Local Areas, 1990-2011. Source: Community Accounts, Government of Newfoundland and Labrador (www.communityaccounts.ca).

While the OECD indicator for income relied on household disposable income in constant (inflation-adjusted) 2002 dollars, we have converted real disposable income per capita from the Community Accounts into 2011 dollars and shown this below. What is clearly demonstrated is that the standard of living in both communities has steadily increased over time. However, as workers retire this upward trend may reverse itself.

Comparing Figure 14 with the data in Table 1 shows that examining these simple relationships in isolation does not demonstrate that an increase in self-reported health status necessarily follows an increase in real income. To gain a better understanding of the complex relationship between income and health when other factors such as education, changing technology and access to public health care are present, more complex models are needed based on randomized surveys.

The “Determinants” of Health Using Statistical Modelling

A more scientific, evidenced-based approach to understanding the relationship between income, wealth and health requires more complicated regression modelling or simulation modelling, along with access to randomized survey data collected on the same individuals over a long period of time. Such data would be integrated with physician and hospital utilization records as well as those of all health care organizations and pharmaceutical records. To our knowledge such data are not available in our Province and to most researchers.

We are fortunate in being able to rely on three studies, however, for Newfoundland or Newfoundland and Labrador, which may provide some insights into the nature and strength of the relationship between income and health.

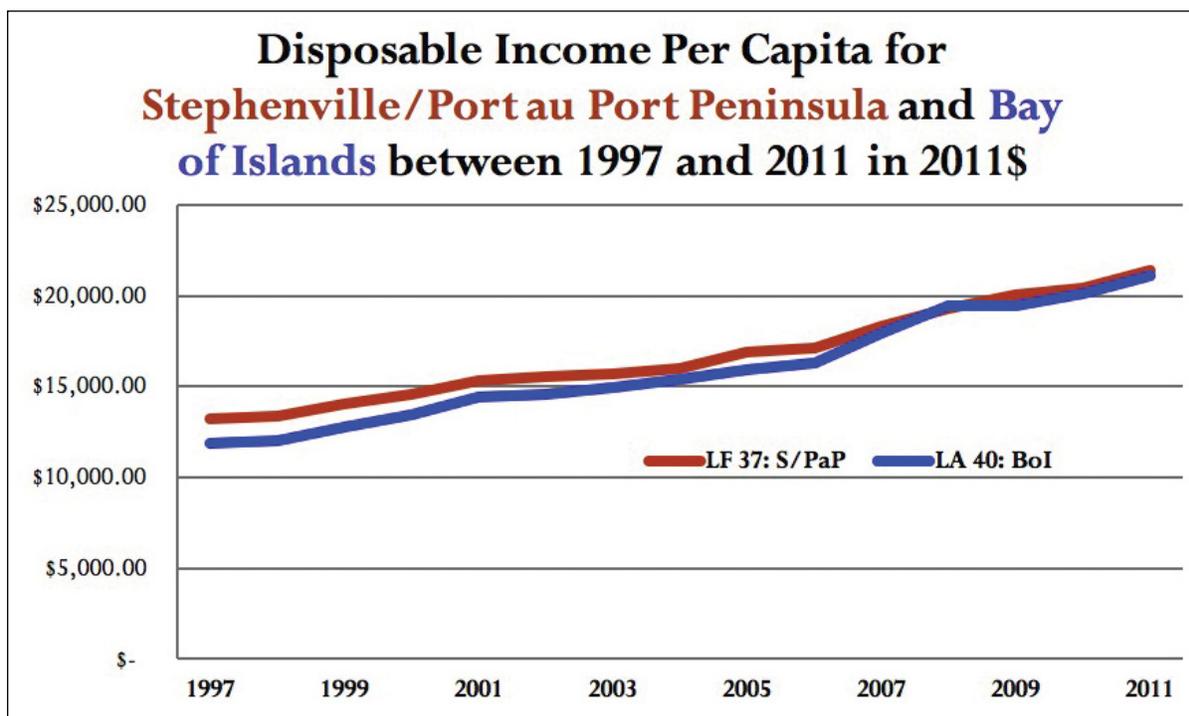


Figure 14. Disposable income per capita in 2011\$ for Local Area 37 (Stephenville) and Local Area 40 (The Bay of Islands), 1997-2011.

