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CENTRE FOR THE STUDY OF LIVING STANDARDS

STATE OF THE EVIDENCE ON HEALTH AS A DETERMINANT OF PRODUCTIVITY

CSLS Research Report 2011-04

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State of the Evidence on Health as a Determinant of Productivity

Abstract

Canada's labour productivity performance has been abysmal since 2000, both relative to our historical experience and to that in the United States. In theory, a deterioration of the health status of Canadian workers could explain slower productivity growth. However, the evidence does not support this hypothesis. Nevertheless, there is no doubt that illness and disability impose a massive indirect economic burden on the Canadian economy because many persons of working age are unable to work. Canada's potential level of 'social productivity' is lower because of this situation. This is an *output* shortfall issue, not a conventional productivity issue, and it is important not to confuse the two.

State of the Evidence on Health as a Determinant of Productivity

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State of the Evidence on Health as a Determinant of Productivity

Foreword

Over the past fifteen years, Canada's productivity performance has been modest, and policy attempts to improve it have had limited success. One potential explanation for this lies in the fact that many determinants of productivity (other than labour, capital and innovation) remain to be identified and clearly understood.

The Policy Research Initiative (PRI) – the policy research organisation of the federal government of Canada – is leading a project that concentrates on those determinants that may not have a direct or immediate effect on Canadian productivity performance but that may have a significant impact through a complex system of relationships, or possibly by influencing the effectiveness of more traditional policy levers. The PRI provides a forum for federal departments and agencies to collaborate on questions of productivity. This forum is essential for the development of policies that encourage productivity growth, given that the productivity question often concerns several departments simultaneously.

The Public Health Agency of Canada is participating in the PRI productivity project. The Agency commissioned the current report to examine the impact of population health on productivity and the growth of the Canadian economy. The mandate of the Public Health Agency of Canada includes promoting and improving the health of Canadians by addressing the social determinants of health[1] and by reducing health inequalities. Part of this work involves expanding the knowledge base with respect to the economic consequences of ill health and health inequalities on the quality of life of Canadians in order to inform future policies and priorities. The current report lays a foundation for identifying pathways from better health to higher productivity and economic prosperity in Canada.

The strengths of the report are two-fold. First, it clearly identifies the impact of health on traditional measures of productivity, such as output per worker and output per hour worked, through presenteeism (present at work while sick), absenteeism (absent from work due to illness) and through the ability to attain education. Second, the authors distinguish a so-called "social productivity" – the *potential* output in the economy which could be achieved by bringing those in poor health and thus, unable to work, into the labour force. These potential gains in output, in the authors' opinion, would have a significant contribution to the Canadian economy, perhaps even more significant than that due to reduced absenteeism and presenteeism. This report calls for future research in this area to identify and measure the impact of the above factors on the

[1] The *social determinants of health* – the conditions under which we live and work – can have a greater impact on health outcomes than factors such as genetics, lifestyles or the health care system. The social determinants of health include income and socioeconomic status, social support, education and literacy, employment and working conditions, social and physical environments, personal health practices and coping skills, early childhood development, gender, and culture.

growth of the Canadian economy. It also invites us to reflect on a broader role that various sectors of the economy could play to improve the health of Canadians by investing in the social determinants of health.

We invite comments and ideas on the content of the report. Please forward your thoughts to Andrew Sharpe at the Centre for the Study of Living Standards.

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State of the Evidence on Health as a Determinant of Productivity[2]

I. Introduction

It is widely recognized that health and productivity are key determinants of quality of life. Good health allows individuals to lead long lives free from excessive pain and discomfort, while robust productivity growth is the long-run driver of increased access to material goods and services. But in addition to their independent effects on quality of life, health and productivity are themselves interrelated in ways that have important implications for living standards and public policy. The relationship between health and productivity, and the policy implications of that relationship, are the focus of this report.

This report addresses the role of health as a determinant of productivity and the potential for health policy to promote productivity growth in Canada. There are two motivating questions. First, is Canada's poor productivity performance since 2000 – both relative to Canada's historical trend and relative to the post-2000 performance of the United States – in any way explained by changes in the health of Canadians? Second, can improvements in the health status of Canadians, either policy-induced or not, contribute to improving Canada's productivity performance in the future?

The health-productivity relationship has other dimensions, including the impact of improved productivity growth on the private and public resources that can be devoted to health (Joumard, 2009); the socioeconomic determinants of health (Heymann *et al.*, 2006); the role of the workplace in the health of Canadians (Sharpe and Hardt, 2006); the appropriate measurement of output and productivity in the health sector (Sharpe *et al.*, 2007; Schreyer, 2010); and the economic burden of illness (Public Health Agency of Canada, 2009). These are important issues in their own right, but they are beyond the scope of our discussion.

In addition, our analysis maintains a focus on the developed country context most relevant to modern Canada. It is common for those who study the economic impact of health either to take a historical perspective within developed countries (e.g. did health improvements promote economic growth in Canada since 1800?) or to focus on the contemporary experience of developing countries (e.g. would health improvements promote economic growth among today's least-developed countries?). While research on these issues is important, we exclude it from our discussion unless it is directly applicable to the modern Canadian context.

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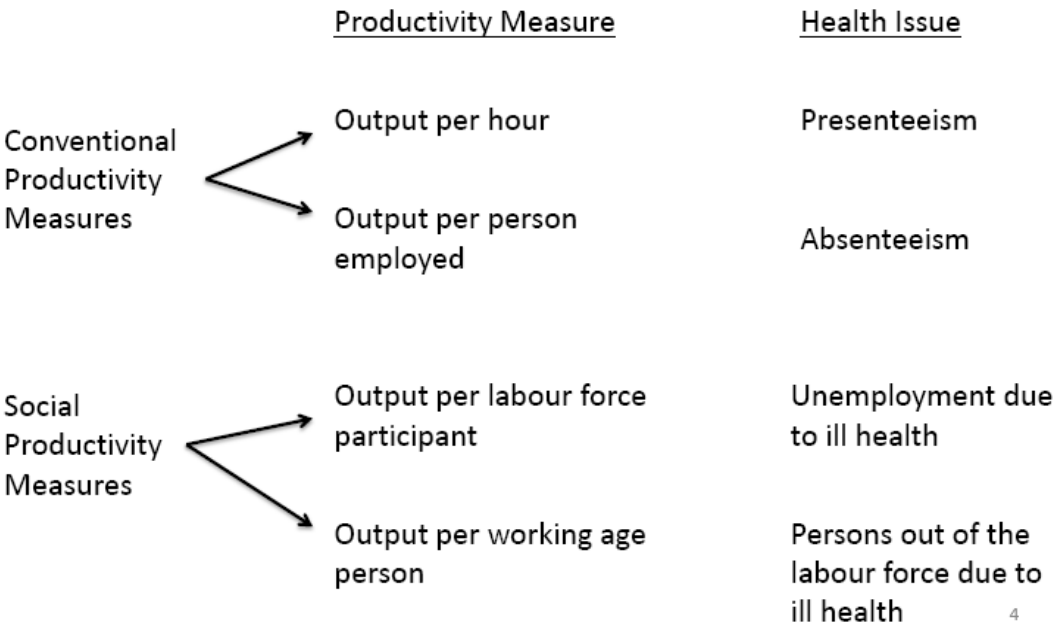
[2] The authors are Executive Director and Economist, respectively, at the Centre for the Study of Living Standards (CSLS). This report was presented at the Workshop on Health as a Determinant of Productivity on March 8, 2010, at the Lord Elgin Hotel in Ottawa, Canada. The authors thank Jean-Francois Abgrall, Linda Jacobsen, Olga Milliken and Jack Triplett for comments on earlier drafts, and Eric Thomson of the CSLS for research assistance. E-mails: andrew.sharpe@csls.ca; alex.murray@csls.ca.

Exhibit 1: Definitions of Productivity in View of the Impacts of Health



It is important to keep this report narrowly focused because the issue of health as a driver of productivity is complex enough on its own. Productivity is defined as output per unit of input, and a society's productivity can be measured in several ways depending on what we choose to consider as inputs. In addition, a large number of proxy measures for health status may be used. Each health proxy may capture different aspects of a society's general health, and each may have a different relationship with the various productivity measures.

In Exhibit 1, we illustrate this complexity in a manageable form. The two conventional productivity measures are output per hour worked and output per person employed (or 'per worker'). Presenteeism (that is, workers going to work while sick) affects output per hour worked, while absenteeism (workers missing work due to sickness) reduces output per worker. 'Social' measures of productivity take a broader view of who is counted as an input; they include output per labour force participant and output per working age person. Unemployment and labour force nonparticipation due to illness or disability can affect these social productivity measures. Note that each of the health issues in Exhibit 1 can encompass any number of specific illnesses, disabilities, and physical, mental or social conditions.

The literature identifies four main pathways by which health status can influence productivity (Bloom and Canning, 2000). These are:

1. *Direct impact on labour quality.* Healthy workers have high physical stamina and mental acuity relative to less healthy workers and are therefore likely to be more productive for a given number of hours worked.

2. *Incentive for educational investment.* Poor health is a barrier to school attendance and to the ability of students to learn while in school. Improved health removes these barriers. In addition, higher life expectancy increases the lifetime return to investment in education early in life.

3. *Incentive for savings and capital investment*. Longer life expectancy provides an incentive for greater retirement savings, since people expect to live longer after retirement. Higher savings translates into higher capital investment and higher productivity.

4. *Demographic Effects*. Greater survival rates for young children may reduce fertility and eventually lead to an increase in the proportion of the total population that is of working age. Female labour force participation may also rise as fewer births are required to achieve a given expected number of surviving children. These changes increase per-capita output.

In the context of a modern developed country, the first and second pathways are likely to be the most relevant. The literature review provided in Section III of this report shows that investments in childhood health may have particularly high returns through improved education. Since Canada (along with most developed countries) already has a high average life expectancy and a low fertility rate, the impacts of marginal health improvements along pathways 3 and 4 are likely to be small.[3]

The remainder of this report is structured as follows. In Section II, we describe recent trends in Canadian productivity. Section III discusses recent trends in the average health outcomes of Canadians, while Section IV discusses health inequalities across the income distribution. Section V addresses the labour market impacts of illness with a focus on absenteeism. Section VI provides a review of the academic literature on health as a determinant of productivity. In section VII, we discuss the impact of health on productivity through the channels outlined in Exhibit 1. Section VIII concludes and provides a discussion of the policy implications of the report.

[3] Many developed countries are experiencing rapid population aging and the proportion of the population that is of working age is expected to sharply decline in the coming decade. Improvements in the health of the elderly could amplify this demographic trend. This would have a negative impact on per-capita output (all else being equal), but would not necessarily affect productivity according to any of the measures listed in Exhibit 1.

II. Trends in Productivity in Canada[4]

Productivity is by far the most important driver of living standards for Canadians. This is because real income can only increase in the long run if more real output is produced.[5] While increased productivity growth is generally associated with higher wages, it also brings to life a new world of possibilities for Canadians. Higher productivity means that Canadians will be able to meet the fiscal pressures associated with an aging population. It means the possibility of more health care funding. It means that workers will have the option of benefiting from increased leisure. In short, productivity growth is vital to the economic destiny of Canadians.[6] From this perspective, Canada's weak productivity performance since 2000 represents a massive shortfall.[7]

In order to assess the importance of government policies on productivity growth, it is important to have an understanding of the trends in productivity growth and the factors behind these trends. Such knowledge provides the context for discussion of the impact on productivity growth of economic policy.

A. Labour Productivity Trends

Business sector real output per hour, which is the official measure of labour productivity produced by both Statistics Canada and the US Bureau of Labor Statistics, grew on average 0.6 per cent per year in Canada over the 2000-2009 period (Chart 1).[8] Output per hour worked experienced no growth in 2007, then fell 0.9 per cent in 2008 as output declined 0.3 per cent and hours worked increased 0.6 per cent. Labour productivity increased 0.4 per cent in the recession year of 2009 as output declined more slowly than hours worked (4.0 per cent versus 4.4 per cent).

Canada's recent performance stands in stark contrast to that of the United States, which recorded labour productivity growth of 2.7 per cent per year over the 2000-2009 period, 2.1 per cent in 2008 and 3.8 per cent in 2009.

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[4] This section draws on Sharpe (2010).

[5] Terms of trade can also lead to an increase in real incomes, as has been the case in Canada in recent years due in large part to the sharp increase in commodity prices (MacDonald, 2008). Yet, given the uncertain outlook for commodity prices, the future contribution of terms of trade to income in Canada is not obvious and, unlike productivity gains, terms of trade have the potential to contribute negatively to real income as seen in 2008 with falling commodity prices. See Ross and Murray (2010) for a discussion of the implications of terms of trade for the measurement of living standards in Canada.

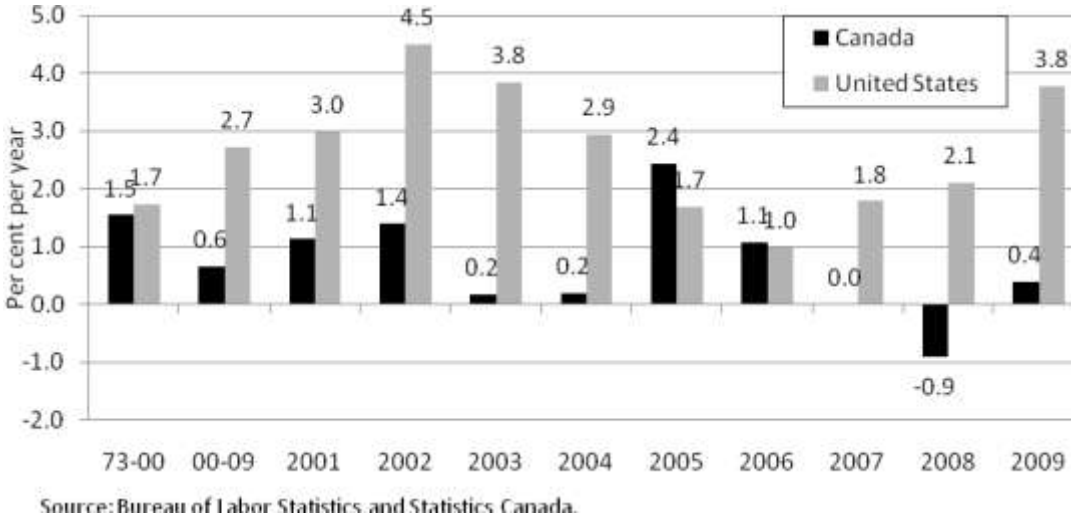
[6] See Sharpe (2007) for a discussion of the importance of productivity.

[7] See Arsenault and Sharpe (2008:15-17) for a discussion of what the Canadian economic landscape would have been in 2007 under two alternative scenarios of productivity growth relative to actual developments. In the first scenario, it is assumed that labour productivity since 2000 grows at the same rate as that experienced in the United States over the 2000-2007 period. The second scenario assumes that labour productivity grew at the historical trend established over the 1973-2000 period in Canada. The impacts on GDP, annual hours worked, GDP per capita and GDP per hour are provided.

[8] Aggregate labour productivity can be measured at the total economy and business sector level. Each measure has strengths and weaknesses. Indeed, the business sector measure suffers from less severe measurement issues than the total economy measure as it excludes industries such as education and health where output is generally not marketed. On the other hand, total economy measures are consistent with GDP per capita and are advantageous for international comparability since, unlike the business sector measures, the definition of what industries are included in the total economy does not differ across countries. See Smith (2004) for a detailed discussion of issues related to the appropriate measurement of aggregate labour productivity.

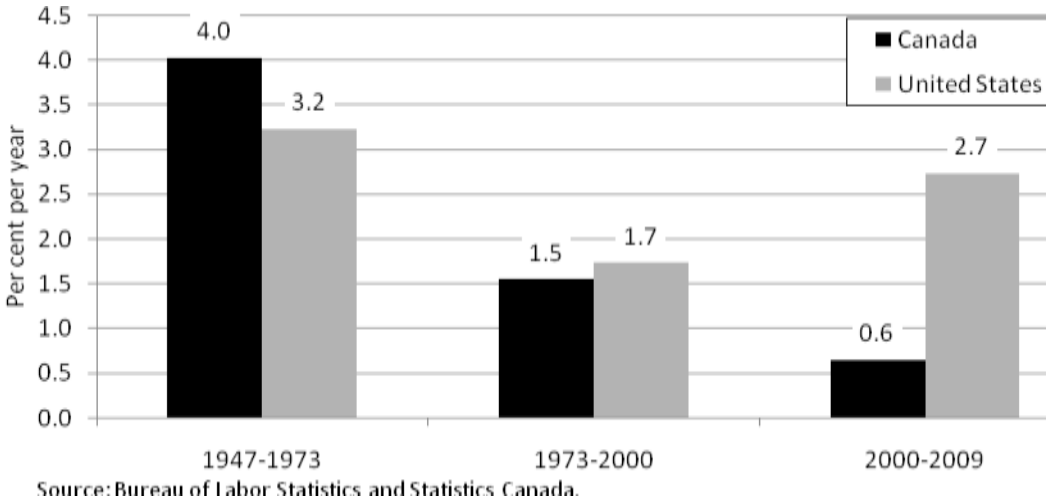
Canada's post-2000 productivity performance has been weak by historical standards. Labour productivity growth was below the annual average growth of 1.5 per cent recorded between 1973 and 2000 and below the 4.0 per cent per year recorded during the golden era of 1947-1973 (Chart 2). Canada's post-2000 productivity performance was weak not only relative to the United States and to earlier periods, but also relative to other OECD countries. Indeed, the Conference Board/GGDC total economy database places Canada 21st out of 30 OECD countries in terms of labour productivity growth over the 2000-2007 period (Chart 3) and 27th in the 1973-2000 period.