The first paper is one by (Gambin 2002) who completed an essay²⁹ under the direction of Dr. D. May as part of an MA in Economics requirement. The paper utilized individual respondent data collected for an Adult Health Survey (AHS³⁰) in 2001 for the Newfoundland and Labrador Statistics Agency. The survey size was 7,936 and Dr. Jorge Segovia was the primary advisor on the questionnaire design, as he had undertaken a similar survey in 1995³¹. The dependent variable was self-rated health status using the five categories already noted for the CCHS. Independent explanatory variables included demographic factors, financial/work-related factors including education level and financial stress, lifestyle factors, social factors and location by economic zone for Newfoundland³². (Gambin 2002) found income to be highly significant³³. For example, with an annual household reference income of \$15,000 or less, the probability of having self-assessed health status of "Excellent" or "Very Good" is 61.7%. If household income were to increase to the range of \$35,001 to \$45,000 then this same statistic would increase to 71.6% or almost 10 percentage points. Gambin pointed out that the greatest marginal impact on health status is associated with financial insecurity and stress. As the author highlighted, it is not only absolute income that is important but a "person's perception of [his or her] financial circumstances has a great effect on health as well."³⁴

The second paper is by (Rogers 2005), who carried out the study for GPI Atlantic financed under a Health Canada, Health Policy Research Program. The research focused on the importance of income-related health inequality

²⁹ This essay is available on the Community Accounts website at nl.communityaccounts.ca/ReferenceDocuments/MastersEssayFinal1.pdf.

³⁰ D. May was the chair of the questionnaire design group for this survey, which was part of a data gathering effort for the Strategic Social Plan and its System of Community Accounts.

³¹ Data for both surveys are available either from the Newfoundland and Labrador Statistics Agency or from the Faculty of Medicine at Memorial University.

³² Data on Zone 6 on the tip of the Northern Peninsula was not surveyed.

³³ Using an ordered logistic regression model

³⁴ (Gambin 2002), p. 37

(IRHI). Here, health inequality refers to the lower health status that exists amongst those groups in society with a lower socioeconomic status. Health status in this study was measured by self-assessed health status. Income was measured as disposable household income³⁵, i.e., including government transfers but net of taxes on an equivalent basis³⁶. His results for Newfoundland were based on four surveys that were conducted in Newfoundland between 1985 and 2001 and two studies that were conducted by GPI Atlantic in Nova Scotia.

Rogers found that the health inequalities for Newfoundland were higher than for most countries and for Canada. For example, he estimated that by 1990, health inequalities in Newfoundland were on a par with those of the United States. His study also observed that this pattern seemed to be persistent over the period of study.³⁷ These inequalities were reduced by 1995. Interestingly, the work by (Locke, et al. 2015) indicated that the most rapid period of rising income inequality in Newfoundland and Labrador was between 1985 and 1995.

(Rogers 2005) divided his data for Newfoundland into the four community health boards for the Island. The Grenfell Board, which included Labrador as well as the tip of the Northern Peninsula, was not examined. Rogers' methodology included in the use of concentration indices to measure the degree of inequalities as well as regression analysis to determine the relative importance of the "determinants" of health status.

In his executive summary, Rogers stated: "The contribution of income alone accounts for between one-third and one-half of the measured socioeconomic health inequality in the locations studied."³⁸ Rogers also noted that "income is the single most important contributor to socioeconomic inequality in health in Newfoundland."³⁹ Other factors that helped to explain the presence of socioeconomic health inequality were employment status and university education. The presence of a long-term disability or restrictions on daily activities also contributed to greater socioeconomic inequality in health. When examining Newfoundland, Rogers followed (Gambin 2002) when using data from the NLSA's 2001 Adult Health Survey, and introduced a financial insecurity variable⁴⁰. The introduction of this variable reduced the explanatory power of income when the household is "just getting by".

Rogers stated: "The main limitation of this study concerns the issue of causality between the health determinants used to measure and decompose IRHI and individual health status."⁴¹ However, citing many studies Rogers concluded "that changes in income do lead to changes in health status and that low income is a cause of poor health."⁴² Still, he noted that studies are needed that have access to good longitudinal data, that is, data that follows an individual over his or her lifetime. We agree. To our knowledge such data for Newfoundland are not available.

The final study for Newfoundland and also Labrador that uses statistical techniques on cross sectional data is a work in progress by Hoskins and May. It is part of a "determinants of determinants" approach in which the ultimate variables to be determined are individual or collective well-being. The initial paper on determinants by (Hoskins and May 2014b) focused on Life Satisfaction or individual well-being. That paper used data for Newfoundland and Labrador from the Share File⁴³ of the 2011-2012 CCHS. Data were restricted to respondents 15 years of age and

³⁵ Current thinking would be to use disposable income adjusted to include social transfers in kind. In particular, those transfers related to health and education should be included when the health care system is primarily a public one. Such data are difficult to come by in Canada.

³⁶ Household income is divided by the square root of the household size and each individual is assigned that adjusted income. This is the standard methodology used by central statistical agencies.

³⁷ These patterns exhibit far greater health inequalities than those discussed in Figure 10. That figure is based on the work-in-progress of Hoskins, which uses a more sophisticated inequality measurement and data from a more recent time period.

³⁸ (Rogers 2005), p. iii

³⁹ Ibid, p. iii

⁴⁰ This variable is not normally available in health surveys but we inserted it.

⁴¹ (Rogers 2005), p. 57

⁴² (Rogers 2005), p. 57

⁴³ The share file contains data for those respondents who have agreed to share their personal data with Statistics Canada partners.

older; the resultant sample size was 3,267⁴⁴. To quote (Hoskins and May 2014b): “The most significant variables in the pairwise regressions⁴⁵ would seem to be marital status and the subjective variables self-rated health, self-rated mental health, sense of belonging to community and self-rated life stress.”⁴⁶ When one moves to the more complex models, equivalent household income is not significant in explaining life satisfaction, although self-rated health, self-rated mental health and self-rated life stress are. One explanation is that income is highly correlated with one or all of self-rated health, mental health and stress, and its association with life satisfaction is captured via those variables.

However, this review focuses on the relationship between income, wealth and health rather than life satisfaction. What do Hoskins and May in their current work in progress on the determinants of self-reported health status⁴⁷ have to say about this relationship for Newfoundlanders and Labradoreans using 2011-12 health data? Well, where you are in the income distribution is important. At lower incomes doubling equivalent household income will have a greater impact on your health status than if your income were higher, i.e., the relationship between income and self-reported health status is nonlinear. Recall that self-reported health status correlates closely with mortality and morbidity, that is, people who report their own health as poor are more likely to die or end up in hospital. Our results with respect to the relationship with income seem to be consistent with (Gambin 2002) and (Rogers 2005) and therefore consistent over time. A major contribution of this study is the importance of establishing where you are in the income distribution, as many other researchers have casually argued.

Summary and Conclusions

The focus of our review is on the relationship between income, wealth and health. There is a wealth of literature that argues and provides evidence that there is a positive relationship between income, wealth and health. The higher one's income then the more likely one is to be in better health. It could also be argued that the better health one is in then the higher one's income is likely to be, since, for example, those in better health retire later. Organizations such as the World Health Organization (WHO) and the federal Public Health Agency of Canada have taken the “deterministic” view that on balance income determines health. Many researchers have supported this perspective by taking a psychosocial or neo-materialistic analytical approach.

What evidence is there on the relationship between income and health specifically in Newfoundland and Labrador? At the provincial level, we find loose evidence for a positive relationship using aggregate data and looking at a simple relationship involving the most commonly used annual indicators for income and health. Higher income is generally associated with better health status, although this relationship may not hold over short periods of time, possibly because of changes in other determinants of health. We do find that both the average estimated health status for the population and average disposable income have increased in Newfoundland and Labrador over the period from 2000-2013. At times, however, the average self-rated health status estimated for the population of our Province has decreased when income has increased. In terms of our ranking with respect to these two indicators amongst the provinces, we find that we are situated slightly higher than the Canadian averages. Using the latest available data we have moved into fourth position in terms of household disposable income and third position for self-rated health status amongst the Canadian provinces.

Much has been discussed in the literature and the media about the health gradient, that is, that inequalities in health status are related to the inequalities in socioeconomic status. Using the latest techniques available to measure inequalities in health status and citing the work in progress by Hoskins on health inequalities, we learn that, in stark

⁴⁴ To protect the confidentiality of participants Statistics Canada uses a complex survey design.

⁴⁵ More complex regressions models were run, including multivariate ordinary least squares, ordered logistic regression and generalized ordered logistic regression.

⁴⁶ (Hoskins and May 2014b), p. 22

⁴⁷ This work obviously builds on the work of (Hoskins and May 2014b) since self-rated health status replaces life satisfaction as the dependent variable to be explained.

contrast to the work of (Rogers 2005), health inequalities in Newfoundland and Labrador are amongst the lowest in Canada. While they have increased somewhat lately, the inequalities are not high by provincial or national standards. This finding is similar to that for family equivalent household income for the Province.

We noted that it is difficult to obtain reliable self-reported health status data at the local area or regional level due to small sample sizes. However, when we do focus on two local areas, the Port au Port/Stephenville area and the Bay of Islands local area, then the former area seems to have a smaller percentage of the population in "Very Good" health compared to the provincial and national profile. The Bay of Islands, on the other hand, seems to have a larger percentage of its population experiencing "Excellent" health. Once again, we point out that these conclusions are based on a few observations and therefore subject to potentially large sampling variability.

Nevertheless, there should be a close association with hospital utilization data for the same local areas. Hospital morbidity data are administrative census data and therefore more reliable. These hospital data show little reason for concern since the results for major disease categories are at the provincial level or better. And while constant dollar disposable incomes per capita are somewhat lower than the provincial average, they have been constantly increasing over the past decade and a half. In an ideal world one would like to know something about the disposable household incomes and family sizes of patients using hospitals but, of course, such data are not collected by our public health system.