Chart 1: Real Output per Hour Growth, Business Sector, Canada and the United States, Average Annual Rates of Change, Per Cent, 1973-2009



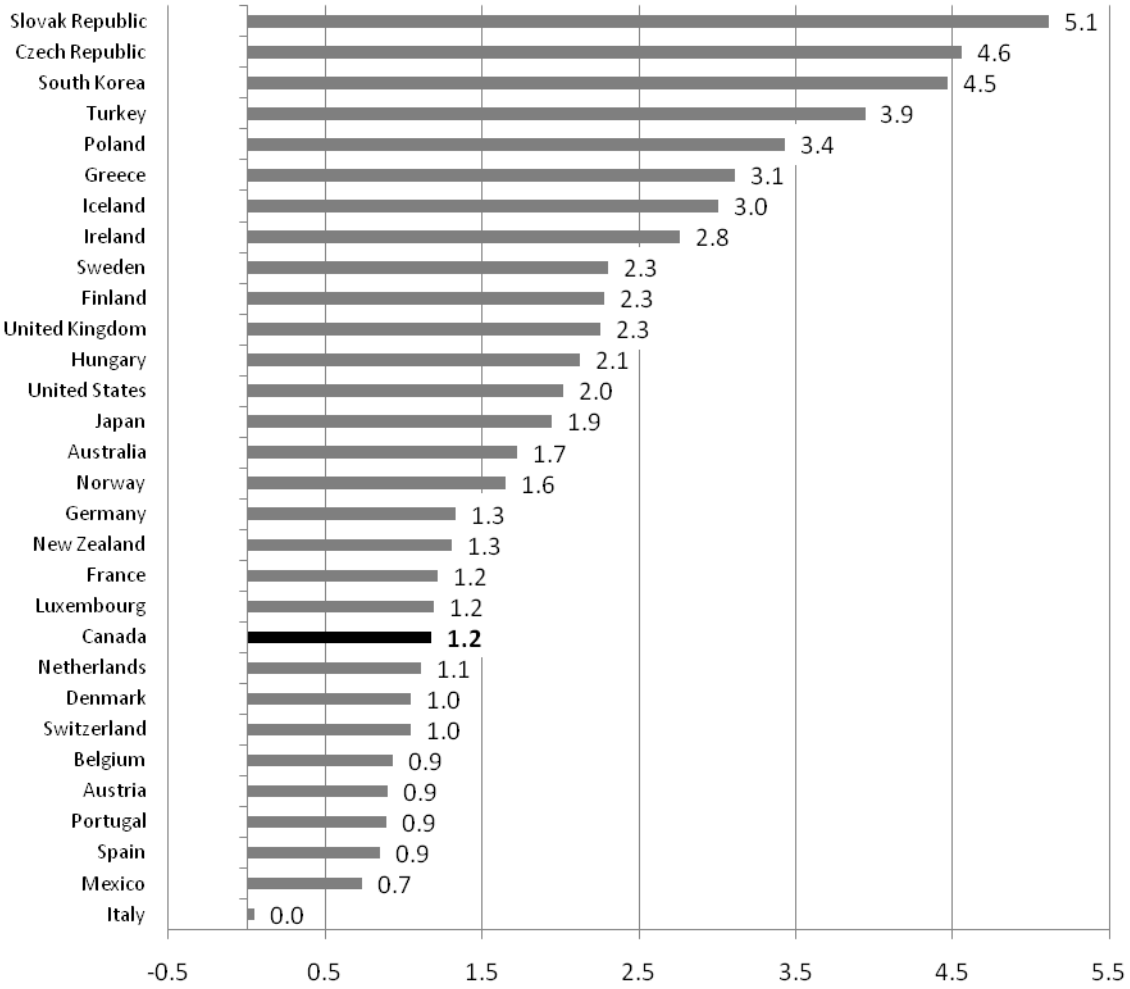
Source: Bureau of Labor Statistics and Statistics Canada.

Chart 2: Real Output per Hour Growth, Business Sector, Canada and the United States, Average Annual Rates, Per Cent, 1947-2009



Source: Bureau of Labor Statistics and Statistics Canada.

Chart 3: GDP per Hour Worked Growth in OECD Countries, 2000-2007 (Compound Annual Rate of Growth, Per Cent)



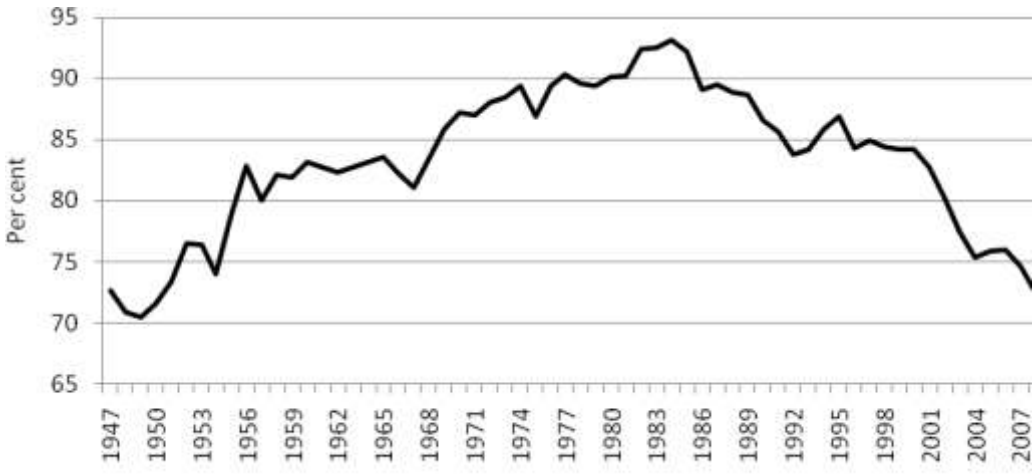
Source: Groningen Growth and Development Centre: www.ggdc.net.

Labour productivity growth is the difference between real output growth and labour input growth. Trends in output growth in the business sector in Canada and the United States have been similar between 2000 and 2009, with annual output growth averaging 1.4 and 1.7 per cent respectively. In both countries, average annual output growth between 2000 and 2009 was well below that of the 1973-2000 period.

Business sector total hours worked in Canada increased at an average annual rate of 0.7 per cent between 2000 and 2009, less than half the growth rate observed between 1973 and 2000. In the United States, business sector hours worked fell 1.0 per cent per year over the 2000-2009 period, largely reflecting the sharp recessions at the beginning and end of the 2000s south of the border. With output growing at a similar pace in both countries, it was the large difference in labour input growth since 2000 that led to a divergence in labour productivity growth between Canada and the United States.

While Canada's trend productivity growth rate seems to have declined in recent years, its closest neighbour appears to have shifted to higher trend productivity growth. In 2009, Canada's business sector output per hour stood at only 70.1 per cent the US level, down from 84.2 per cent in 2000 (Chart 4).

Chart 4: Real Output per Hour Worked, Business Sector, Canada as a Percentage of the US Level, 1947-2009



Source: CSLS Aggregate Income and Productivity Database (http://www.csls.ca/data/ipt1.asp), Table 7a.

III. Trends in Health

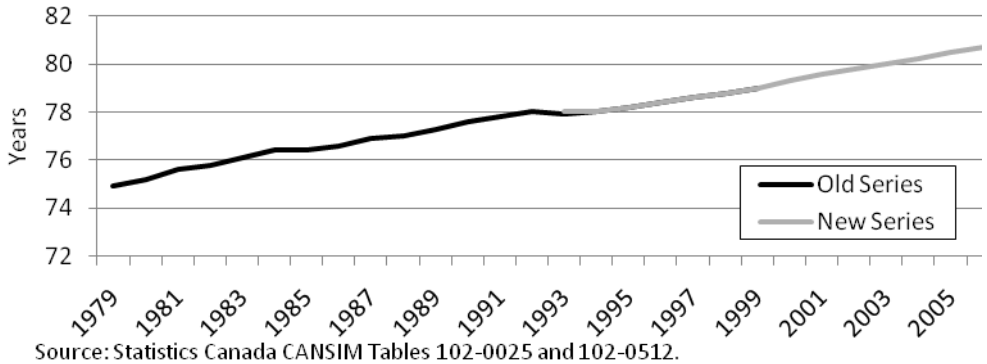
In this section, we discuss recent trends in Canadian health by examining a variety of health indicators. The objective of the section is to identify possible relationships between health and productivity over the last two decades. Labour productivity growth has been positive in recent years, although the growth rate has fallen off since 2000. Trends in the health of Canadians may have contributed to these trends.

The analysis reveals that Canada's health performance has been a mix of good and bad in recent years.

A standard measure of general health in a society is average life expectancy at birth. Life expectancy in Canada reached 80.7 years in 2006, up 5.8 years (or 7.7 per cent) from 74.9 years in 1979 (Chart 5). The increase in Canada's life expectancy occurred at a fairly constant rate of 0.21 years per year over the 1979-2006 period.

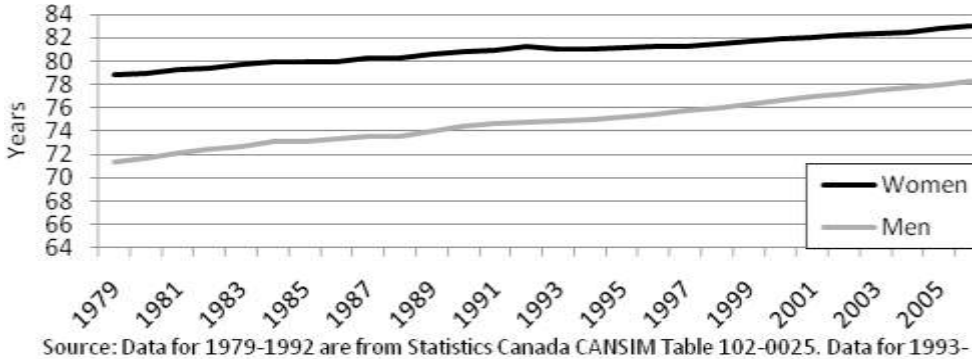
Life expectancy at birth increased over the period for both men and women (Chart 6). By 2006, average life expectancy was 83.0 years for women (up from 78.8 in 1979) and 78.3 years for men (up from 71.4 in 1979). Female life expectancy exceeded that of men over the period, but the gap closed from 7.4 years in 1979 to 4.7 years in 2006.

Chart 5: Life Expectancy at Birth, Canada, 1979-2006



Source: Statistics Canada CANSIM Tables 102-0025 and 102-0512.
Note: Statistics Canada's estimates for 1993-2006 are three-year moving averages. We assign them to the mid-year of the three-year period. For example, the 2006 estimate is for 2005-2007.

Chart 6: Life Expectancy at Birth by Sex, Canada, 1979-2006

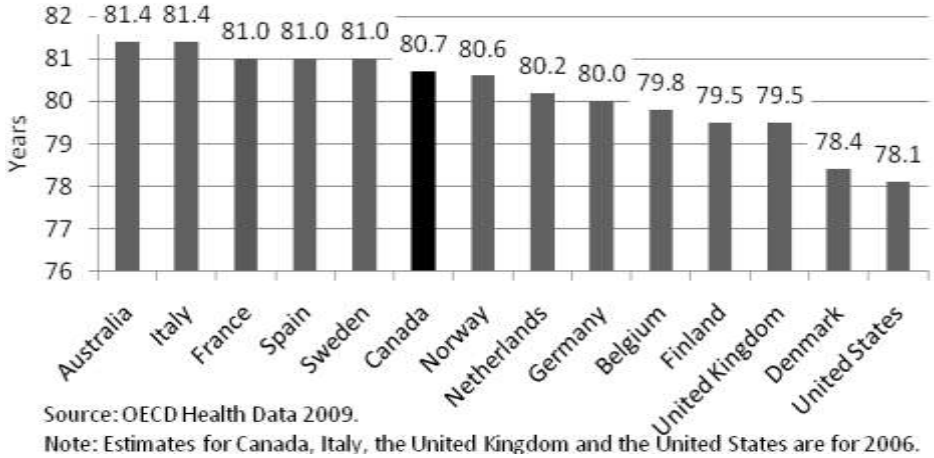


Source: Data for 1979-1992 are from Statistics Canada CANSIM Table 102-0025. Data for 1993-2006 are from CANSIM Table 102-0512.
Note: Statistics Canada's estimates for 1993-2006 are three-year moving averages. We assign them to the mid-year of the three-year period. For example, the 2006 estimate is for 2005-2007.

Chart 7 shows average life expectancy in a set of selected OECD countries as of 2007. Canada's life expectancy is sixth among the fourteen countries, behind Australia and Italy (81.4 years) and France, Spain and Sweden (81.0 years). The average life expectancy among the countries is 80.2 years, slightly below Canada's 80.7 years.

Average life expectancy at birth is sensitive to mortality rates in the early years of life. Indeed, a large decline in infant mortality in Canada – from 10.9 per 1,000 live births in 1979 to 5.1 per 1,000 live births in 2007 – has contributed to the increase in average life expectancy (Chart 8).[9] In contrast, the total mortality rate has been constant at about 7

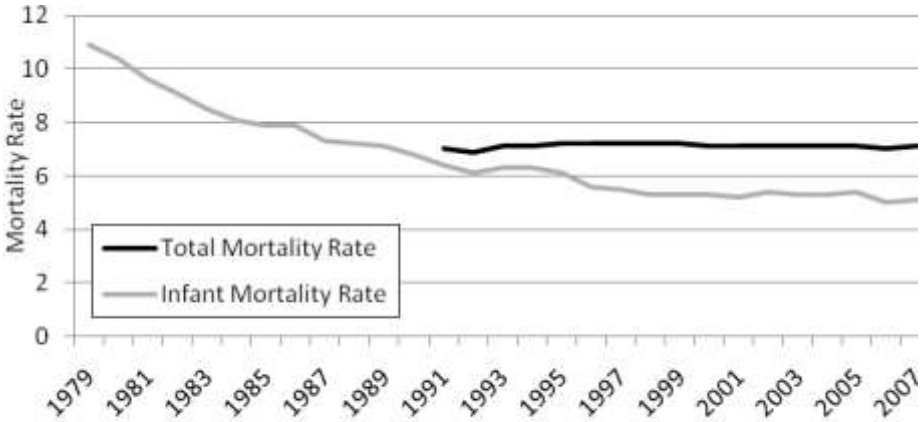
Chart 7: Average Life Expectancy, Selected OECD Countries, 2007



Source: OECD Health Data 2009.
Note: Estimates for Canada, Italy, the United Kingdom and the United States are for 2006.

[9] In spite of this large decline, Canada's standing relative to other advanced countries has deteriorated as other countries experienced larger reductions in infant mortality. In 2007, Canada ranked 24th in the world in infant mortality. This poor ranking reflects the poverty and isolation of certain communities in Canada (e.g. Aboriginal people), as well as the way the data are collected (Priest, 2010).

Chart 8: Total and Infant Mortality Rates, Canada, 1979-2007



Source: Statistics Canada CANSIM Tables 102-0030, 102-0504 and 102-0506.
Note: Total mortality rate = deaths per 1,000 population.
Infant mortality rate = infant deaths per 1,000 live births.

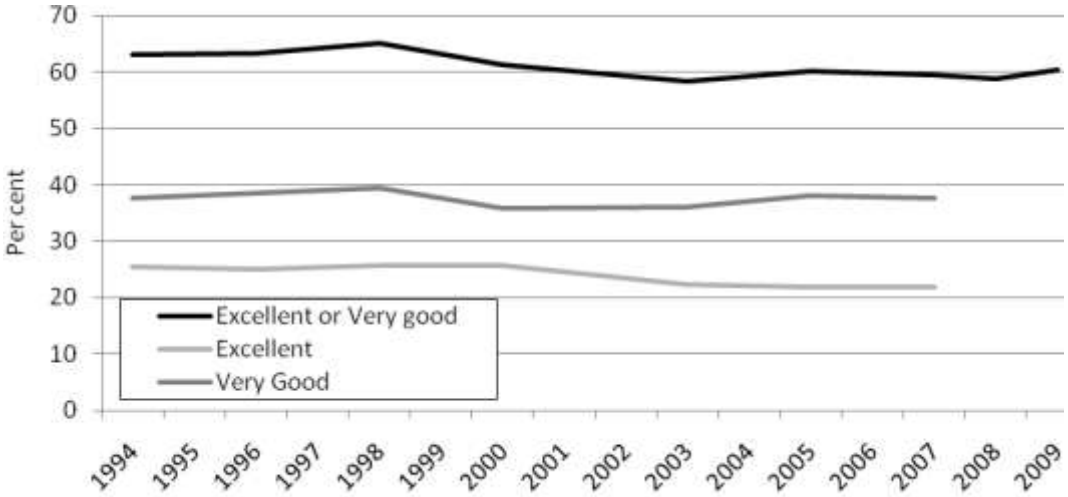
deaths per 1,000 Canadians since 1991 (the earliest year for which data are readily available).[10] This highlights the importance of early childhood health, an issue to which we shall return later in the report.

Canadians are living longer on average, but this has not led to an increase in the proportion of Canadians who feel that they are in good or excellent health. In 2009, 60.5 per cent of Canadians reported that their health was 'excellent' or 'very good' (Chart 9). This was down 2.6 percentage points (or 4.1 per cent) from 63.1 per cent in 1994. Over the 1994-2007 period, the decline in self-perceived health was entirely attributable to a 3.6 percentage-point decline in the proportion of people whose health was 'excellent' (from 25.5 per cent in 1994 to 21.9 per cent in 2007). The proportion of Canadians whose health was 'very good' was 37.6 per cent in both 1994 and 2007.

Another key summary measure of the health of Canadians is the average self-reported health score, which takes account of the health status of Canadians at both the high and low ends of the self-reported health scale. This average was nearly constant at about 2.7 (between 'fair' and 'very good') over the 1994-2007 period (Chart 10). It did decline slightly – from 2.78 to 2.70 – but the change was too small to be meaningful. On average, Canadians were about as healthy in 2007 as they were in 1994.

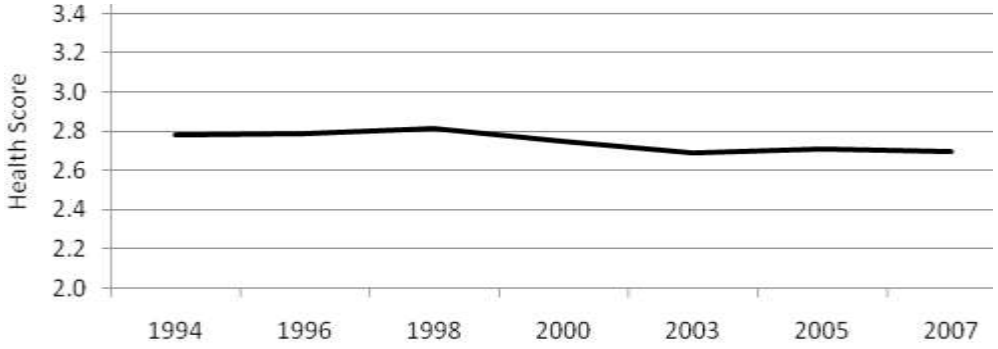
[10] Note that the total mortality rates do not adjust for the age distribution of the population. As the elderly rise as a share of the total population, we would expect more deaths per capita. To some degree, this offsets health improvements that reduce aggregate-level mortality rates at a given age. Consequently, an age-adjusted total mortality rate would be more relevant than the unadjusted rate as an indicator of the impact of health improvements on mortality.

Chart 9: Proportion of the Population Aged 12 and Over Reporting 'Excellent' or 'Very Good' Health, Canada, per cent, 1994-2009



Source: Canadian Community Health Survey (CCHS), 1994-2009

Chart 10: Average Self-Reported Health among the Population Aged 12 and Over, Canada, 1994-2007

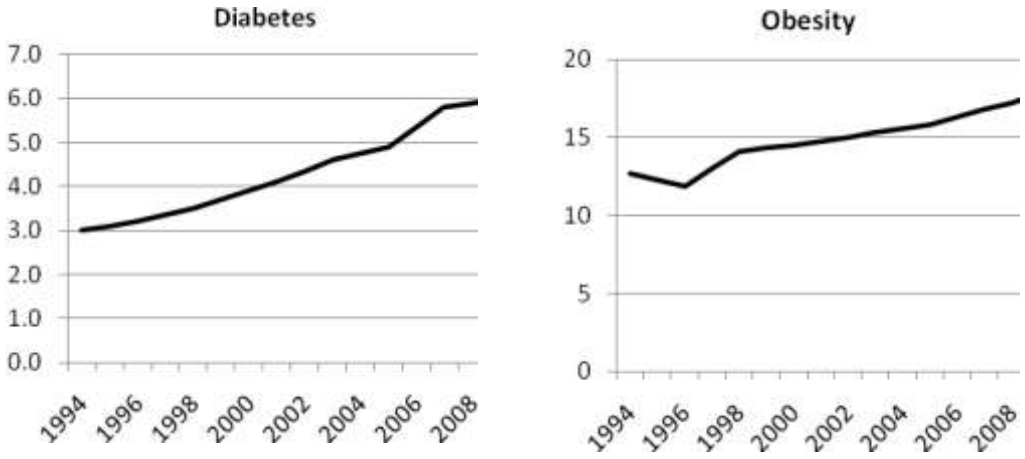


Source: Canadian Community Health Survey 1994/1995 to 2007
Note: The average was created by weighting 'Excellent' as 4, 'Very good' as 3, 'Good' as 2 and 'Fair or poor' as 1.