While aggregate data of this sort can provide trends, good stories and apparent "stylized facts", they do not provide the evidence generated through the use of advanced statistical techniques based on a large number of cross-sectional observations (for individuals) over a large number of variables. Our statistical models seem to be consistent with common sense in that there can be a number of socioeconomic variables that can affect an individual's overall self-reported health status. Happily, the three studies that we have examined in our review seem to provide evidence consistent with one another and with empirical analyses carried out elsewhere. In our opinion, the work in progress by Hoskins and May on the determinants of health status, which uses the most advanced statistical methodology as well as relatively recent data, offers the most accurate estimates for Newfoundland and Labrador of the association of rising incomes and improved self-reported health status⁴⁸. The evidence to date is clear: there is a highly "significant"⁴⁹ positive association between income and health in Newfoundland and Labrador that seems to exist over time.

The issue of causality is one of concern, although the evidence to date would seem to support the view that generally income is a determinant of health rather than the reverse. However, one can easily construct situations where clearly the reverse is possible⁵⁰. In our opinion, what is required is the availability of more longitudinal data to assist in answering the causality question. Such data would track individuals' income and health over longer periods of time, and in the limit, over a lifetime.

In this review we have not dealt with wider issues such as the source of income. For example, does it come through employment income, capital income or through transfers? Of greater importance, we suspect, is the timing of the increase in income in an individual's life. We postulate the earlier in one's life that you receive the benefits of higher household incomes the greater the effect is in improving health over a lifetime.

We hope that this review will not only inform but also promote interest and discussion of the relationship between income, wealth, and health, an often-overlooked area in the very important policy arena.

⁴⁸ D. May was involved with all three studies and helped to design the 2001 Adult Health Survey.

⁴⁹ "Significant" in a statistical sense

⁵⁰ People retire early because of poor health and their incomes are therefore lower.

PART 3: CONSIDERATIONS WITH RESPECT TO DATA REQUIREMENTS, METHODOLOGIES AND RESEARCH EFFORTS FOR BETTER UNDERSTANDING THE HEALTH BENEFITS FROM INCREASES IN INCOME AND WEALTH

We are breaking our considerations into three interconnected parts: data needs, desirable statistical methodologies, and analytical modelling. In summary, we need to start with good data, which means being able to track the relationship between income and health at an individual level over time⁵¹, for a representative sample of the population of interest. However, while good data are needed, data alone are not sufficient for understanding any association between income and health. We also require the appropriate statistical methodology. Our brief description of such methodologies, for example those used in the current research efforts of Hoskins and May, shows that estimation techniques are relatively sophisticated and constantly evolving. It should be understood these sophisticated regression techniques quietly assume causality mechanisms and mathematical relationships which may not always hold⁵². Finally, we must recognize that the data and the regression techniques are simply the means to an end, which is trying to understand the nature of the relationship between income and health⁵³.

More and Better Data

In our review of the literature in Part 1 and research efforts related to Newfoundland and Labrador in Part 2, it was clearly established that the impact of income on health is dependent on other characteristics of the individuals in the sample or population. Recall that these characteristics include gender, age, marital status and level of physical activity. Other factors to consider are occupation and financial security⁵⁴.

We must clearly identify the population of interest, that is, the population that includes the individuals whose incomes are likely to change because of some event. In other words, it is important to know who would be likely to receive a direct benefit in the region either by being employed or self-employed. Because the financial resources of workers are shared within their households, data on household members also need to be collected. As noted previously, the income impacts on health are probably the greatest in childhood.

Given the income data presented in Part 2 of this Review, it is clear that individual households in the geographical areas of interest are already experiencing increased incomes. Therefore, in measuring the impact of an event, it's important to distinguish between the health benefits associated with estimated increases in household equivalent incomes that would have occurred in any case, and those specifically associated with the event. This sort of "difference-in-difference" analysis requires the collection of data for a "control" group, that is, a group of individuals whose incomes would not be affected by the same event.

There is also a need to build on the local/community data collected currently by Statistics Canada's Canadian Community Health Survey (CCHS) or by the Newfoundland and Labrador Statistics Agency (NLSA) in their own surveys⁵⁵. It may be possible to produce more local data using Small Area Estimation techniques currently being developed at Statistics Canada.

In Part 2 of this Report, we noted that it would help our understanding of the associations between income and health

⁵¹ For income and health data, the time period would be as long as possible and, in the limit, over the lifetime of the individual.

⁵² For example, a linear model may be used when the relationship between income and health may be better described by a nonlinear model. By nonlinear, we mean that an increase in income to someone in poverty is likely to result in a greater improvement in health than the same increase in income to someone whose income is in the top 1%.

⁵³ We would also include income inequalities and the health gradient in these investigations.

⁵⁴ This variable may even be better than estimates of wealth since it seems to capture the extent to which the individual can secure resources not only from within the household but also from friends and family.

⁵⁵ The NLSA does have a survey unit and they did oversee the collection of the 2001 Adult Health Survey for Newfoundland.

if we could relate subjective health status to objective health indicators at the provincial and regional levels. For example, we could link self-reported health status to the prevalence of a specific illness. Some limited data linkage does occur between the survey data, administrative hospital morbidity data, and administrative physician utilization data. Dr. Jorge Segovia, who was in the Community Health Division of Memorial's Faculty of Medicine, attempted such linkages with his survey data and was a leader in this area. The National Population Health Survey (NPHS) also moves in this direction and could be expanded.

While some aspects of survey and administrative data are available, restrictions are placed on these data to maintain privacy. Furthermore, additional collection of income data is not required by health care administrators in a public health care system. Privacy restrictions may limit the availability of data to academic researchers, even though Statistics Canada's Research Data Centres are located in Canada's major universities, including Memorial University. These trade-offs should be closely examined, as should opportunities for further co-operation between federal and provincial agencies and departments, since each has some access to health statistics and/or socioeconomic survey data. The recommendation here is to continue the move towards linked longitudinal data and then subsequently investigate ways to increase access to these data by academic researchers while addressing privacy considerations.

A final recommendation in this section relates to the association between "income" and health. We have stated that the correct definition of income uses household income after tax (plus direct government transfers) in constant (inflation-adjusted) dollars, which is then converted to equivalized units for the individual. The Organisation for Economic Co-operation and Development (OECD) goes one step further and introduces a measure that was proposed⁵⁶ for the NLSA's Income Domain in its System of Community Accounts. The proposal was to include social transfers in kind as a component of personal and household income. This is because it is very important to differentiate between those who have to pay for health care expenses out of their after-tax income and those that do not. In some societies individuals will not receive potentially beneficial health care because they cannot afford it. Given the availability of provincial administrative records including tax, health and education records, it is possible to link social transfers in kind to the family. Moreover, the NLSA, in constructing the Newfoundland and Labrador Market Basket Measure (MBM) of low income, internally estimates the out-of-pocket expenses associated with health care for individuals.

If, as Napoleon Bonaparte said, "an army marches on its stomach", then applied researchers drink data. Generally, the more data the better the analysis results, but it must be good data. Otherwise, as Fuechsel stated, it's "garbage in, garbage out". That said, we recognize that there are privacy and coordination issues that may make some of these suggestions difficult to implement, but it's important to point out what further data would be useful as there may also be some quick wins.

New Statistical Methodologies

Applied statistics and the associated software packages such as STATA 14 are constantly evolving⁵⁷. To our knowledge, the generalized ordered logistic model and STATA routines⁵⁸ that we are using currently in our determinants of self-reported health are the most advanced available⁵⁹. We also believe this to be true of our self-reported health inequalities that use the Naga-Yalcin methodology for ordered categorical variables.

⁵⁶ By D. May

⁵⁷ As the number 14 after STATA should indicate.

⁵⁸ Gologit 3

⁵⁹ Writing up the results and then submitting them to a peer-reviewed journal is a good way to test this statement.

Discussion with a colleague who is an econometrician has pointed to the possibility of improving the bootstrapping technology we currently employ and combining CCHS data sets.

While both these observations may be interesting, they do not result in recommendations to the panel.

Additional Research Efforts

Two areas of concern that should be tackled are the causality issue and the linkage between subjective and objective measures of health status.

The causality issue can be resolved by the use of longitudinal data so long as there is no concurrent change in other circumstances affecting self-assessed health across the population. However, when other circumstances do change, such as changes to the physical environment, we need to use a framework that allows us to discount the effect of factors other than income. In some cases, access to more detailed administrative records might resolve the issue.

The other aspect of this modelling process is to better understand the transmission mechanism from changes in income to changes in health. This seems to be somewhat of an interdisciplinary problem but perhaps is best led by health researchers and psychologists.

The work by Hoskins and May on the determinants of health status is a first effort but needs to be written up so that it is open to scrutiny. In continuing this research, it would be useful to introduce occupation since that information ties in more directly to the nature of the impact which might occur with the hydraulic fracturing development. Another line of inquiry is to better understand the relationship between various health indicators, that is, subjective measures relating to general and mental health, and objective measures such as mortality rate and incidence/prevalence of specific illnesses, in the provincial and perhaps local/regional context.

A General Thought

The considerations/observations outlined above are very general in nature. Income inequalities and any health gradient, as well as associations between the levels of income and health, are tied to the largest expenditure by the provincial government, namely those expenditures related to health care. More importantly, health is the area of well-being that has been identified as being the most important to Newfoundland and Labrador's populace. In our opinion, a better understanding of the nature and strength of the relationship between income, wealth and health is needed at all levels.

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APPENDIX

Table 5. Predicted probabilities of self-assessed health outcomes. Source: (Gambin 2002), Table 4.7.