Furthermore, many specific illnesses are becoming more prevalent in Canada. In 2009, 6.0 per cent of Canadians had diabetes, double the rate of 3.0 per cent recorded in 1994 (Chart 11). This is a key health indicator because diabetes (Type 2) is known to be related to other health characteristics such as obesity and physical inactivity. The second panel of Chart 11 illustrates that obesity also increased over the period, from 12.7 per cent in 1994 to 17.9 per cent in 2009.

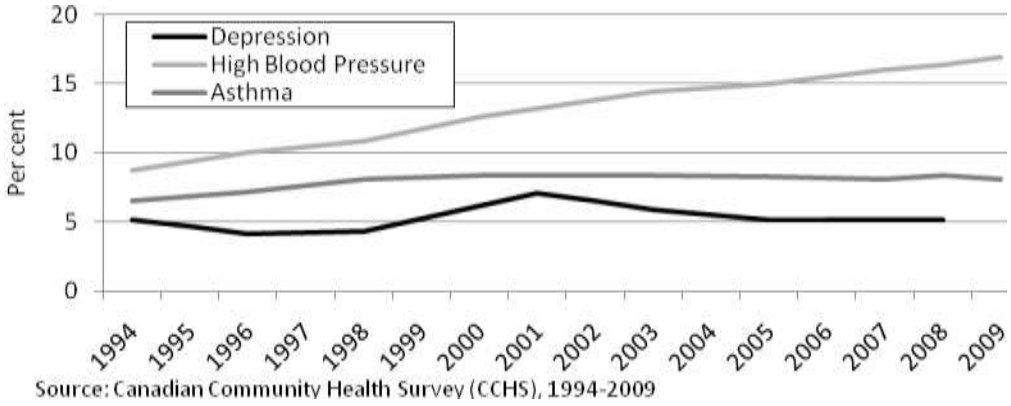
The prevalence of depression (a key indicator of mental health) was the same in 2008 as in 1994, at 5.2 per cent. However, it varied substantially over the 1994-2008 period, reaching a low of 4.1 per cent in 1996 and a high of 7.1 per cent in 2001 (Chart 12).

Chart 11: Proportions of the Population with Diabetes and Obesity, Canada, per cent, 1994-2009



Source: Canada Community Health Survey (CCHS), 1994-2009
Note: Diabetes data are for the population aged 12 and over. Obesity data are for the population aged 18 and over.

Chart 12: Proportions of the Population Aged 12 and Over with Depression, High Blood Pressure, and Asthma, Canada, per cent, 1994-2009



The proportion of Canadians age with high blood pressure increased dramatically over the 1994-2008 period. In 2009, 16.9 per cent of Canadians had high blood pressure. This was 8.2 percentage points (or 94.3 per cent) above the 1994 rate of 8.7 per cent.

The prevalence of asthma also increased over the 1994-2009 period, although all of the increase occurred between 1994 and 2000. The proportion of Canadians with asthma was 8.1 per cent in 2009, up 1.6 percentage points (or 24.6 per cent) from 6.5 per cent in 1994.

Productivity has many determinants. In developed countries, health is likely less important for productivity advance than factors such as investment, human capital and technological progress. This section has briefly reviewed major trends in health in Canada. A key development has been the rise in life expectancy. As this development is

largely driven by improvements in the life expectancy of the population 65 and over, which are largely or entirely out of the workforce, these positive developments are of little relevance for productivity.

More relevant from a productivity perspective is the health of the overall population, which includes the workforce. This is captured by the average self-reported health of the population 12 and over and this variable has showed a slight downward trend in recent years, which may be linked to the aging of the population. It is doubtful that such a small change would have a major effect on labour productivity.

There have been marked increases in the incidence of diabetes, obesity, high blood pressure. It is possible that these developments could have contributed somewhat to greater absenteeism, and hence lower productivity growth when measured on a per worker basis. It is interesting to note that the incidence of depression, which likely has a greater productivity-reducing impact than the other three conditions, has been stable.

IV. Health Inequalities

Total population averages are important, but they may mask variation in health outcomes across members of the population. In this section, we examine health outcomes inequalities with respect to income distribution. Income is a proxy for labour productivity.[11]

The relationship between income and health is complex and by-directional, likely, with contributions going from one direction to another over an individual's life course. The impact of health on income is through labour productivity, as healthier people are, generally, more productive; but it is also through the mere ability and decision to participate in the labour market. In addition, according to human capital theory, more educated individuals are more productive. Since healthier children tend to achieve higher educational attainment (Hack *et al.*, 2002; Case *et al.*, 2005; Currie, 2005; and Currie *et al.*, 2009), health in early life stages contributes to higher future productivity and income. There are also a number of pathways from income to health. The most common focus is on social and material deprivation in terms of disproportionate exposure to risk factors and the inability to access basic necessities, and on psychosocial stress in terms of the inability to control life circumstances (Lynch *et al.*, 2000; Mackenbach *et al.*, 2007; and Marmot, 2003). While the individual interpretation within these two broad pathways concentrates on income-related characteristics such as occupation, education, attitudes and values, structural analyses emphasize political, economic, and social conditions (Raphael *et al*., 2005).

The data show that healthier people have higher household incomes, but the direction of causation is not clear. One view is that healthy people are more energetic and productive and therefore earn higher incomes than unhealthy people. An equally plausible view is that people with high incomes have more resources to devote to the maintenance of good health and that this leads to their superior health outcomes. High income people may be able to access better education, allowing them to make better informed decisions about their health. As the literature review in Section VI below illustrates, it is likely that forces act in both directions in the health-income relationship.

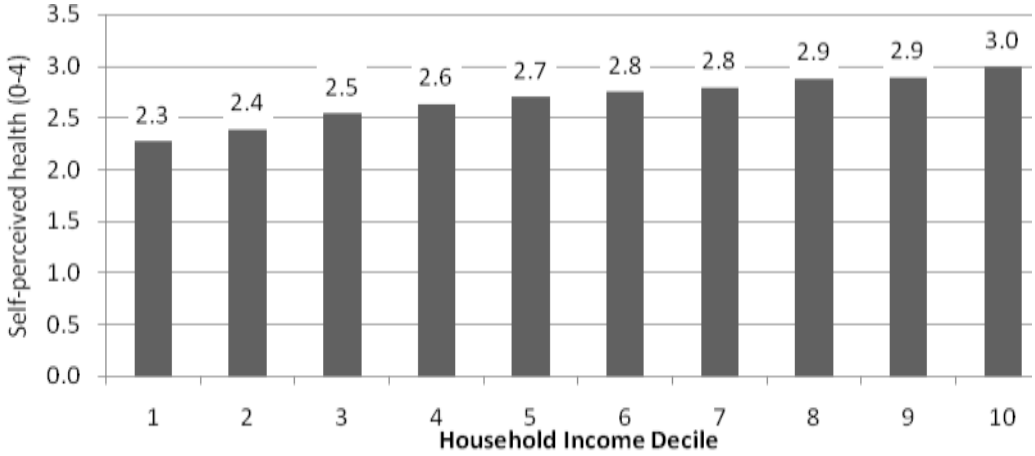
A. Population 12 and Over

Chart 13 illustrates self-perceived health by income decile. The relationship is clear: the higher the income decile, the higher the average self-perceived health of persons in that decile. The overall average for the Canadian population in 2007 and 2008 was 2.7 (on a 0-4 scale, with 0 indicating poor health and 4 indicating excellent health). Canadians in the bottom ten per cent of the income distribution had an average self-perceived health score of 2.3, while those in the top decile had an average score of 3.0.

[11] Strictly speaking, individual employment income is the income measure that best approximates labour productivity. Unfortunately, the Canada Community Health Survey includes data only on household income. Household income is a much worse proxy for productivity than individual income because it is not individual-specific and because it includes non-employment income (e.g. income from government transfers). Nevertheless, it is likely that high-income households have at least one member with high employment income and vice versa.

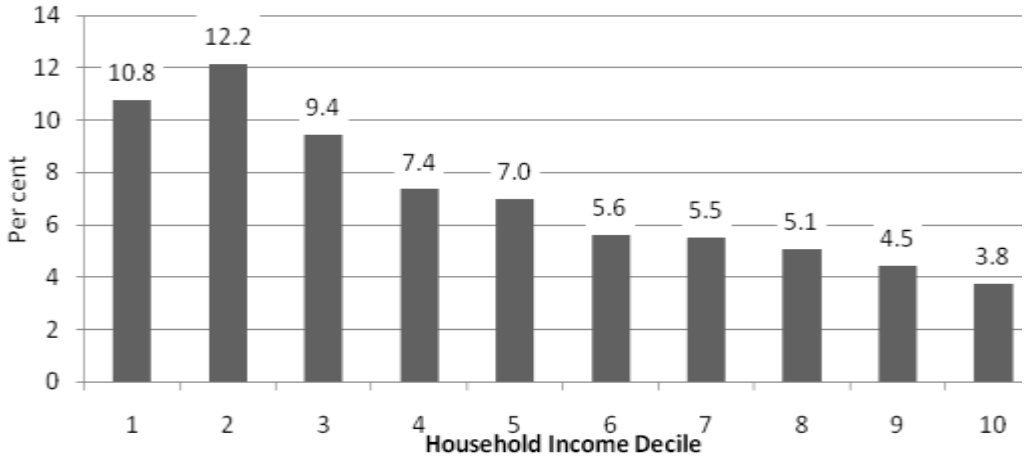
Similar patterns hold for specific health conditions. Diabetes prevalence is over 10 per cent in each of the bottom two income deciles, but below 5 per cent in each of the top two deciles (Chart 14). With the exception of the increase from the first to the second decile, diabetes prevalence decreases as we move up the income distribution.

Chart 13: Self-perceived Health of Persons Aged 12 and Over by Household Income Decile, Canada, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

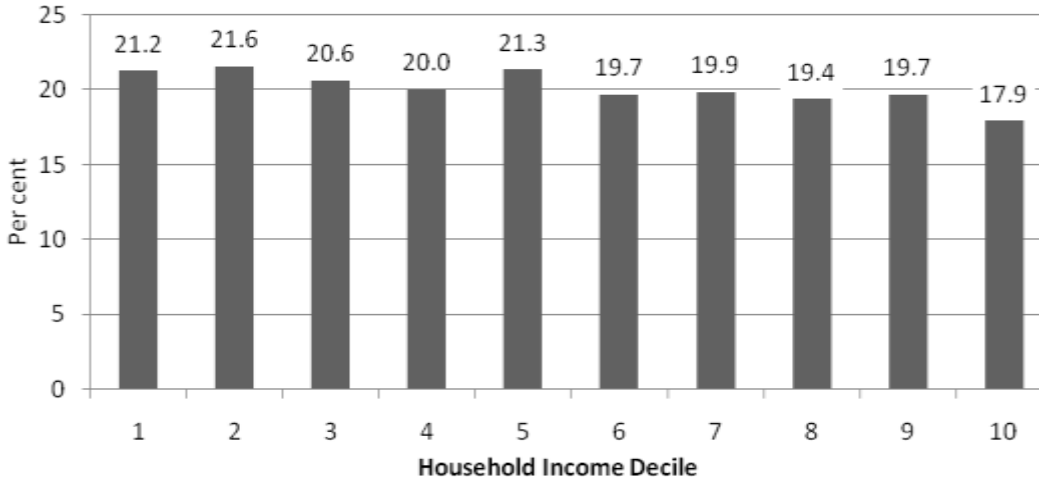
Chart 14: Proportion of Population Aged 12 and Over with Diabetes by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Obesity is a known risk factor for diabetes. Like diabetes, obesity is more common at the bottom of the income distribution than at the top (Chart 15). Obesity rates are 21.2 per cent and 21.6 per cent in the first and second household income deciles, respectively; in the ninth and tenth deciles, they are 19.7 per cent and 17.9 per cent. However, the differences in obesity across the income distribution are not as pronounced as the differences in diabetes. Obesity rates are stable at about 20 per cent throughout the middle 60 per cent of the income distribution.

Chart 15: Proportion of the Population Aged 18 and Over that is Obese (BMI > 30) by Household Income Decile, Canada, Per Cent, 2007 and 2008

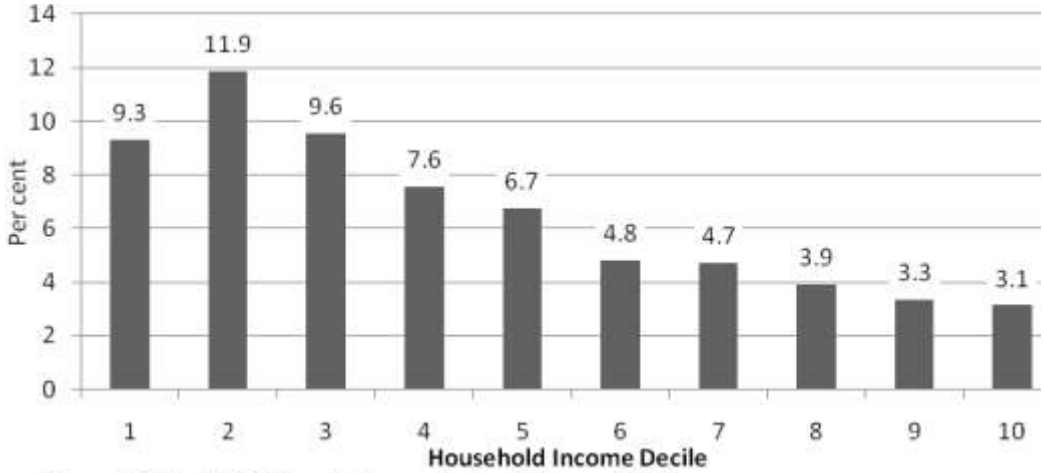


Source: 2007 and 2008 Canada Community Health Survey (CCHS)

The prevalence of heart disease by income decile is very similar to that of diabetes. Heart disease afflicts between 9 and 12 per cent of Canadians within each of the bottom three income deciles, but the rate declines to about three per cent in the top deciles (Chart 16).

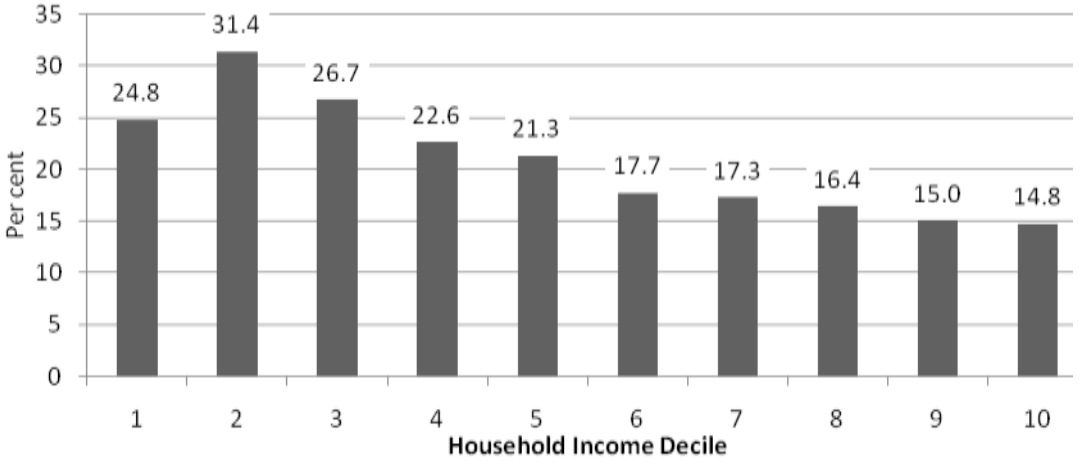
Similarly, the prevalence of high blood pressure is higher among those at the bottom of the distribution (Chart 17). The proportions of persons with high blood pressure in the first and second income deciles are 24.8 per cent and 31.4 per cent, respectively. In the ninth and tenth deciles, the rates are 15.0 per cent and 14.8 per cent.

Chart 16: Proportion of the Population Aged 12 and Over with Heart Disease by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 17: Proportion of the Population Aged 12 and Over with High Blood Pressure by Household Income Decile, Canada, Per Cent, 2007 and 2008

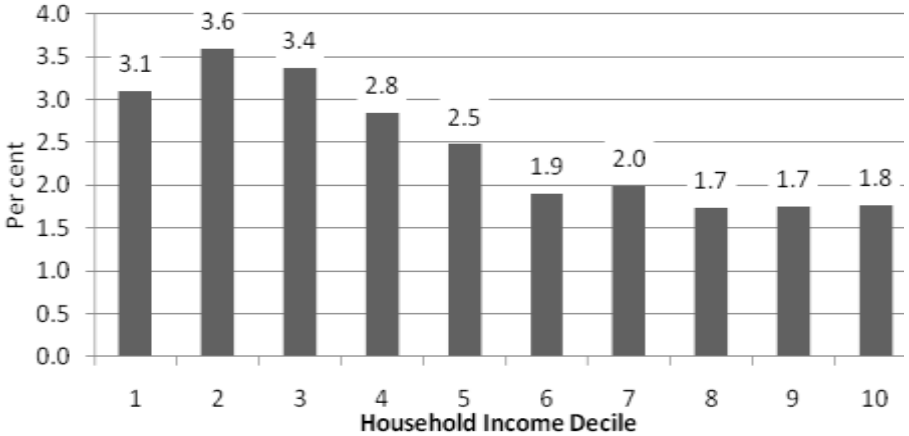


Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Even cancer is more common among the relatively poor than among the relatively rich (Chart 18). Cancer rates are 3.1 per cent in the bottom decile and 3.6 per cent in the second decile; in the ninth and tenth deciles, the rates are 1.7 per cent and 1.8 per cent, respectively.

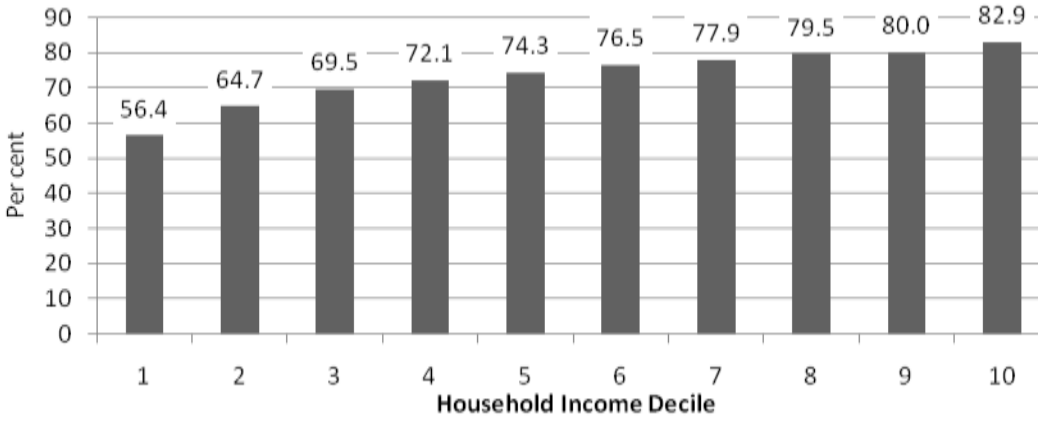
The inequalities are just as pronounced when it comes to mental health. Chart 19 illustrates that self-reported mental health is substantially better among those at the top of the income distribution than among those at the bottom. The higher the decile, the greater the proportion of people who report having excellent or very good mental health. Only 56.4 per cent of people in the bottom decile are in good mental health. Among members of the top decile, the proportion is 82.9 per cent – 26.5 percentage points higher.