	VARIABLE	PROBABILITY OF SAH OUTCOMES				
		Pr(poor)	Pr(fair)	Pr(good)	Pr(very good)	Pr(excellent)
Total Annual Household Income	\$15,000 or less	0.020465	0.096295	0.266595	0.495212	0.121433
	\$15,001 to \$20,000	0.018524	0.088157	0.252952	0.507668	0.132699
	\$20,001 to \$25,000	0.014177	0.069228	0.216278	0.533096	0.167220
	\$25,001 to \$30,000	0.014250	0.069553	0.216972	0.532727	0.166498
	\$30,001 to \$35,000	0.016456	0.079275	0.236649	0.520431	0.147189
	\$35,001 to \$45,000	0.013167	0.064686	0.206344	0.537886	0.177917
	\$45,001 to \$55,000	0.012926	0.063594	0.203886	0.538924	0.180671
	\$55,001 to \$75,000	0.013138	0.064553	0.206046	0.538015	0.178248
	\$75,001 to \$100,000	0.010716	0.053426	0.179611	0.545769	0.210477
	More than \$100,000	0.009437	0.047415	0.164013	0.546524	0.232612
Employment Status	Not employed for pay	0.020465	0.096295	0.266595	0.495212	0.121433
	Self-employed	0.012964	0.063763	0.204269	0.538766	0.180238
	Employed by company	0.013800	0.067539	0.212638	0.534960	0.171062
	Retired	0.019242	0.091186	0.258171	0.503096	0.128305
	Student	0.011042	0.054941	0.183391	0.545133	0.205494
Age	18-24 years	0.020465	0.096295	0.266595	0.495212	0.121433
	25-34 years	0.017213	0.082553	0.242845	0.515852	0.141537
	35-44 years	0.019483	0.092200	0.259879	0.501548	0.126891
	45-54 years	0.025015	0.114649	0.293257	0.465912	0.101168
	55-64 years	0.027526	0.124367	0.305291	0.450240	0.092576
	65+ years	0.029662	0.132407	0.314256	0.437361	0.086314
Financial Security	Very good	0.020465	0.096295	0.266595	0.495212	0.121433
	Good	0.026969	0.122234	0.302765	0.453673	0.094359
	Satisfactory	0.031880	0.140552	0.322482	0.424463	0.080623
	Just getting by	0.037318	0.159647	0.338668	0.395037	0.069329
	Can't cope	0.061356	0.231227	0.367861	0.297248	0.042309
Stress in Daily Life	Not at all stressful	0.020465	0.096295	0.266595	0.495212	0.121433
	Not very stressful	0.028375	0.127587	0.308986	0.445067	0.089985
	A bit stressful	0.042121	0.175548	0.349140	0.371568	0.061624
	Quite a bit stressful	0.062626	0.234499	0.368201	0.293242	0.041432
	Extremely stressful	0.098537	0.310315	0.355993	0.209416	0.025738
Education	Less than or some high school	0.020465	0.096295	0.266595	0.495212	0.121433
	High School diploma	0.018903	0.089761	0.255737	0.505258	0.130340
	Some university/college	0.017397	0.083342	0.244305	0.514724	0.140232
	Community/tech college diploma	0.018685	0.088839	0.254142	0.506646	0.131687
	University degree	0.015251	0.073996	0.226212	0.527385	0.157156
	Postgraduate	0.013007	0.063961	0.204716	0.538580	0.179736

	VARIABLE	PROBABILITY OF SAH OUTCOMES				
		Pr(poor)	Pr(fair)	Pr(good)	Pr(very good)	Pr(excellent)
Marital Status	Single-never married	0.020465	0.096295	0.266595	0.495212	0.121433
	Married	0.020303	0.095623	0.265513	0.496260	0.122301
	Common-law	0.013601	0.066641	0.210679	0.535912	0.173167
	Widowed	0.013361	0.065562	0.208298	0.537019	0.175760
	Separated/divorced	0.016543	0.079652	0.237373	0.519913	0.146519
Drinks?	Drinks alcoholic	0.017128	0.082183	0.242156	0.516377	0.142156
Sex	Female	0.016755	0.080572	0.239127	0.518639	0.144906
Smokes?	Smoked regularly	0.028231	0.127043	0.308372	0.445940	0.090414

Table 6. Regression estimates of the determinants of self-reported health status in Newfoundland and Labrador, (2011-12). Source: Work in progress of Hoskins and May.