Chart 18: Proportion of the Population Aged 12 and Over Diagnosed with Cancer by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 19: Proportion of the Population Aged 12 and Over Reporting Excellent or Very Good Mental Health by Household Income Decile, Canada, Per Cent, 2007 and 2008

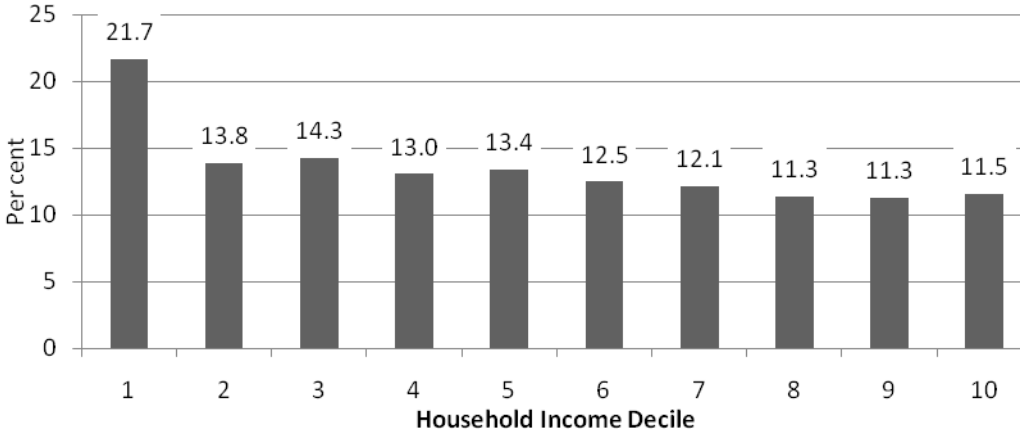


Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 20 illustrates the prevalence rates for depression. The depression rate in the bottom ten per cent of the income distribution is 21.7 per cent, much higher than the rates observed across the rest of the distribution. Starting from the second decile, depression rates decline from about 14 per cent to 11.5 per cent at the top of the distribution.

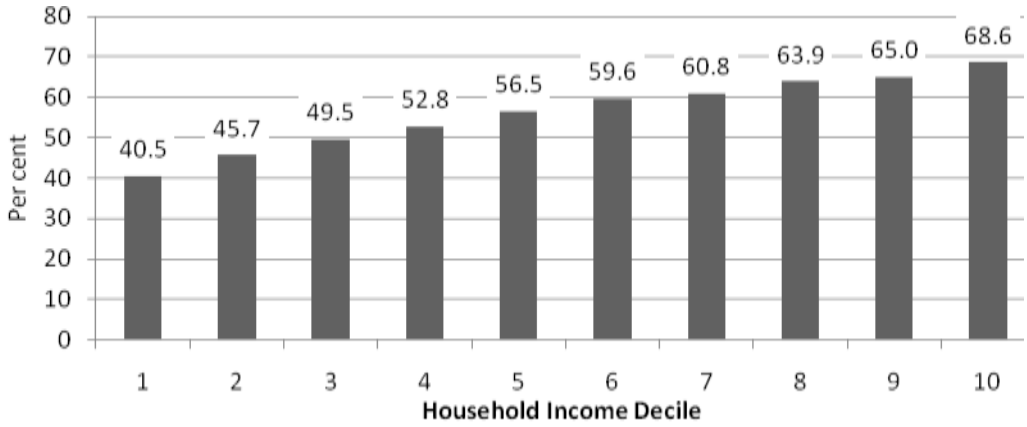
Particularly large inequalities in health status exist for illnesses that are not covered by Canada's national healthcare system. The proportion of the population reporting excellent or very good oral health (including dental health) increases with household income decile (Chart 21). In each of the bottom three deciles, fewer than half of Canadians report excellent or very good oral health. The proportion for the top ten per

Chart 20: Proportion of the Population Aged 12 and Over Reporting Depression in the Past Year by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 21: Proportion of the Population Aged 12 and Over Reporting Excellent or Very Good Mouth and Tooth Health by Household Income Decile, Canada, Per Cent, 2007 and 2008



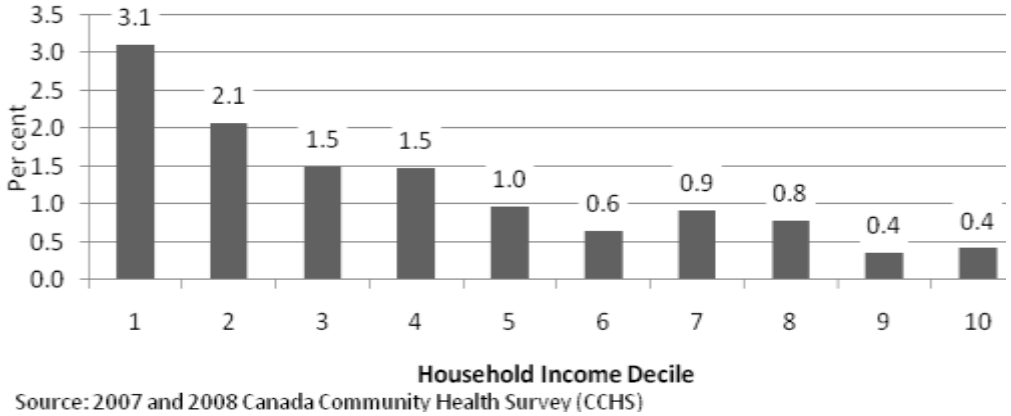
Source: 2007 and 2008 Canada Community Health Survey (CCHS)

cent of the income distribution is 68.6 per cent, 28.1 percentage points higher than the proportion for the bottom decile (40.5 per cent).

Similarly, Canadians at the bottom of the income distribution are more likely than those at the top to have an uncorrected vision problem (Chart 22). Uncorrected vision problems afflict 3.1 per cent of those in the bottom decile, but only 0.4 per cent of those at the top.

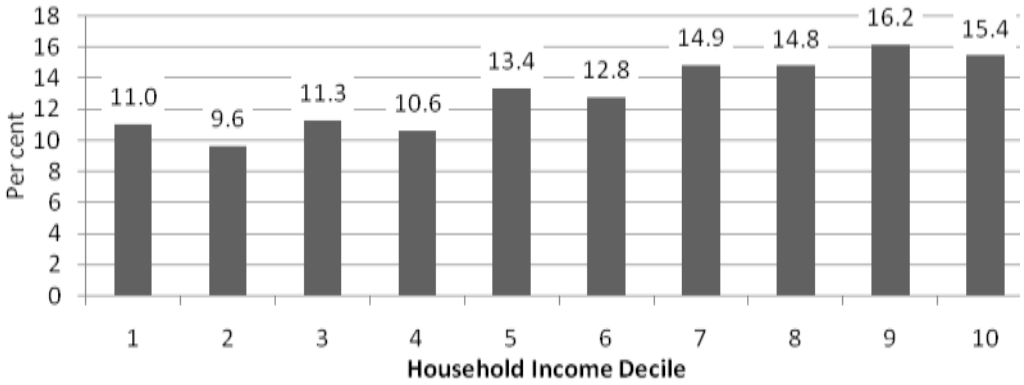
Repetitive strain injury is an indicator according to which those at the top of the income distribution are worse off than those at the bottom (Chart 23). Prevalence rates in the ninth and tenth deciles are 16.2 and 15.4 per cent, respectively. By comparison, the rates for the first and second deciles are 11.0 and 9.6 per cent, respectively. The reversal of the typical pattern may reflect higher employment rates among members of higher income deciles. Repetitive strain injuries are often associated with occupational tasks.

Chart 22: Proportion of the Population Aged 12 and Over with an Uncorrected Vision Problem by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 23: Proportion of the Population Reporting a Repetitive Strain Injury in the Past Year by Household Income Decile, Canada, Per Cent, 2007 and 2008

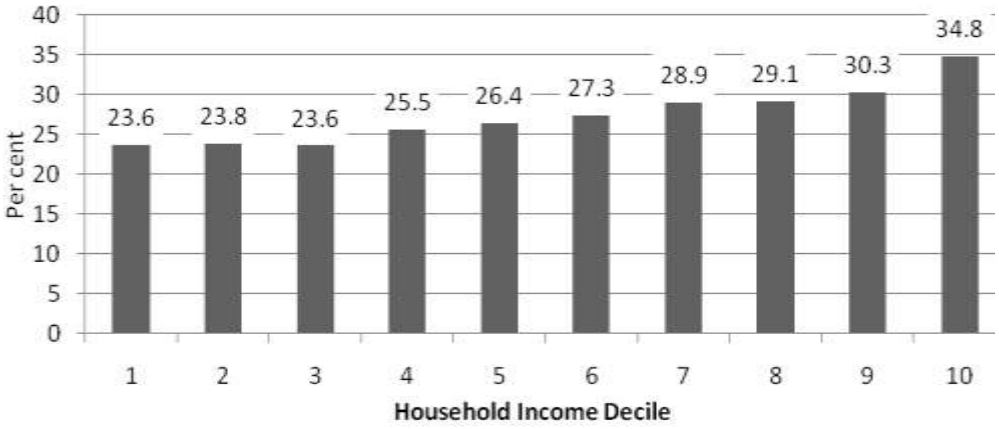


Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Members of the top income deciles report higher work-related stress than members of lower deciles (Chart 24). In the ninth and tenth income deciles, 30.3 and 34.8 per cent (respectively) of Canadians report high levels of work stress. The corresponding proportion is about 23.6 per cent in the bottom three deciles. As in the case of repetitive strain injuries, this pattern may reflect higher employment rates among higher income groups. High income people may also have more high-pressure jobs than low-income people on average.

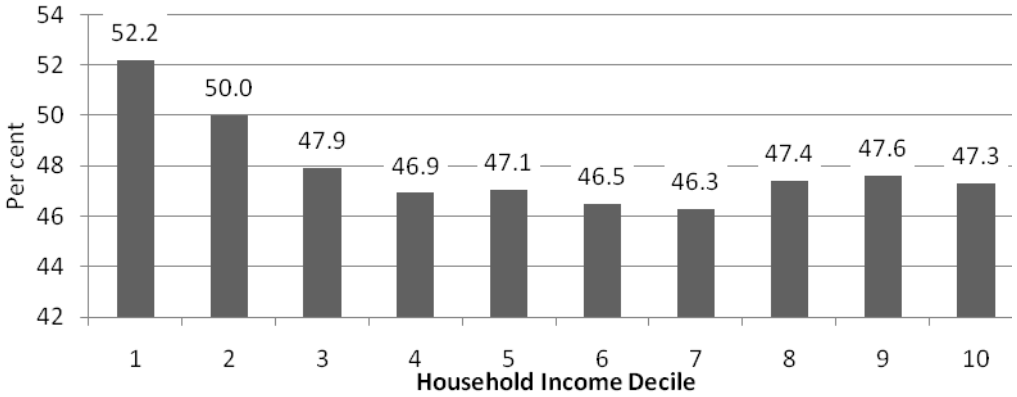
In spite of these work-related matters, the fact remains that the health outcomes of those at the bottom of the income distribution are worse, on average, than those of people at the top of the distribution according to most of the health indicators we examine. While this report does not focus on the socioeconomic determinants of health, it is worth noting that people at the bottom of the income distribution face greater self-perceived barriers to health improvement than do those at the top. Chart 25 shows that 52.2 per cent of

Chart 24: Proportion of the Population Reporting 'Quite a Bit' or 'Extreme' Work Stress by Household Income Decile, Canada, Per Cent, 2007 and 2008



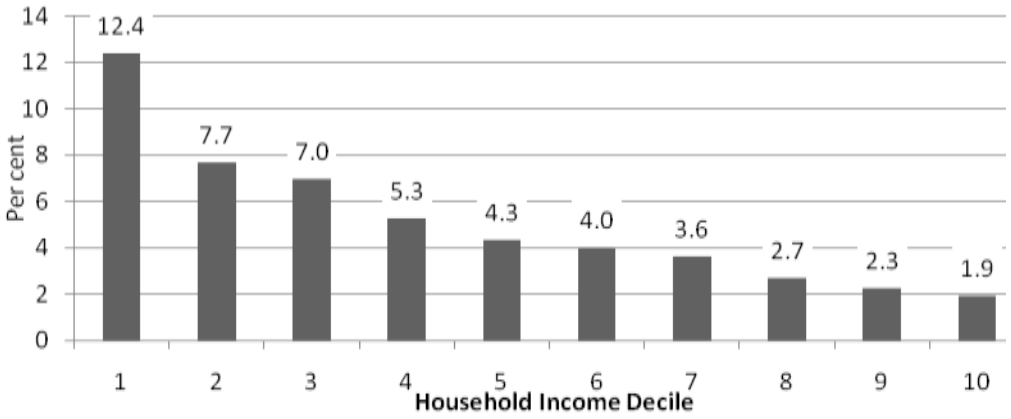
Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 25: Proportion of the Population who Believe they Face Barriers to Health Improvement, by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 26: Proportion of the Population Facing Cost-related Barriers to Health Improvement, by Household Income Decile, Canada, Per Cent, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Canadians in the bottom income decile and 50.0 per cent of those in the second decile believe that they face barriers to health improvement. Among those in the top decile, the proportion is slightly lower, at 47.3 per cent. The inequality is more pronounced if we consider only cost-related barriers. Over 12 per cent of those in the bottom income decile believe that financial barriers prevent them from improving their health (Chart 26). This proportion declines as income rises, and only 1.9 per cent of those in the top decile regard financial costs as a barrier to health improvement.

Exhibit 2 summarizes the health inequalities described in this subsection. Canadians (aged 12 and over) in the top household income decile had 30 per cent higher self-perceived health, 47 per cent higher self-rated mental health, and 69 per cent higher self-rated mouth and tooth health than those in the bottom decile. The inequality is largest for mouth and tooth health, which is not covered by the public health care system in Canada. This is consistent with the fact that the proportion of top-decile Canadians who

face cost-related barriers to health improvement is only 15 per cent of the proportion of bottom-decile Canadians who face such barriers.

In general, illnesses are more common at the bottom of the income distribution than at the top. Exceptions are repetitive strain injuries and work-related stress, which likely reflects the fact that people at the bottom of the income distribution are less likely to be employed than those at the top.

Exhibit 2: Summary of Health Inequalities by Household Income Groups, Population Aged 12 and Over, 2007 and 2008

Health Status	90:10	80:20	50:50
Conditions for which a Higher Score Implies Better Health			
Self-perceived Health	1.30	1.26	1.15
Self-reported Mental Health	1.47	1.35	1.18
Self-reported Mouth and Tooth Health	1.69	1.55	1.30
Conditions for which a Higher Score Implies Worse Health			
Diabetes	0.35	0.36	0.52
Obesity	0.84	0.88	0.92
Heart Disease	0.33	0.30	0.44
High Blood Pressure	0.60	0.53	0.64
Cancer	0.58	0.52	0.59
Depression	0.53	0.64	0.77
Uncorrected Vision Problem	0.13	0.15	0.34
Repetitive Strain Injury	1.40	1.53	1.33
Work-related Stress	1.47	1.37	1.22
Face Barriers to Health Improvement	0.91	0.93	0.96
Face Cost-related Barriers to Health Improvement	0.15	0.21	0.40

Note: The 90:10 ratio is the ratio of the average score of those in the top household income decile (i.e. above the 90th percentile) to that of those in the bottom decile (i.e. those below the 10th percentile). The 80:20 and 50:50 ratios are similarly defined.

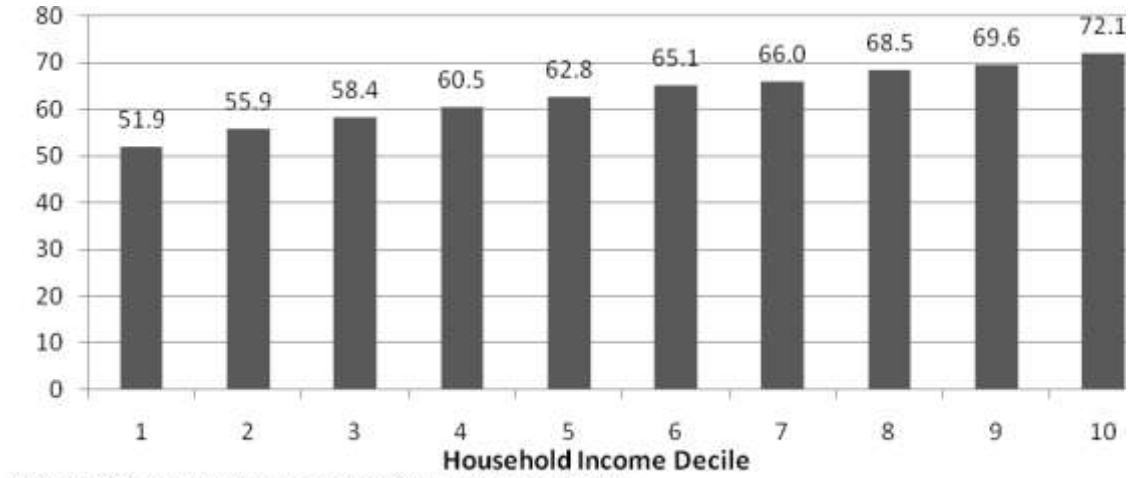
B. Working Population

In many cases, health variables and income may be codetermined. If one has cancer, or another severe health problem, the inability to work will reduce his or her income. Therefore, while lower income may cause more health problems, more health problems may also cause lower income. By looking at only those who are working, we can alleviate some of the complications that arise from this two-way relationship.

Among employed persons, the discrepancy between the self-perceived health of those at the top income deciles remains. There is a clear relationship between income and the self-perceived health of individuals even only looking at those who are not working. Among working people with household incomes in the first decile, 52 per cent had a self-

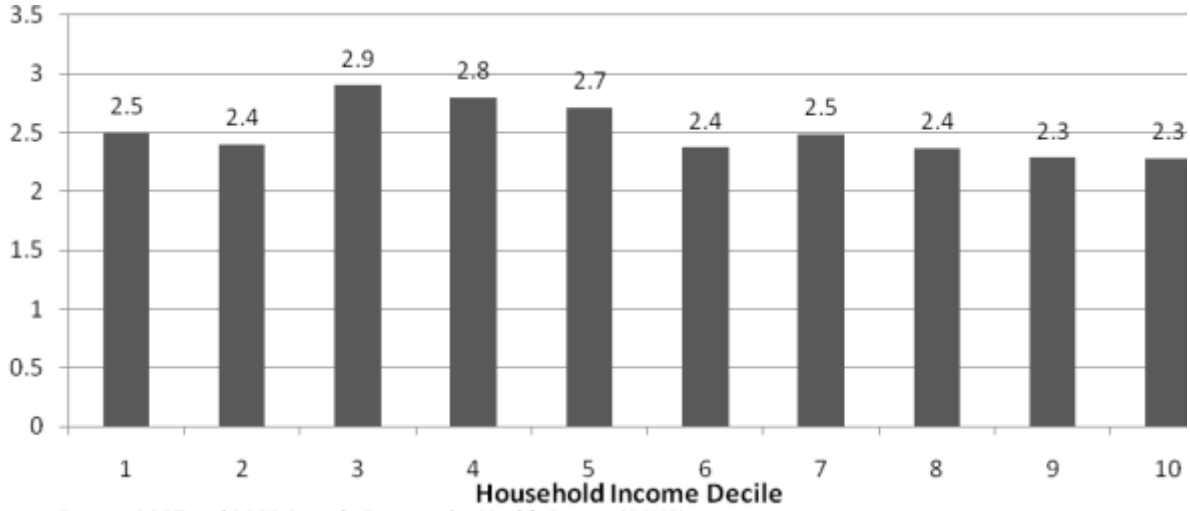
perceived health of very good or excellent versus 72.1 per cent in the tenth decile (Chart 27). However, the relationship is much less strong for some of the diseases looked at in the previous section.

Chart 27: Per Cent of Workers Rating their Health as Very Good or Excellent by Household Income Decile, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 28: Per Cent of Workers with Heart Disease by Household Income Decile, 2007 and 2008



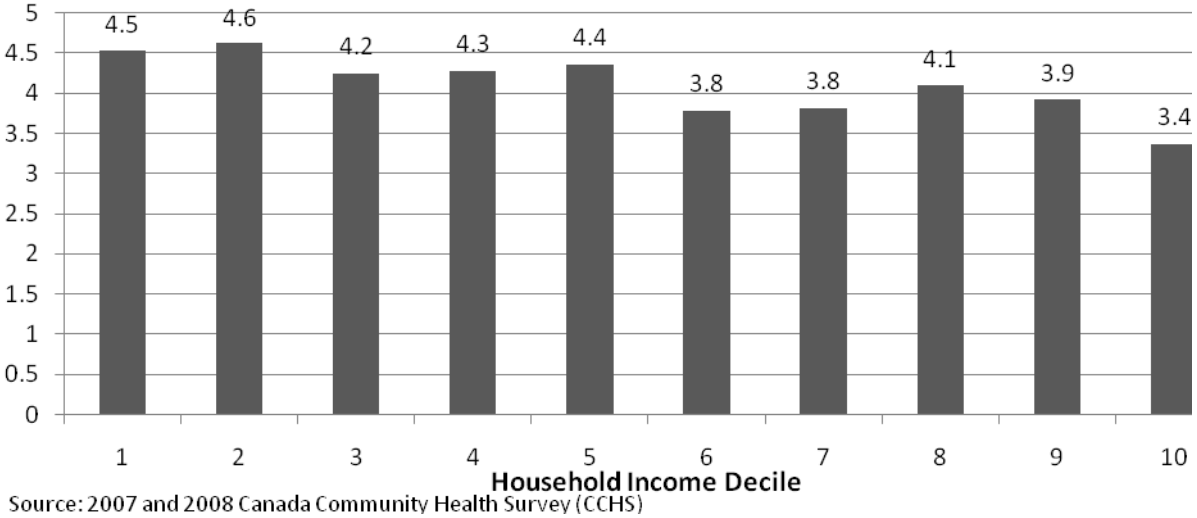
Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Although there is a strong relationship between income deciles and heart disease among the whole population, the relationship is significantly reduced when considering only those who are employed. In fact the highest incidence of heart disease is among those with only slightly below average incomes in the third, fourth, and fifth deciles (Chart 28). Furthermore, rates of heart disease in the working population are virtually identical between the first and tenth decile of income at 2.5 per cent and 2.3 per cent respectively.

The relationship between diabetes and income decile also becomes less apparent when only considering the working population. The proportion of workers with diabetes in the two lowest household income deciles (Chart 29) is less than half of the proportion in the entire population (Chart 14). However, the proportion of those in the top income decile with diabetes is very similar (3.8 per cent versus 3.4 per cent) suggesting that many of those in the top household income deciles are working even if they have diabetes compared to those in the bottom.

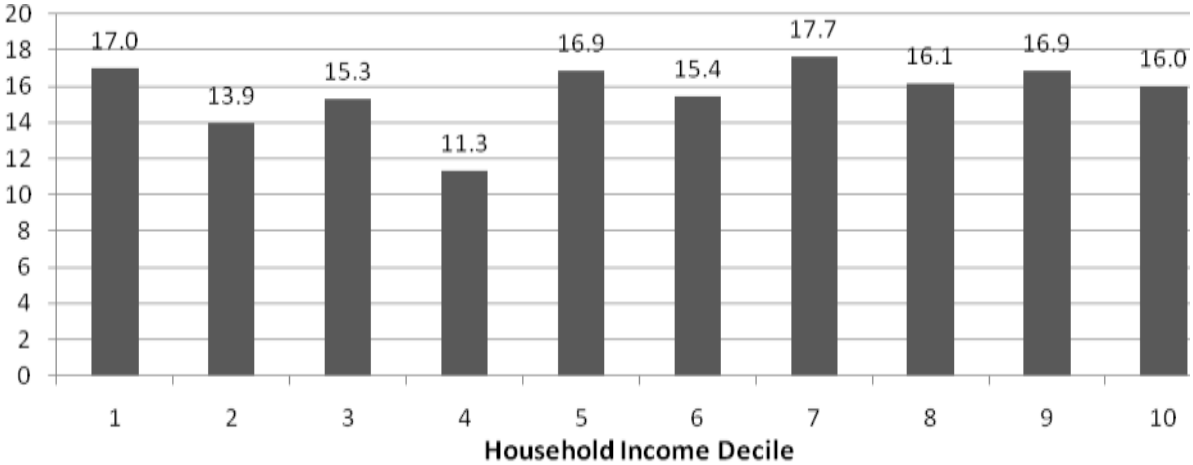
In the first section, there was a positive relationship between repetitive strain injuries and income level. Chart 30 shows that repetitive strain is slightly more prevalent in the top three deciles than the lower deciles, however, the relationship is much less strong than in the entire population of those 12 and up (Chart 23). Again, the proportions

Chart 29: Per Cent of Workers with Diabetes by Household Income Decile, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 30: Per Cent of Workers with a Repetitive Strain Injury by Household Income Decile, 2007 and 2008



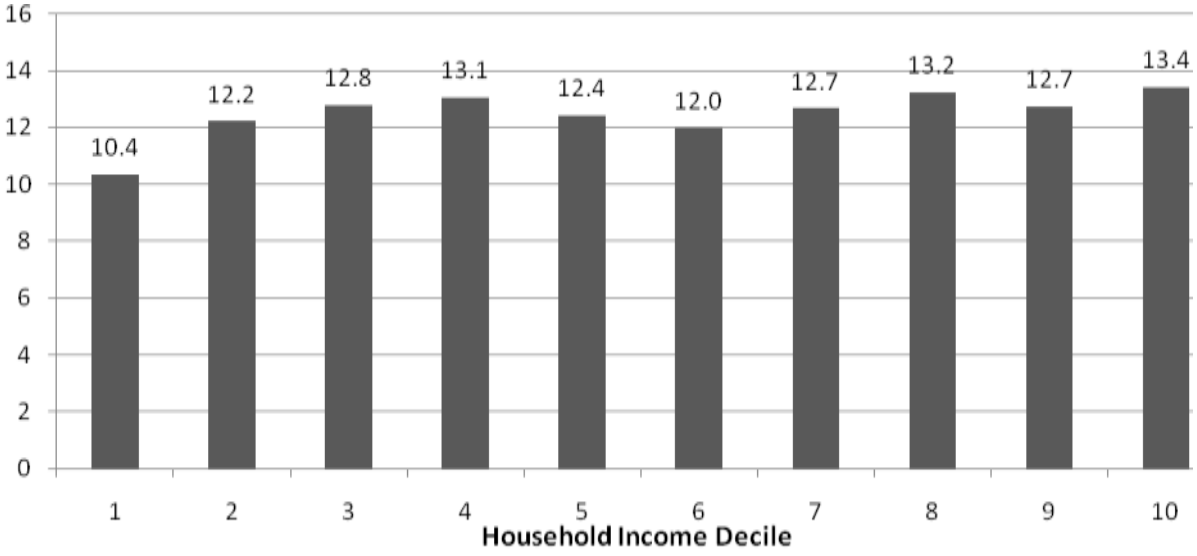
Source: 2007 and 2008 Canada Community Health Survey (CCHS)

of those who work with a household income in the top decile have about the same rate of repetitive strain injury as the general population. Unsurprisingly, this indicates that the bulk of those who are in households in the top decile are also those who are working.

Within the general population of those 12 and older, there is a higher prevalence of high blood pressure in the lower household income deciles. However, the opposite is true among the working age population (Chart 31). Among the working population, the highest household income decile has the highest proportion of those with high blood pressure (13.4 per cent) and the lowest income decile has the lowest (10.4 per cent). A possible explanation is the additional stress of working in a higher paying job which generally has more responsibility. Alternatively, high-income workers may be more likely to have the financial means to manage their high blood pressure (and any co-morbidities that may be associated with it) and remain in the workforce. Age may also be a factor; older workers are likely to have both higher earnings and higher blood pressure than younger workers.

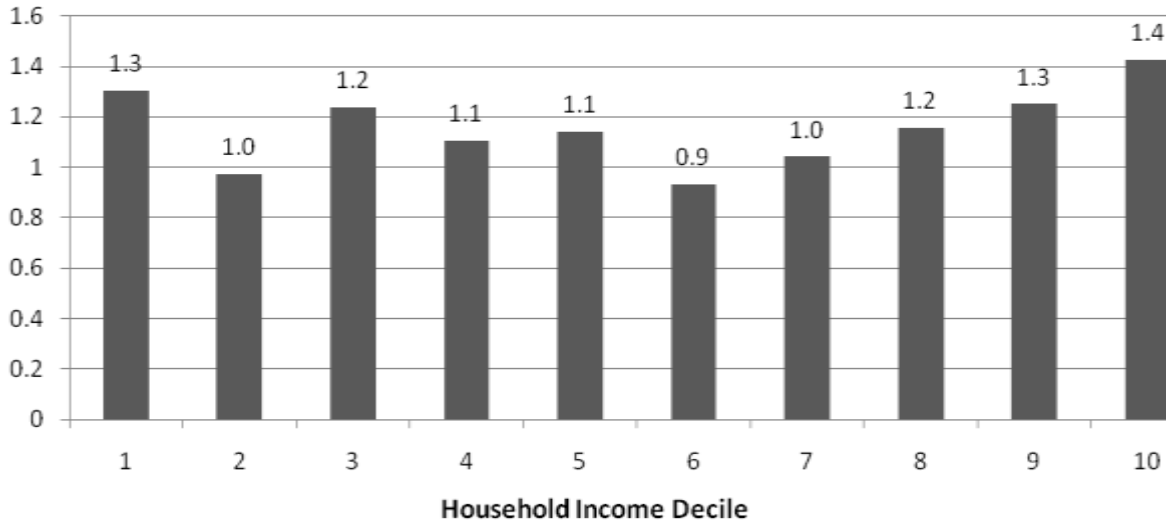
The incidence of cancer appears to have little correlation with household income among workers (Chart 32). This is not true for the entire population, in which those with lower incomes tend to have higher rates of cancer. This indicates that people with cancer are less likely to be working and therefore have lower household income.

Chart 31: Per Cent of Workers with High Blood Pressure by Household Income Decile, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Chart 32: Per Cent of Workers with Cancer by Household Income Decile, 2007 and 2008



Source: 2007 and 2008 Canada Community Health Survey (CCHS)

Exhibit 3 summarizes the health inequalities in the employed population. In most cases, the data indicate that workers at the top of the household income distribution are in better health than those at the bottom. Cancer and high blood pressure are exceptions; workers in the top household income decile are 8 per cent and 29 per cent more likely to have cancer and high blood pressure (respectively) than those in the bottom decile. This may reflect the fact that older workers are more likely than younger workers to live in high-income households and to have these illnesses.

In summary, there are large inequalities in health indicators by income group, with persons in low income households in general manifesting poorer health outcomes that persons in high-income households.

Exhibit 3: Summary of Health Inequalities for Workers by Household Income Groups, Population Aged 12 and Over, 2007 and 2008

Health Status	90:10	80:20	50:50
Conditions for which a Higher Score Implies Better Health			
Self-perceived Excellent or Very Good Health	1.39	1.31	1.00
Conditions for which a Higher Score Implies Worse Health			
Diabetes	0.76	0.80	0.86
Heart Disease	0.92	0.94	0.89
High Blood Pressure	1.29	1.15	1.05
Cancer	1.08	1.17	1.02
Repetitive Strain Injury	0.94	1.06	1.10

Note: The 90:10 ratio is the ratio of the average score of those in the top household income decile (i.e. above the 90th percentile) to that of those in the bottom decile (i.e. those below the 10th percentile). The 80:20 and 50:50 ratios are similarly defined.

The comparison of the general population aged 12 and over with the working population in terms of the distribution of health outcomes indicates that there is a more severe health gradient among non-workers than among workers (Exhibits 2 and 3). Age is probably a major factor underlying this pattern; senior citizens are less likely to work and more likely to suffer from poor health than younger people. But it may also be the case that poor health prevents some working-age people from working. This reduces 'social productivity.'

The importance of non-workers in societal health measures is highlighted by Exhibit 4, which provides a comparison between the working population and the population aged 12 and over in terms of several health status measures. All the comparisons indicate that the general population is less healthy than the population of workers (with the exception of repetitive strain injuries, which are often associated with work). As noted above, this reflects the fact that the population aged 12 and over includes elderly retirees who are likely to have low health status relative to working-age people. It also reflects the influence of non-elderly people who are kept out of the labour force by illness or injury.

Exhibit 4: Summary of Health Inequalities by Household Income Groups, Population Aged 12 and Over, 2007 and 2008

Health Status	Population Aged 12+	Employed Population	Difference
Conditions for which a Higher Score Implies Better Health			
Self-perceived Excellent or Very Good Health	59.30	63.08	-3.78
Conditions for which a Higher Score Implies Worse Health			
Diabetes	7.13	4.10	3.03
Heart Disease	6.49	2.52	3.97
High Blood Pressure	20.80	12.49	8.31
Cancer	2.45	1.15	1.30
Repetitive Strain Injury	13.00	15.65	-2.65

V. Health and the Labour Market in Canada

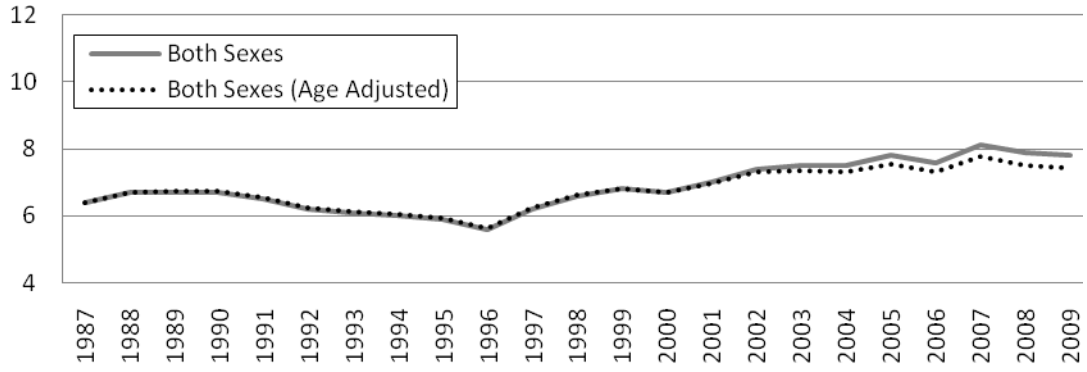
A. Absenteeism

Illness may affect productivity in per-worker terms through increased worker absence (Exhibit 1). In 2009, the average full-time worker missed 7.8 days of work due to illness or disability in Canada. Per-worker sickness absence has increased 1.4 days per year from 6.4 days in 1987 (Chart 33). About 29 per cent of this increase is due to population aging. In age adjusted terms, average days lost increased from 6.4 to 7.4 over the 1987-2009 period – an increase of 1.0 days per year. Lost days (in both age-adjusted and unadjusted terms) fell between 1987 and 1996 and reached a low of 5.4 days in 1996. The increase since then has been more dramatic than the increase over the whole 1987-2009 period.

Women miss more days of work due to illness or disability than men. Female workers lost an average of 9.3 days in 2009, while male workers lost only 6.6 (Chart 34).[12] Most of the growth in total worker absences is due to increased absence by female workers. In 1987, male workers missed 6.3 days on average. This declined to 5.0 in 1996, before rising to its 2009 level of 6.6 days – just 0.3 days higher than in 1987. Among female workers, the increase was 2.8 days, from 6.5 in 1987 to 9.3 in 2009. The female-male gap in lost work days widened from 0.2 days in 1987 to 2.7 days in 2008.

On average, older workers miss considerably more days due to illness or disability than young and prime-age workers (Chart 35). Workers aged 55 and over missed an average of 10.5 days of work in 2009, compared to 7.6 days among workers aged 25-54 and 5.3 days among workers aged 15-24. Average days missed increased

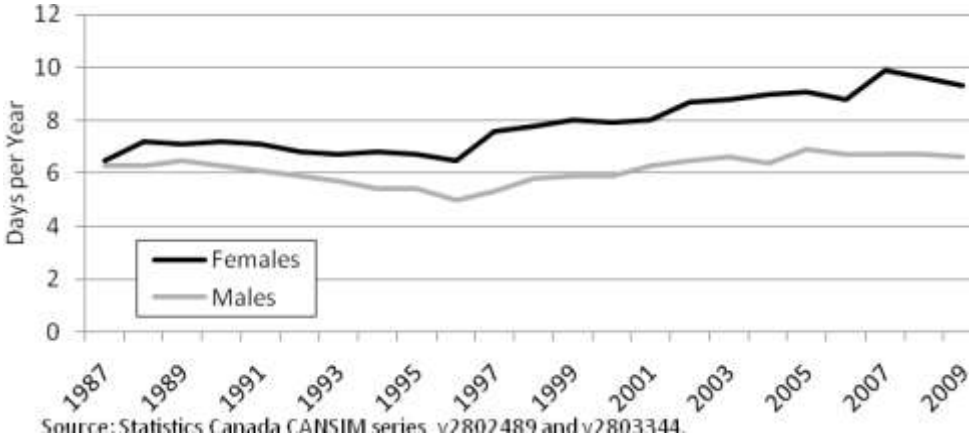
Chart 33: Average Number of Work Days Lost due to Own Illness or Disability per Full-time Employee Aged 15 or Older, Canada, Days, 1987-2009



Source: CANSIM series v2801634.
Note: Age adjustment was carried out by applying the share of full time employed workers that are 55 years of age or older in 1987 to the average days lost each year.