	ORDERED LOGISTIC REGRESSION	GENERALIZED ORDERED LOGISTICS REGRESSION		
		Fair/Poor vs (Good, Very Good and Excellent)	(Fair/Poor and Good) vs (Very Good and Excellent)	(Fair/Poor, Good and Very Good) vs Excellent
Gender (reference: Men)				
Women	1.471***	1.465*	1.531***	1.451**
Age	0.998	1.060	0.979	0.989
Children under 12 (reference: None)				
One	1.249	3.506**	1.315	1.017
Two or more	1.382	1.779	1.376	1.302
Log base two household equivalent income	1.271***	1.327**	1.330***	1.181*
Education (reference: Less than secondary)				
Secondary	0.837	0.665	0.891	0.735
Some postsecondary	1.639	1.449	1.616	1.623
College diploma	0.939	1.021	0.893	0.882
University degree	0.948	0.611	1.134	0.847
Marital status (reference: Married)				
Living common-law	0.771	0.348**	0.700	1.189
Widowed	1.209	1.534	0.999	1.501
Divorced or separated	1.387	0.942	1.149	2.036**
Single	1.156	1.810	0.870	1.360
Employed (reference: Employed)				
Unemployed	0.564***	0.366***	0.601***	0.568***
Owner (reference: Renter)				
Owner	1.021	1.199	0.898	1.179
Physical activity (reference: Inactive)				
Moderately active	1.036	0.971	1.227	0.791
Active	1.789***	1.962*	1.845***	1.680***

	ORDERED LOGISTIC REGRESSION	GENERALIZED ORDERED LOGISTICS REGRESSION		
		Fair/Poor vs (Good, Very Good and Excellent)	(Fair/Poor and Good) vs (Very Good and Excellent)	(Fair/Poor, Good and Very Good) vs Excellent
Smoking (reference: Non-smoker)				
Smoker	0.807	1.013	0.890	0.605**
Heavy drinking (reference: Not heavy drinker)				
Heavy drinker	1.164	1.353	1.144	1.146
Chronic conditions (reference: No chronic condition)				
Chronic condition	0.451***	0.406**	0.513***	0.355***
Food security (reference: Food secure)				
Moderately/Severely food insecure	0.783	0.615	1.100	0.407
Life satisfaction (reference: Dissatisfied/Very dissatisfied)				
Neither satisfied nor dissatisfied	1	2.004	0.815	5.317
Satisfied	2.121	6.103***	1.557	6.291
Very satisfied	5.315***	9.738***	2.648	12.15
Self rated mental health (reference: Poor/Fair)				
Good	2.234**	2.506*	2.277*	7.455
Very Good	4.768***	4.360***	6.441***	8.730
Excellent	7.600***	4.581***	8.528***	20.31
Sense of belonging to community (reference: Very weak)				
Somewhat weak	1.155	1.132	1.250	1.288
Somewhat strong	1.032	1.171	1.402	0.663
Very strong	1.458	1.437	1.772	1.152
Self-rated life stress (reference: No stress)				
Not very much	0.893	1.834*	1.087	0.680*
A bit of stress	0.655**	0.633	0.741	0.645*
Quite a bit/extreme	0.827	0.726	0.957	0.870

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

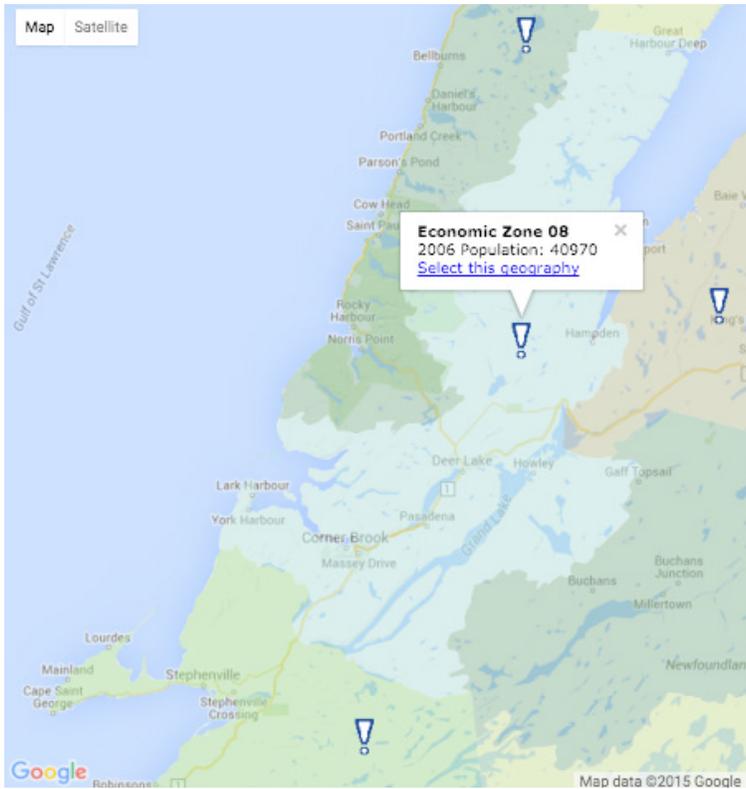


Figure 15. Zone 08 (Bay of Islands, Corner Brook to Great Harbour Deep). Source: Community Accounts, Government of Newfoundland and Labrador.