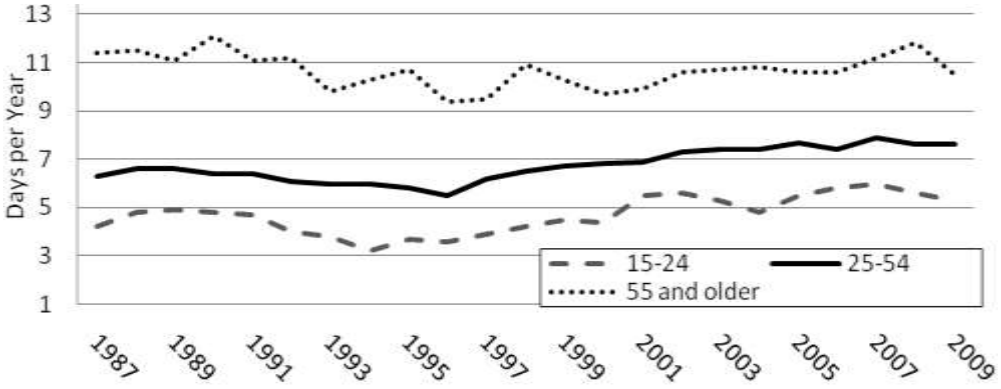
[12] Absences due to sickness or disability account for the majority of work days missed in Canada. The average worker missed 9.8 days of work in 2009 (excluding maternity leave), of which we know that 7.8 (or 80 per cent) were due to his or her own illness or disability (as opposed to personal business, looking after sick relatives, etc.). This proportion is down from 83.8 per cent in 1997; that year, 6.2 of the average worker's 7.4 missed work days were due to illness or disability. See Statistics Canada CANSIM series v2801631 for total days of work missed, excluding maternity leave.

Chart 34: Average Number of Work Days Lost due to Own Illness or Disability per Full-time Employee Aged 15 or Older by Sex, Canada, Days, 1987-2009



Source: Statistics Canada CANSIM series v2802489 and v2803344.

Chart 35: Average Number of Work Days Lost due to Own Illness or Disability per Full-time Employee Aged 15 or Older by Age Group, Canada, Days, 1987-2009



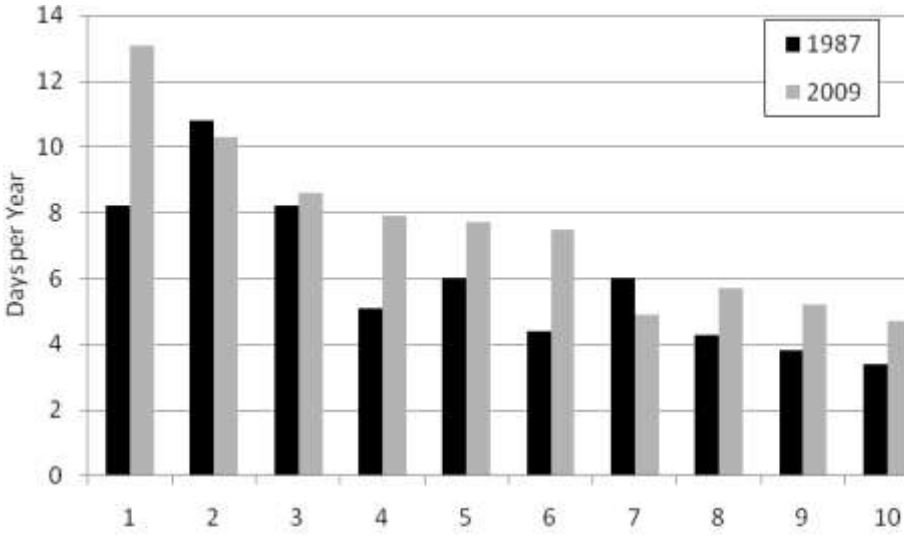
Source: CANSIM Tables v2801729, v2801919, and v2802204.

for the two youngest age groups between 1987 and 2009. The increases were 1.1 days for workers aged 15-24 and 1.3 days for prime-age workers. Among workers 55 and older, average missed days declined by 0.9 days over the period. The within-group increases drove the overall increase in missed days illustrated in Chart 33, with the compositional effect of the aging workforce also playing a role.

Chart 36 shows the average per-worker number of days lost due to own illness or disability in 1987 and 2009, broken down by occupational category. The average worker in the health sector missed 13.1 days in 2009, the most among the ten occupational categories. Workers in management missed the fewest days (on average) in 2009, with 4.7 missed days.

By far the largest absolute increase in lost days was 4.9 days, which occurred in the health sector. This is consistent with the expansion of the female-male gap in lost days over the 1987-2009 period. Note that the occupational categories with the smallest

Chart 36: Average Number of Work Days Lost due to Own Illness or Disability per Full-time Employee Aged 15 or Older by Occupational Category, Canada, Days, 1987 and 2009

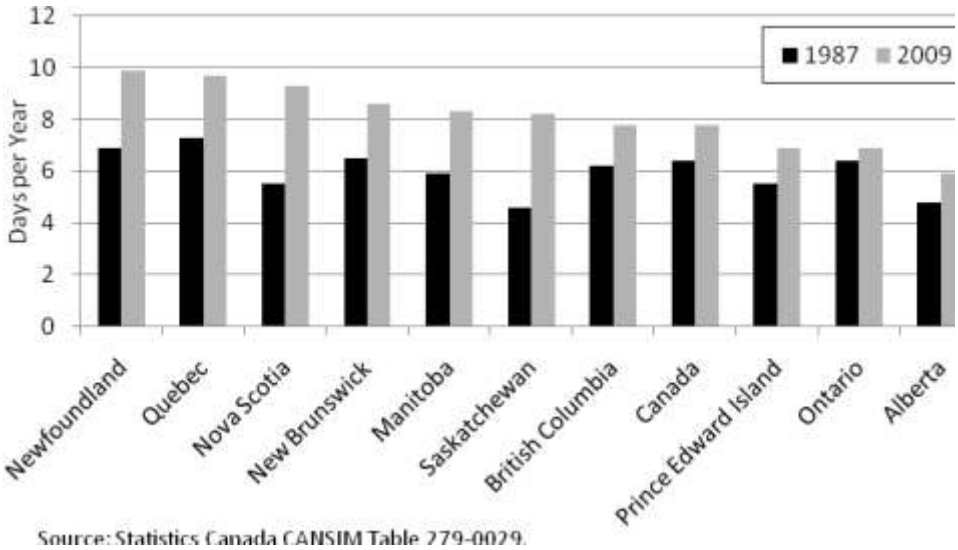


Source: Statistics Canada CANSIM Table 279-0031.
Note: The categories are defined as follows:
1. Health occupations;
2. Occupations unique to processing, manufacturing and utilities;
3. Trades, transport and equipment operators and related occupations;
4. Business, finance and administrative occupations;
5. Sales and service occupations;
6. Occupations in social science, education, government service and religion;
7. Occupations unique to primary industry;
8. Occupations in art, culture, recreation and sport;
9. Natural and applied sciences and related occupations; and
10. Management occupations.

increases (or, in some cases, decreases) in lost days over the period – trades and transport; manufacturing and utilities; primary industry; and the natural sciences – are traditionally male-dominated fields, while women are more often found in the occupations that had larger increases in lost days – health; social science, education and government; sales; and art and culture. However, these data do not explain why the average number of sickness days has increased more in 'female-friendly' occupations than in 'male-dominated' ones. Occupational characteristics are a possible explanation. For example, skilled workers in the health or government sectors may be allowed more days of paid sick leave than less well-educated workers in the trades, manufacturing, and so on.

Newfoundland lost the largest number of work days to illness or disability on average in 2009 (9.9 days per worker), followed by Quebec (9.7 days per worker) and Nova Scotia (9.3 days per worker). The lowest average was 5.9 days per worker in Alberta, perhaps reflecting the high opportunity cost of missing work in the high-wage

Chart 37: Average Number of Work Days Lost due to Own Illness or Disability per Full-time Employee Aged 15 or Older, Canada and the Provinces, Days, 1987 and 2008



Source: Statistics Canada CANSIM Table 279-0029.

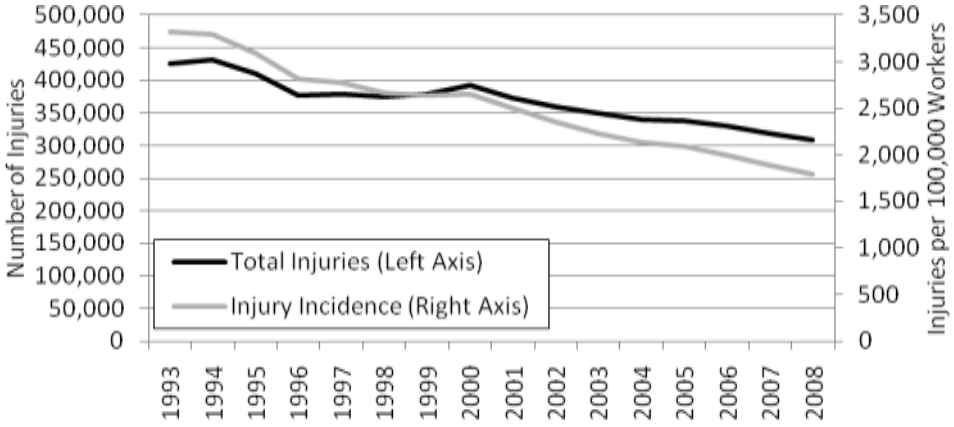
province. The average number of worker absences due to illness or disability increased in every province over the 1987-2009 period. The largest increase was 3.8 days in Nova Scotia; the smallest was 0.5 days in Ontario.

B. Workplace Injuries

Many injuries take place in the workplace. Although this report does not focus on the role of the workplace in the health of Canadians, it is worth noting that workplace injuries have declined dramatically in recent years. In 2008, 307,814 workplace injuries occurred in Canada. This was down 27.5 per cent from 424,848 in 1993. The incidence of workplace injury declined from 3,321 to 1,797 per 100,000 workers over the same period (Chart 38).[13]

[13] While workplace injuries declined over the 1993-2008 period, workplace fatalities increased. In 2008, 1,038 workers (or 6.1 per 100,000) died due to workplace accidents or occupational diseases in Canada. This was up slightly from 758 (or 5.9 per 100,000) in 1993.

Chart 38: Number and Incidence of Workplace Injuries, Canada, 1993-2008



Source: AWCBC National Work Injury and Disease Statistics and Statistics Canada Labour Force Survey, CANSIM series v2461119.

VI. Impact of Health on Productivity: Literature Review

In this section, we review the existing literature relating health to productivity. Although there are many intuitive reasons to expect a relationship running from health to productivity, relatively little theoretical work has been done to formalize those intuitions. However, a substantial empirical literature provides evidence on the health-productivity relationship at both the micro- and macroeconomic levels. At the microeconomic level, better health is associated with improved labour market outcomes for individuals. Health affects labour market participation and hours worked, while its impact on earnings per hour is less clear. At the macroeconomic level, evidence suggests that better health is associated with faster economic growth.

Before discussing the literature, it is important to note a number of challenges facing empirical work on the health-productivity relationship. It is difficult to establish the direction of causation even when a significant correlation is found. In addition, both health and productivity can be measured in various ways. Countries may differ in the types of health issues that are important for their aggregate productivity performances, and different measures of productivity may have different relationships to a given health measure. The 'best' measure of labour productivity is output per hour worked (because hours worked is a more accurate measure of labour input than other measures such as the number of workers), but most studies – especially at the macroeconomic level – use output per worker or output per capita as the productivity metric. Improvements in per-worker output do not necessarily imply improvements in per-hour output.

This literature review has six subsections. The first outlines general mechanisms linking health to productivity. The second discusses two ways of incorporating health into standard neoclassical growth theory and describes related empirical work. The third subsection addresses the impact of health on educational investment. The fourth discusses productivity losses due to absenteeism and presenteeism, and the fifth addresses the impact of health on individual labour market outcomes. The sixth subsection provides a brief summary.

A. Mechanisms Linking Health to Productivity

There are several plausible mechanisms by which health could influence productivity. As noted earlier, Bloom and Canning (2000) specify four such mechanisms:

1. *Direct impact on labour quality.* Healthy workers have high physical stamina and mental acuity relative to less healthy workers and are therefore likely to be more productive for a given number of hours worked.

2. *Incentive for educational investment.* Poor health is a barrier to school attendance and to the ability of students to learn while in school. Improved health removes these barriers. In addition, higher life expectancy increases the lifetime return to investment in education early in life.

3. *Incentive for savings and capital investment*. Longer life expectancy provides an incentive for greater retirement savings, since people expect to live longer after retirement. Higher savings translates into higher capital investment and higher productivity.

4. *Demographic Effects*. Greater survival rates for young children may reduce fertility and eventually lead to an increase in the proportion of the total population that is of working age. Female labour force participation may also rise as fewer births are required to achieve a given expected number of surviving children. These changes increase per-capita output.

The same list had been mentioned earlier by Sachs and Bloom (1998) in a paper on geography and economic development in Africa. Several of the mechanisms are likely to play a more significant role in developing countries than in developed ones. It is plausible, for example, that a poor country would experience substantial increases in the incentive for savings and investment if health investments increased the average life expectancy from 40 years to 50 years. It is less likely that similar health investments in a rich, healthy country would have large effects because life expectancy is already high. For wealthy countries, the mechanism related to the *direct impact of health on labour quality* is likely to be the most significant of the four.

This report is concerned with health as a determinant of productivity, but it is plausible that causality runs in the opposite direction. At the individual level, high-income persons may be more able to devote resources to the maintenance of their health than low-income persons. At the macro level, good average health may require investments in medical technologies or public awareness campaigns, or in underlying determinants of health such as education and early childhood development. To the extent that good health requires substantial investments, one would expect rich persons and highly productive (and therefore rich) societies to be more healthy than poor ones because they can afford to be.

B. Health and Neoclassical Growth Theory

The baseline model for understanding growth in per-capita or per-worker output is the neoclassical growth model (Solow, 1956; Swan, 1956).[14] In the standard model, output is produced using two inputs – physical capital and labour – and technology is assumed to improve the productivity of labour. Everything other than physical capital and labour that affects output is assumed to be part of technology and is not explicitly measured.

It is possible to augment the neoclassical model with additional factors of production in two ways. The first is to add additional inputs, so that instead of physical

[14] It does not matter whether we use the phrase ‘per-worker output’ or ‘per-capita output’ in this subsection, since the neoclassical model assumes that the entire population is employed in production.

capital and labour, we have physical capital, labour, and human capital (for example). [15] The second approach is to assume a precise functional form for the technology factor and explicitly include the additional factors as part of technology. Both approaches have been used to incorporate health into the neoclassical model.

The seminal work on the augmented neoclassical model is Mankiw *et al.* (1992), in which the authors include human capital as a third input in production. The term 'human capital' is broad in its meaning, but in their theoretical and empirical work, Mankiw *et al.* conceive of it as embodying only education. Knowles and Owen (1995) use the same approach to build a neoclassical growth model in which education and health are included as separate inputs to production.

Note that under this approach, health is considered to be a stock variable. Just as the economy has a stock of physical capital at any point in time, so too does it have a stock of health. The aggregate health stock can be influenced by saving a certain share of income in each time period (e.g. a share of GDP in each year) and devoting it to investment in health. Health is assumed to depreciate at a fixed rate over time (e.g. through 'wear and tear' on people's bodies), so a certain minimum level of investment is needed in each period to offset depreciation and maintain the health stock at a constant level. Moreover, additional health investment is required to keep the health-labour ratio constant because the population is assumed to grow over time. (All of these statements also apply to the stocks of physical capital and educational capital).

The augmented neoclassical model gives rise to a steady state equilibrium in which the stocks of health, physical capital and education are constant over time *in per-worker terms*. Their equilibrium per-worker levels can be derived as functions of various model parameters, including the savings rates for each type of capital. These can then be used to compute output per worker (or productivity), which is what we care about.

As is well known, the steady-state *growth rate* of output per worker is determined by an exogenous model parameter; namely the rate of technological progress. Since the neoclassical model does not explain technical progress, it does not provide a satisfactory explanation of per-worker output growth. In particular, health does not affect productivity growth in the augmented neoclassical model.

The *level* of per-worker output in a given period, however, is an increasing function of the savings rates for each type of capital. If a country increases the annual proportion of its GDP it devotes to health investment, then its per-worker health stock will increase and lead to higher output per worker.[16] The model does not explain how

[15] When factors are added in this way, a steady state solution to the model exists only under certain technical conditions. It is always possible to add more factors of production if the aggregate production technology is assumed to take a Cobb-Douglas form. All the models discussed in this subsection use a Cobb-Douglas production function.

[16] Note that the equilibrium associated with the highest productivity level is not necessarily the best from a welfare perspective. If a country devoted 100 per cent of its output to investment in productive inputs such as health, it would become extremely productive but would have zero consumption (since consumption is the difference between output and investment). It is possible to derive 'Golden Rule' savings rates that maximize consumption (in the present period and across future periods). Such savings rates are 'not too high and not too low.' There is no guarantee that real-world rates of investment in health approximate the theoretical 'Golden Rule' rate.

savings rates are determined, but it does show how higher investment in health can lead to higher steady-state productivity levels. The model predicts that countries with high savings rates for investment in health (and in physical capital, education, and any other stocks included in the model) will converge to high-productivity equilibria, and vice versa.

The neoclassical model is simplistic, but it is useful in that it generates a linear (in logarithms) equation for per-worker GDP growth as a function of the model parameters and the stocks of inputs. This equation lends itself to empirical testing by linear regression. Using cross-country regression analysis, Knowles and Owen (1995) show that the health-augmented neoclassical model explains more of the cross-country variation in per-worker income than does the neoclassical model augmented with only education (as in Mankiw *et al.* [1992]). When health (measured using life expectancy as a proxy) is included in the regressions, education loses its significance as a predictor of per-worker GDP growth.

As mentioned earlier, the second way to augment the neoclassical growth model to account for health is to explicitly model health as part of labour-improving technology.[17] Knowles and Owen (1997) assume that labour-improving technology comprises education, health, and a catch-all term that captures everything else (experience, innate ability, etc.). Each of these three variables is assumed to grow at a constant exogenous rate. This differentiates the health-as-technology approach from the health-as-input approach of Knowles and Owen (1995), in which health was a stock whose growth could be influenced by investment.

More recently, Acemoglu and Johnson (2007) use the same approach to model the impact of life expectancy in the neoclassical growth model. They assume that life expectancy determines three variables – total factor productivity, human capital, and population size – that in turn combine with physical capital and land to determine output.

In the health-as-input approach to incorporating health in the neoclassical model, investment in health affects the level of productivity but not the equilibrium growth rate. In the health-as-technology approach, increasing health directly affects the equilibrium growth rate of productivity. The level of productivity is affected only indirectly, through the compounding impact of the growth rate over time. This is the key difference between the two approaches in terms of the results they generate.

Both approaches lead to linear estimation equations that can be taken to the data. The empirical findings of Knowles and Owen (1997) are consistent with those of Knowles and Owen (1995), discussed earlier. It is noteworthy that Acemoglu and Johnson (2007) find a *negative* relationship between health and productivity in their cross-country panel regressions for the 1940-2000 period. They attribute this to health

[17] To augment the model in this way while preserving the linearity of the reduced form equation (which is desirable to the extent that we want to claim that linear GDP growth regressions are theoretically grounded) requires additional technical assumptions. In particular, technology must be modeled as a log-linear function of health (and whatever other variables are included). The models we discuss here do use this approach. There is no particular reason to think that this is a 'good' way of modeling technology. See Rodriguez (2007).

improvements having increased the population by more than they increased output, so that output per person fell. In both Acemoglu and Johnson (2007) and Knowles and Owen (1997), the samples include both rich and poor countries.

Finally, we note that the augmented neoclassical growth model – especially when it is augmented using the health-as-technology approach – is consistent with the *direct impact on labour quality* mechanism identified by Bloom and Canning (2000) and discussed above.

C. Investment in Health and its Relationship to Education

Grossman (1972) provides the standard theoretical model of demand for health and health-improving goods and services. In the Grossman model, health delivers two benefits for the consumer: it generates utility directly, and it provides 'healthy time' that can be used to perform various productive activities that ultimately lead to consumption and utility. Thus, health has properties of both consumption goods and capital goods.

The consumer has a stock of health that changes over time according to his or her investment decisions. Health is assumed to depreciate at a rate that increases with age, but the consumer can offset this by investing in health-promoting activities (medical care, healthy behaviours, etc.).

Health increases the quantity of healthy time available for production. It does not affect the quality or quantity of the work that can be done over a given span of time. In productivity terms, health improvements can increase output per person (by allowing the person to work more hours), but not output per hour worked.

The model also implies a positive relationship between health and education, with higher education causing improved efficiency in health investment. (Education increases productivity in per-hour terms and thereby increases the efficiency of all types of activities, including health investment.) This is important because education is a key driver of productivity growth. The positive relationship between health and education is substantiated by the empirical literature (Grossman and Kaestner, 1997; Smith, 2005), but the direction of causation is not clear. It is plausible that better health leads to increased education (Bloom and Canning, 2000). The model does not capture this potential aspect of the health-education relationship.

Aizer and Straud (2010) provide compelling evidence that education affects the degree to which people respond to information that is important to their health. The authors study pregnant women's behavioural responses to the 1964 United States Surgeon General Report on Smoking and Health, the report that first brought the negative health effects of smoking to public attention. They show that pregnant women with relatively high levels of education reduced their smoking immediately following the release of the report, while less well-educated women did not. Education exerted an additional influence through peer effects; women who were surrounded by well-educated women were more likely to reduce their smoking than women surrounded by less well-

educated women. These behavioural changes led to improvements in the health status of the well-educated women's children, relative to the children of the less educated women.

The findings of Aizer and Straud also suggest that improvements in the general public's health-related knowledge may exacerbate inequalities in health status (at least in the short run), since the relatively well-educated are more likely than the relatively less educated to change their behaviour in response to new health-related information.

The impact of health on education has been studied, but mostly in historical perspective or in the context of developing countries. Kalemli-Ozcan (2002, 2008) and Soares (2005) show that uncertainty about the survival rates of children causes parents to have more children as a hedge against the likelihood of deaths. When mortality rates fall (through health improvements), precautionary childbearing also declines and parents divert their resources toward investment in the human capital of their children. Earlier theoretical works that incorporated very similar mechanisms in general equilibrium models include Ehrlich and Lui (1991), Meltzer (1992), and Kalemli-Ozcan *et al.* (2000).

Since mortality rates are very low and average life expectancy is very high in developed countries today, the insights from these models may not be applicable to modern developed economies. That being said, Soares (2005) notes that the mechanisms in his model, connecting health improvements to reduced fertility to greater human capital attainment, remain operative even when mortality rates are low and educational attainment is high. He suggests that these mechanisms are consistent with the experiences of rich countries in recent years, during which fertility rates have continued to fall and education has continued to increase.

There is a great deal of empirical evidence to suggest that health in early childhood is associated with subsequent educational achievement. Low birth weight (a proxy for infant health) is associated with lower achievement in terms of high school graduation, post-secondary enrolment, standardized test scores, and IQ test scores (Currie and Hyson, 1999; Conley and Bennett, 2000; Hack *et al*, 2002). Using a rich longitudinal dataset from the United Kingdom, Case *et al.* (2005) attribute poor educational outcomes to various indicators of poor health, including shortness of height, whether or not the mother smoked during pregnancy, and the number of physician-diagnosed chronic conditions suffered at ages 7 and 16.

Currie (2005) shows that indicators of poor health are associated with low school-readiness among American toddlers. Currie *et al.* (2009) find that air pollution in Texas school districts causes increased school absences through its impact on health. Currie and Stabile (2006) and Fletcher and Wolfe (2008) examine mental health among American and Canadian children and show that attention deficit hyperactivity disorder (ADHD) increases the probability of repeating grades in school and decreases scores on math tests. Evidence on the effects of obesity on education is mixed. Okunade *et al.* (2009) and Cho (2009) find that overweight students perform relatively poorly in school, while Kaestner and Grossman (2008) and Kaestner *et al.* (2009) find that their performance is the same as that of students of average weight.

There exists some evidence that runs contrary to these findings. Gorman (2002) finds no statistically significant relationship between low birth weight and subsequent cognitive development as measured by scores on tests of verbal ability. Kaestner and Corman (1995) find only weak relationships between reading and math scores and various health measures including birth weight, shortness of height, very low BMI, and the presence of illnesses (e.g. asthma, heart trouble, or a chronic nervous disorder). However, the balance of the evidence suggests that children's health does affect their cognitive and educational outcomes. This is important because the accumulation of human capital is a key determinant of productivity at both the individual and aggregate levels. The implication is that child health is a key productivity issue that policymakers should examine closely.

We know of no studies that examine the impact of health on education among adults. It is plausible that poor health could make it more difficult for older workers to pursue training. Poor health could also reduce the efficiency of the mental process by which workers transform work experience into human capital. These possibilities have productivity implications, but research is required to understand whether or not they are empirically significant issues.

D. Health, Absenteeism, and Presenteeism

A key impact of health on production at the firm level is that unhealthy workers may frequently miss work (absenteeism) or come to work in spite of illness and operate at below-normal productivity (presenteeism).[18] Absenteeism reduces productivity in per-worker terms, since the absent worker produces no output but is still counted as a worker. It may reduce per-hour output if the absence of one worker reduces the productivity of other workers. Presenteeism reduces productivity in both per-worker and per-hour terms, since the worker is still working normal hours but is producing abnormally low output per hour.

Most studies of the impact of absenteeism assume that the cost (in terms of lost output) of a worker's absence from work is equal to the daily wage rate, with the wage assumed to be equal to the worker's marginal productivity (e.g. Rice and Miller, 1993; Greenberg *et al.*, 1993). Pauly *et al.* (2002) construct a model to show that the true costs of worker absence can actually be much greater than the wage rate. In particular, the wage understates the value of lost output if the production process is team-based and a perfect substitute for a missing worker is not available. In the extreme case illustrated by Pauly *et al.*, two types of workers must be used along with capital in fixed proportions in order to produce output. If one worker is absent and cannot be replaced, then some of the other workers and capital must sit idle that day (since they cannot operate without the

[18] Absenteeism is habitual absence from work for any reason. It need not be associated with health. In this report, however, we use it to refer to worker absence due to illness.

missing worker). The reduction in output therefore reflects the lost output of the entire team, which is necessarily greater than the wage of the missing worker.[19]

In productivity terms, absenteeism in the context of team production reduces both per-hour and per-worker output. The absence of one worker reduces the productivity of the team members although they are still at work, so output per hour worked at the firm declines.

Nicholson *et al.* (2006) summarize the results of the Pauly *et al.* model in terms of three necessary conditions for the productivity loss from absenteeism to exceed the wage rate of the absent worker:

1. The employer must not be able to find a close substitute for the missing worker;

2. Production must be team-based in the sense that one worker's absence affects the productivity of other workers in the team; and

3. The firm's demand must be time-sensitive in the sense that revenue will fall if production is postponed.

Using survey data on 810 American firms, Nicholson *et al.* show that the cost associated with absenteeism varies across jobs according to the degree to which these three conditions are satisfied. The negative impact of a two-week worker absence (as subjectively assessed by firm managers) is larger for jobs that satisfy the three conditions than for those that do not. Across all jobs and firms, the median ratio of the two-week absence-induced output loss to the annual wage of the worker is 1.28.

Pauly *et al.* (2008) use the same data to examine the productivity impact of presenteeism. The find that jobs with low worker substitutability, substantial team production and time-sensitive demand are associated with larger productivity losses from presenteeism than jobs without those characteristics. This shows that the Pauly *et al.* (2002) model can account not only for the effects of absenteeism, but also for presenteeism. Indeed, Tompa (2002) points out that the model can be generalized to account for any health-related productivity changes.

There is a substantial empirical literature on worker absence, but the role of health as a determinant of absence has received surprisingly little attention. There are many reasons that a person may be absent from work that are unrelated to health. For example, workers with greater perceived job security experience more sickness absences (Khan and Rehnberg, 2009; Olsson, 2009), as do workers whose spouses have retired (Hesselius, 2009). But comprehensive literature reviews by Alexanderson (1998) and Harrison and Martoccio (1998) find that health (and especially short-term health problems) had rarely been analyzed as causes of absenteeism as of the late 1990s. This is

[19] The team is paid a combined wage equal to its marginal revenue product, and the wage must be shared among the team members. Thus, the wage of each team member must be less than the marginal product of the team.

especially perplexing because most of the 320 studies included in Alexanderson's review are from the field of medicine rather than economics or management.

Nevertheless, the existing evidence does support the intuition that sickness is an important determinant of worker absence. Barmby and Larguem (2009) show that manufacturing workers are more likely to miss work due to illness when many of their coworkers are also missing work due to illness. This suggests that the transmission of illnesses between coworkers is a driver of absenteeism. Evidence from the Whitehall II study in the United Kingdom indicates that persons with 'average' or 'worse' health over the year prior to the survey experienced high levels of sickness absence relative to respondents in better health (Marmot *et al.*, 1995; North *et al.*, 1993). A literature review by Tompa (2002) finds that mental health problems such as depression and anxiety are commonly cited reasons for worker absence (Kessler *et al.*, 1999; Simon *et al.*, 2001).

Presenteeism is less well-researched than absenteeism. Theoretical work by Chatterji and Tilley (2002) and Brown and Sessions (2004) shows that presenteeism provides an incentive for firms to provide more generous sickness benefits than they otherwise might. Workers who come to work sick may infect coworkers and precipitate increased absenteeism in the future. Empirical evidence suggests that the spread of disease among workers is a significant cause of worker absence (Barmby and Larguem, 2009). In addition, persons who report to work in spite of illness place their own health at risk and may cause greater productivity losses down the road (Bergstrom *et al.*, 2009).

Loeppke *et al.* (2007; 2009) provide empirical evidence to suggest that the productivity costs of absenteeism and presenteeism are substantial. The authors collect data on almost 50,000 workers from nine firms in the United States. The data include workers' self-reported chronic health conditions, self-reported sickness absences over a one-month period, and self-assessed on-the-job performance during work days over a one-month period. The results indicate that the productivity losses associated with health-related absenteeism and presenteeism are, on average, 2.3 times greater than the direct medical and pharmacy costs faced by firms. The most important illnesses in terms of total workplace costs are depression, obesity, arthritis, back or neck pain, and anxiety.

E. Health, Wages, and Labour Market Participation

The impact of health on earnings and labour market participation has been well researched. Poor health, either in childhood or in adulthood, is associated with lower earnings and lower rates of labour force participation. A key issue from a productivity perspective is whether the reduction in earnings is the result of a lower hourly wage or fewer hours worked. A lower wage suggests a lower productivity level, under the assumption that wages reflect workers' productivity. Fewer hours worked do not necessarily imply anything about individual productivity on a per-hour basis. To the extent that labour market non-participants are likely to be less productive than participants, lower labour market participation could improve aggregate labour productivity through a compositional effect (although total output would be lower).

A large empirical literature shows that adult wages are influenced by childhood health. Many studies find that low birth weight babies go on to earn lower wages (Currie and Hyson, 1999; Bartley *et al.*, 1994). In particular, Behrman and Rosenzwerg (2004) and Black *et al.* (2007) exploit birth weight differences between twins to eliminate unobservable characteristics driven by genetic or environmental factors. Both studies find that higher birth weight leads to significantly higher wages. Case and Paxson (2010) use childhood height as an indicator of health and find that shorter children go on to earn lower hourly wages than their taller peers (and, in particular, their siblings). Smith (2009) shows that an index of self-assessed childhood health is positively related to the level and growth of wages in adulthood.

Labour market outcomes are also affected by health during adulthood. Currie and Madrian (1999) review the literature on health and labour market outcomes through the late 1990s. Their overview suggests that health does affect wages, but the size of the impact depends on the health measure being used and the impact of health on hours worked tends to be larger than the impact on wages. The latter finding is consistent with the Grossman (1972) model, in which good health increases the healthy time available for work.

In more recent research, Andren and Palmer (2008) find that Swedish workers with a long sickness spell in their past work fewer hours than those with no such history. Cai (2009) estimates a simultaneous equation model for health and wages and shows that self-assessed health has a positive impact on the wages of male Australian workers.

A particularly important health challenge for developed countries is mental health. The empirical literature consistently finds that mental illnesses have negative effects on employment and labour market participation (which affect output per working-age person), while the findings are mixed with respect to wages. Using instrumental variables techniques, Ettner *et al.* (1997) show that mental illness (of any type) reduces employment by 12 to 14 per cent. Their regressions also find negative effects on wages, but they are not statistically significant. Jofre-Bonet *et al.* (2005) find that poor mental health has a significant negative effect on the hourly wages of both men and women, while Marcotte *et al.* (2000) find a negative effect only for women. Suicidal behaviour – a particularly extreme expression of mental unrest – is associated with decreases of up to 50 per cent in annual income among American workers (Kalist *et al.*, 2007). This is driven by a 20 percentage-point reduction in the probability of employment among persons who have attempted suicide; the effect on wages is not clear.

There is evidence that most estimates of the impact of mental health suffer from omitted variable bias. Using longitudinal data on labour market activity and depressive symptoms, Cseh (2008) finds that the estimated impact of depression on wages is drastically smaller when individual fixed effects are used to control for personal characteristics. Cseh suggests that the larger effects often found in the literature may capture unmeasured personality characteristics such as pessimism, passivity, and indecisiveness, which are associated with both mental illness and poor labour market outcomes.

Health-related issues such as obesity and smoking are commonly found to be associated with labour market outcomes. For example, Mocan and Tekin (2009) find that obesity leads to lower self-esteem and lower wages, especially among women. Smoking is associated with a wage penalty of two to four per cent (Heineck and Schwarze, 2003; van Ours, 2004; Auld, 2005). However, the evidence does not prove that the reduced earnings reflect lower productivity. Recent studies on obesity (Han *et al.*, 2009; Kromann, 2009), smoking (Anger and Kvasnicka, 2006; Baum *et al.*, 2006), and dental health (Glied and Neidell, 2008) suggest that the negative wage effects of obesity, smoking and bad dental health may reflect consumers' and employers' distaste for those characteristics rather than productivity shortfalls on the part of the workers.[20] Further, most studies do not adequately address the problem of two-way causation between labour market outcomes and unhealthy characteristics. When Norton and Han (2008) use genetic information to create instrumental variables for obesity, they find that obesity has no impact on wages.

Alcohol consumption has no negative impact on wages (Bray, 2005). Indeed, some studies find that drinkers – even heavy drinkers – earn higher wages than non-drinkers on average (Zarkin *et al.*, 1998). Renna (2006) provides evidence that alcoholism does reduce hours worked, but has no effect on wages conditional on being employed.

F. Summary

The balance of the evidence suggests that health is an important underlying determinant of productivity at the micro- and macroeconomic levels. Macroeconomic studies tend to emphasize health metrics such as life expectancy, which may be more relevant to developing countries than to developed ones. Empirical studies use cross-country regression analysis, usually on a sample that includes both rich and poor countries. Most of these studies find that health is a key driver of growth in per-worker output – even more important than education – but they suffer from the statistical problems of multicollinearity and two-way causality that plague all cross-country growth analysis. We found no study that analyzes the impact of health on output per hour worked, the best measure of productivity.

At the microeconomic level, empirical studies use a broad variety of health measures and typically use labour market outcomes (wages, employment, etc.) as the outcome variables. Health tends to have more significant effects on labour time (i.e. employment, hours worked, etc.) than on per-hour wages, but some studies do find that health affects wages. The strongest evidence pertains to the impact of childhood health on subsequent educational and labour market outcomes. This suggests that investments in prenatal and childhood health could yield substantial long-run returns.

[20] Note that in some industries, particularly those that require direct interaction with customers, consumer distaste for certain personal characteristics is likely to be important for productivity. Workers who are physically fit, have good teeth, and do not smell of cigarette smoke may indeed be more productive than those who do not have those characteristics if customers find them more appealing to deal with. The findings of Kromann (2009) suggest that firms are less likely to hire overweight people for jobs that involve direct contact with customers.

VII. Impact of Health on Productivity

Section III showed that Canadians are leading longer lives than ever before but that those lives are not necessarily becoming healthier. In this section, we discuss the potential impact of health on Canada's productivity performance. In keeping with the framework outlined in Exhibit 1, we focus on the three health-related issues linking health to labour markets: presenteeism, absenteeism, and the impacts of health on 'social productivity' measures.

A. Presenteeism

When a worker goes to work sick, his or her physical and mental capabilities are likely to be below average due to the illness. This reduces productivity in both per-hour and per-worker terms.

Unfortunately, we do not possess data that allows us to directly examine the issue of presenteeism. As we noted in the literature review in Section VI, presenteeism is not a well-researched problem in general. We know from Section III that the prevalence rates of several long-lasting health conditions have been rising – diabetes, obesity, high blood pressure, asthma – and such conditions could affect productivity through presenteeism (Loeppke *et al.*, 2009). A mental illness such as depression might also have an impact, but depression rates have fallen throughout the post-2000 period of low productivity growth in Canada and were no higher in 2008 than they had been in 1994. Presenteeism is also likely to be an issue when a worker suffers from an acute, temporary illness, such as a flu or a bad case of the common cold, that reduces productivity for a short time but is not bad enough to prevent the worker from attending work.

Presenteeism has two equally important components. First, workers must get sick. Second, they must decide to go to work given that they are sick. Thus, it depends as much on the formal and informal institutions surrounding work as it does on the condition of workers' health. For example, presenteeism may be high if firms do not provide many days of paid sick leave or if workers believe that they will be punished for taking a day off. The best way to combat presenteeism may be to encourage workers to stay home when they are sick. Indeed, firms have an incentive to encourage sick workers to stay home in order to prevent the spread of communicable illnesses (Chatterji and Tilley, 2002; Brown and Sessions, 2004).

We have no reason to conclude that the problem of presenteeism is growing more severe in Canada – especially given that absenteeism has increased – but neither can we rule it out. More research and better data on presenteeism are required, especially when the aging of society leads to an increase in the share of the labour force that is over the age of 65.

B. Absenteeism

As shown in Section V, absenteeism due to illness or disability increased in Canada over the 1987-2009 period. Since absent workers produce no output but are still classified as workers, absenteeism necessarily reduces output per worker. Absenteeism could affect output per hour if high-productivity workers and low-productivity workers are not equally likely to get sick and miss work, but we have no reason to think that this is the case.