Figure 16. Zone 09 (Port au Port Peninsula to Ramea). Source: Community Accounts, Government of Newfoundland and Labrador.



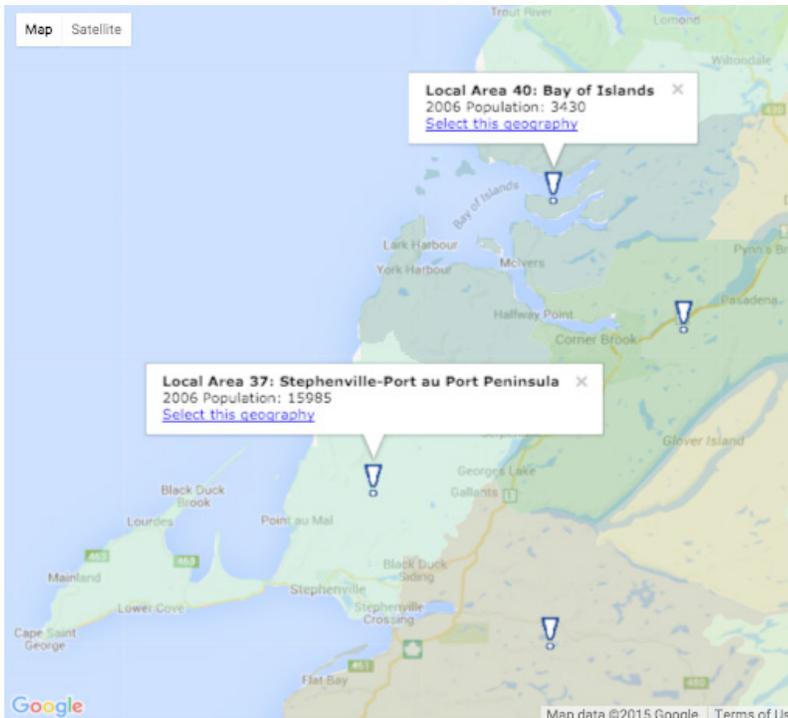


Figure 17. Map of Local Areas 37 and 40. Source: Community Accounts, Government of Newfoundland and Labrador.

Figure 18. Map of the municipalities of Cox's Cove, Lark Harbour and Humber Arm South with their estimated populations in 2012. Source: Community Accounts, Government of Newfoundland and Labrador.

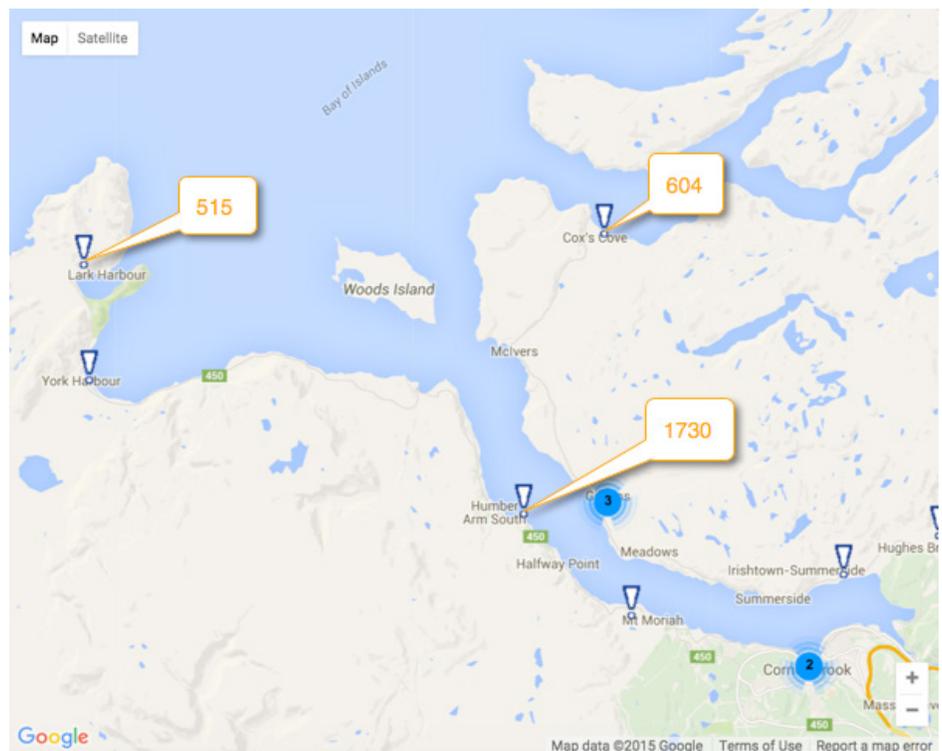


Figure 19. Map of the municipalities of Cape St. George, Kippens, Stephenville and Stephenville Crossing with their estimated populations in 2012. Source: Community Accounts, Government of Newfoundland and Labrador.