As a practical matter, the impact of rising absenteeism on aggregate productivity is small but not negligible. The average per-worker number of days lost due to illness or disability increased by 1.5 days (from 6.4 to 7.9) between 1987 and 2008. Assuming that the average worker can work up to 250 days per year, output per worker would have been only 0.6 per cent higher than it actually was in 2008 if the 1.5-day increase in absences had not occurred.[21] In terms of annual growth over the span of 21 years, this would barely have registered; the compound annual growth rate of per-worker output would have been 0.029 percentage points higher – 1.076 per cent per year instead of 1.048 per cent per year.[22] Per-worker real GDP in 2008 would have been $463 higher than its actual 2008 value (in 2002 dollars).[23] In aggregate terms, this amounts to an increase of $7.9 billion (or 0.6 per cent) in real GDP in 2008. This is not insignificant.

The *level* of absenteeism is also important. If zero days had been lost to illness or disability, real per-worker GDP in 2008 (in 2002 dollars) would have been $79,594 – $2,438 higher than its true value of $77,156. In aggregate terms, real output in 2008 would have been $41.8 billion (or 3.2 per cent) higher in 2008 if there had been no absenteeism.

The key message is that absenteeism imposes substantial losses in terms of foregone output. The *change* in absenteeism over the 1987-2008 period made a small but non-negligible impact on Canada's productivity growth in per-worker terms. None of this analysis touches on output per hour worked, the standard measure of productivity. These calculations assume that the absence of an average worker does not affect the productivity of other workers. The productivity losses from absence could be larger if such externalities do exist (Pauly *et al.*, 2002). Nevertheless, the fact remains that the change in average annual worker absences over the 1987-2008 period was not large. It is unlikely that worker absence has had a substantial impact on productivity growth during that time period.

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[21] If output per day were unchanged and each worker worked 1.5 more days per year, then output per worker would have increased by 100*(1.5/250) = 0.6 per cent.

[22] Per-worker output would have increased by 0.6 per cent, or by a factor of 1.006. Simple calculations show that: $1.006 = (1+x)^{21}$ implies $x = 0.000285$.

[23] This is based on per-worker GDP figures taken from Table 10 in the CSLS database *Aggregate Income and Productivity Trends: Canada vs United States, 1961-2008*, available at http://www.csls.ca/data/ipt1.asp.

C. Impact of Health on 'Social Productivity'

The most substantial impact of health improvements on productivity is likely to occur in the domain of 'social productivity,' as defined in Exhibit 1. A chronic illness like diabetes or asthma may not cause a worker to experience periods of unusually low productivity, but long-term illness or disability may prevent people from entering the labour force at all. Unemployment results in lower output per labour force participant, while labour force non-participation results in lower output per working-age person.

We have called these concepts 'social productivity measures' because one can view them as measures of the efficiency with which a society utilizes its total potential labour input. However, they are not productivity measures in the strictest sense of the term (that is, measures of the output of a production process per unit of input used). It is better to think of them as output measures. Poor health may not have a large impact on aggregate productivity (in per-hour or per-worker terms), but it can substantially reduce living standards by reducing the total amount of output available to support the population.

From this perspective, this report ties in with the literature on the economic burden of illness. Many studies assess the total cost of poor health to an economy, including both direct costs (e.g. medical expenses) and the indirect cost of foregone output (Health Canada, 2002; Public Health Agency of Canada, 2009). To estimate the amount of output foregone due to illness is beyond the scope of this report, but the losses are likely to be substantial. Such costs are important even if they do not show up in the data in the form of lower per-worker or per-hour productivity levels.

The health conditions that prevent people from finding employment are not likely to be problems with easy medical solutions. To the extent that it is amenable to policy, however, the health of the non-employed is a key area for policy focus. In Section IV, we showed that health inequalities across the income distribution are much less pronounced for the employed population than they are for the total population (employed plus non-employed). This suggests that employment is a key variable underlying the health inequalities; those with poor health have low incomes because they are unable to work. If the health of these people could be improved enough to allow them to enter the labour force, less output would be foregone and 'social productivity' would increase.

VIII. Conclusions and Policy Directions

Canada's labour productivity performance, defined as output per hour worked, has been abysmal since 2000, both relative to our historical experience and to that in the United States. From a growth accounting perspective a fall in multifactor productivity accounts for the lion's share of the slowdown in labour productivity growth. Unfortunately, multifactor productivity growth is a measure of our ignorance. In theory, a deterioration in the health status of Canadian workers could explain slower labour and multifactor productivity growth. Yet there is no evidence that there is greater incidence of presenteeism; that is, that a greater proportion of sick (and therefore less productive) workers are on the job. Indeed, with the increased absenteeism, it is possible that presenteeism is falling as sick workers have a greater propensity to stay home, assuming the incidence of work-absence-inducing sickness is constant. In any case, we need better information on the number of persons who go to work sick, the type of sicknesses they suffer from, their productivity at work, and their contagion effect on other workers.

When productivity is defined in terms of output per worker, increased absenteeism in Canada due to sickness can be shown to have decreased the rate of growth of output per worker over the 1987-2008 period. However, the magnitude of the effect, 0.03 per cent per year, is minute.

There is no doubt that illness and disability impose a massive indirect economic burden on the Canadian economy because many persons of working age are unable to work. Canada's potential output level, or social productivity, is lower because of this situation. But this is an output shortfall issue, not a conventional productivity issue, and it is important not to confuse the two.

From the point of view of potential benefits to society, the issue of presenteeism, a true productivity issue, is likely less important than the issue of absenteeism and the issue of social productivity. From this perspective it is lost output that should be the focus, not lost productivity. Unfortunately, the two concepts are often confused in the eyes of the public and media. A recent example is the HIN1 episode where media headlines screamed of lost productivity while Statistics Canada accurately reported on lost work hours.

Consequently, a key societal goal should be to reduce absenteeism and to foster the entry of disabled persons into the workforce. This is equivalent to saying that better health will reduce the indirect burden of illness.

There are many policy directions that can be taken to promote a healthier and more productive population. Three suggestions are made here. First, the link between child health and subsequent labour earnings (which are a proxy for productivity) is one of the strongest empirical results in the literature on health and productivity. This suggests that investments in prenatal and infant health may have a significant impact on productivity. Although the gains would not be observed for many years, the investments would pay off in the long run.

Second, it has been shown that the health status of the population is strongly correlated with educational attainment and that much of this relationship flows from education to better health. Better educated persons make better health decisions. Consequently, policies that promote increased education will have the additional bonus of improving health outcomes.

Finally, many persons are out of the workforce permanently or temporarily because of workplace accidents and occupational illnesses. These accidents impose a massive cost on society, both directly and indirectly. A key priority should be to strengthen health and safety programs and regulations to reduce workplace accidents and occupational illnesses.

Bibliography

Acemoglu, Daron, and Simon Johnson (2007) "Disease and Development: The Effect of Life Expectancy on Economic Growth," *Journal of Political Economy*, Vol. 115, No. 6, pp. 925-985.

Aizer, Anna, and Laura Straud (2010) "Education, Knowledge and the Evolution of Disparities in Health," National Bureau of Economic Research, Working Paper No. 15840, March.

Alexanderson, Kristina (1998) "Sickness Absence: A Review of Performed Studies with (sic) Focused on Levels of Exposures and Theories Utilized," *Scandanavian Journal of Social Medicine*, Vol. 26, No. 4, pp. 241-249.

Andren, Daniela, and Edward palmer (2008) "The Effect of Sickness History on Earnings in Sweden," *Economic Issues*, Vol. 13, No. 1, pp. 1-23.

Anger, Silke, and Michael Kvasnicka (2006) "Biases in Estimates of the Smoking Wage Penalty," DIW Berlin Discussion Paper No. 654. http://www.diw.de/documents/publikationen/73/diw_01.c.55665.de/dp654.pdf.

Arsenault, Jean-Francois and Andrew Sharpe (2008) "An Analysis of the Cause of Weak Productivity Growth in Canada Since 2000," *International Productivity Monitor*, Spring, pp. 14-39.

Auld, M. Christopher (2005) "Smoking, Drinking, and Income," *Journal of Human Resources*, Vol. 40, No. 2, pp. 505-518.

Barmby, Tim, and Makram Larguem (2009) "Coughs and Sneezes Spread Diseases: An Empirical Study of Absenteeism and Infections Illness," *Journal of Health Economics*, Vol. 28, pp. 1012-1017.

Bartley, M., C. Power, D. Blane, G. D. Smith, and M. Shipley (1994) "Birth Weight and Later Socioeconomic Disadvantage: Evidence from the 1958 British Cohort Study," *BMJ*, Vol. 309, pp. 1475-1478.

Baum, Charles L., William F. Ford, and Jeffrey D. Hopper (2006) "The Obese Smoker's Wage Penalty," *Social Science Quarterly*, Vol. 87, No. 4, pp. 863-881.

Behrman, Jere R., and Mark R. Rosenzweig (2004) "Returns to Birthweight," *Review of Economics and Statistics*, Vol. 86, No. 2, pp. 586-601.

Bergstrom, G., L. Bodin, J. Hagberg, G. Aronsson, and M. Josephson (2009) "Sickness Presenteeism Today, Sickness Absenteeism Tomorrow? A Prospective Study on Sickness Presenteeism and Future Sickness Absenteeism," *Journal of Occupational and Environmental Medicine*, Vol. 51, No. 6, pp. 629-638.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes (2007) "From the Cradle to the Labor market? The Effect of Birth Weight on Adult Outcomes," *Quarterly Journal of Economics,* Vol. 122, No. 1, pp. 409-439.

Bloom, David E., and David Canning (2000) "The Health and Wealth of Nations," *Science's Compass* No. 287, pp. 1207-1209.

Bloom, David and David Canning (*2008)* "Population Health and Economic Growth," Working paper No 24.. Commission on Growth and Development. World Bank.

Bloom, David E., and Jeffrey D. Sachs (1998) "Geography, Demography, and Economic Growth in Africa," *Brookings Papers on Economic Activity,* Vol. 29, Iss. 2, pp. 201-296.

Branca, F. H. Kikogosian, and T. Lobstein, eds. (2007) *The Challenge of Obesity in the WHO European Region and the Strategies for Response* (Geneva: World Health Organization).

Bray, Jeremy W. (2005) "Alcohol Use, Human Capital, and Wages," *Journal of Labor Economics,* Vol. 23, No. 2, pp. 279-312.

Brown, Sarah, and John G. Sessions (2004) "Absenteeism, 'Presenteeism', and Shirking," *Economic Issues,* Vol. 9, No. 1, pp. 15-23.

Cai, Lixin (2009) "Effects of Health on Wages of Australian Men," *The Economic Record,* Vol. 85, No. 270, pp. 290-306.

Case, Anne, Angela Fertig and Christina Paxson (2005) "The Lasting Impact of Childhood Health and Circumstance," *Journal of Health Economics,* Vol. 24, pp. 365-389.

Case, Anne, and Christina Paxson (2010) "Causes and Consequences of Early Life Health," National Bureau of Economic Research, Working Paper 15637, January.

Chatterji, Monojit, and Colin J. Tilley (2002) "Sickness, Absenteeism, Presenteeism, and Sick Pay," *Oxford Economic Papers,* Vol. 54, No. 4, pp. 669-687.

Cho, Seong-Hoon, Dayton M. Lambert, Hyun Jae Kim and Seung Gyu Kim (2009) "Overweight Korean Adolescents and Academic Achievement," *Journal of Family and Economic Issues,* Vol. 30, No. 2, pp. 126-136.

Collins-Nakai, Ruth (2005) *A Prescription for Productivity: Toward a more Efficient Equitable and Effective Health System.* Canadian Medical Association. Presentation to the Standing Committee on Finance. Ottawa. October 24th, 2005.

Conley, Dalton, and Neil G. Bennett (2000) "Is Biology Destiny? Birth Weight and Life Chances," *American Sociological Review*, Vol. 65, pp. 458-467.

Cseh, Attila (2008) "The Effects of Depressive Symptoms on Earnings," *Southern Economic Journal*, Vol. 75, No. 2, pp. 383-409.

Currie, Janet (2005) "Health Disparities and Gaps in School Readiness," *Future of Children*, Vol. 15, No. 1, pp. 117-138.

Currie, Janet, Eric A. Hanushek, E. Megan Kahn, Matthew Neidell, and Steven G. Rivkin (2009) "Does Pollution Increase School Absences?" *Review of Economics and Statistics*, Vol. 91, No. 4, pp. 682-694.

Currie, Janet, and Mark Stabile (2006) "Child Mental Health and Human Capital Accumulation: The Case of ADHD," *Journal of Health Economics*, Vol. 25, No. 6, pp. 1094-1118.

Currie, Janet, and Rosemary Hyson (1999) "Is the Impact of Health Shocks Cushioned by Socioeconomic Status? The case of Low Birthweight," *American Economic Review*, Vol. 89, No. 2, pp. 245-250.

Currie, Janet, and Brigitte C. Madrian (1999) *Health, Health Insurance and the Labor Market* (New York: Elsevier Science).

Ehrlich, Isaac, and Francis T. Lui (1991) "Intergenerational Trade, Longevity, and Economic Growth," *Journal of Political Economy*, Vol. 99, No. 5, pp. 1029-1059.

Ettner, Susan L., Richard G. Frank, and Ronald C. Kessler (1997) "The Impact of Psychiatric Disorders on Labor Market Outcomes," *Industrial and Labor Relations Review*, Vol. 51, pp. 64-81.

Finkelstein, E.A., P.S. Corso, and T.R., Miller (2006) Associates. *Incidence and Economic Burden of Injuries in the United States*. (New York: Oxford University Press).

Fletcher, Jason, and Barbara Wolfe (2008) "Child Mental Health and Human Capital Accumulation: The Case of ADHD Revisited," *Journal of Health Economics*, Vol. 27, No. 3, pp. 794-800.

Gabriel, Phyllis, and Marjo-Riitta Liimatainen (2000) *Mental Health in the Workplace*. (Geneva: International Labour Office).

Glied, Sherry, and Matthew Neidell (2008) "The Economic Value of Teeth," National Bureau of Economic Research, Working Paper 13879, March.

Goldsmith, L.J., B. Hutchinson, J. Hurley (2004) "Economic Evaluation Across the Four Faces of Prevention: A Canadian Perspective," Centre for Health Economics and Policy Analysis, Working Paper 06-01.

Gorman, Bridget K. (2002) "Birth Weight and Cognitive Development in Adolescence: Causal Relationship or Social Selection?" *Social Biology*, Vol. 49, No. 1-2, pp. 13-34.

Greenberg, P. E., L. Stiglin, S. Finkelstein and E. Berndt (1993) "Depression: A Neglected Serious Illness," *Journal of Clinical Psychiatry*, Vol. 54, No. 11, pp. 419-424.

Grossman, Michael (1972) "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy*, Vol. 80, No. 2, pp. 223-255.

Grossman, Michael, and Robert Kaestner (1997) "Effects of Education on Health," in J. R. Behrman and N. Stacey (eds.) *The Social Benefits of Education* (Ann Arbor: University of Michigan Press).

Hack, Maureen, Daniel J. Flannery, Mark Schluchter, Lydia Carter, Elaine Borawski, and Nancy Klein (2002) "Outcomes in Young Adulthood from Very-Low-Birth-Weight Infants," *New England Journal of Medicine*, Vol. 346, No. 3, pp. 149-157.

Han, Euna, Edward C. Norton and Sally C. Stearns (2009) "Weight and Wages: Fat versus Lean Paychecks," *Health Economics*, Vol. 18, No. 5, pp. 535-548.

Harrison, David A., and Joseph J. Martocchio (1998) "Time for Absenteeism: A 20-Year Review of Origins, Offshoots, and Outcomes," *Journal of Management*, Vol. 24, No. 3, pp. 305-350.

Hay, David I. (2007) *Developing an Economic Case for Financing and Social Determinants of Health*. Report on the April 2007 Roundtable. Canadian Policy Research Networks Research Report. November.

Health Canada (2002) *Economic Burden of Illness in Canada 1998*, Ottawa: Minister of Public Works and Government Services Canada.

Heineck, Guido, and Johannes Schwarze (2003) "Substance Use and Earnings: The Case of Smokers in Germany," IZA Discussion Paper No. 743. ftp://repec.iza.org/RePEc/Discussionpaper/dp743.pdf.

Hesselius, Patrik (2009) "Is Leisure Contagious? The Relationship Between Sickness Absence and Spousal Retirement," *National Institute Economic Review*, No. 209, pp. 104-115.

Heymann, Jody, Clyde Hertzman, Morris Barer and Robert Evans, eds. (2006) *Healthier Societies: From Analysis to Action* (Oxford: Oxford Unversity Press).

Jofre-Bonet, Mireia, Susan H. Busch, Tracy A. Falba, and Jody L. Sindelar (2005) "Poor Mental health and Smoking: Interactive Impacts on Wages," *Journal of Mental Health Policy and Economics*, Vol. 8, pp. 193-203.

Joumard, Isabelle & all (2004)"Health, Mental Health and Labour Productivity: The Role of Self-Reporting Bias," Working Paper. Department of Economics, Rice University.

Kaestner, Robert, and Hope Corman (1995) "The Impact of Child Health and Family Inputs on Child Cognitive Development," National Bureau of Economic Research, Working Paper 5257, September.

Kaestner, Robert, and Michael Grossman (2008) "Effects of Weight on Children's Educational Achievement," National Bureau of Economic Research, Working Paper 13764, January.

Kaestner, Robert, and Michael Grossman, and Benjamin Yarnoff (2009) "Effects of Weight on Adolescent Educational Attainment," National Bureau of Economic Research, Working Paper 14994, May.

Kalemli-Ozcan, Sebnem, Harl E. Ryder, and David Weil (2000) "Mortality Decline, Human Capital Investment, and Economic Growth," *Journal of Development Economics*, Vol. 62, pp. 1-23.

Kalemli-Ozcan, Sebnem (2002) "Does the Mortality Decline Promote Economic Growth?" *Journal of Economic Growth*, Vol. 7, pp. 411-439.

Kalemli-Ozcan, Sebnem (2008) "The Uncertain Lifetime and the Timing of Human Capital Investment," *Journal of Population Economics*, Vol. 21, pp. 557-572.

Kalist, David E., Noelle-Angelique M. Molinari, and Freddy Siahaan (2007) "Income, Employment and Suicidal Behavior," *Journal of Mental Health Policy and Economics*, Vol. 10, No. 4, pp. 177-187.

Kessler, R.C., Heeringa S, Lakoma MD, Petukhova M, Rupp AE, Schoenbaum M, Wang PS, Zaslavsky AM. (2008) "The individual-level and societal-level effects of mental disorders on earnings in the United States: Results from the National Comorbidity Survey Replication*," American Journal of Psychiatry*, published online ahead of print May 7, 2008.

Kessler, R. C., C. Barber, H. Birnbaum, R. G. Frank, P. E. Greenberg, R. M. Rose, G. E. Simon, and P. Wang (1999) "Depression in the Workplace: Effects on Short-Term Disability," *Health Affairs*, Vol. 18, No. 5, pp. 163-171.

Khan, Jahangir, and Clas Rehnberg (2009) "Perceived Job Security and Sickness Absence: A Study on Moral Hazard," *European Journal of Health Economics*, Vol. 10, no. 4, pp. 421-428.

Knowles, Stephen, and P. Dorian Owen (1995) "Health Capital and Cross-country Variation in Income per Capita in the Mankiw-Romer-Weil Model," *Economic Letters*, Vol. 48, no. 1, pp. 99-106.

Knowles, Stephen, and P. Dorian Owen (1997) "Education and Health in an Effective-Labour Empirical Growth Model," *The Economic Record*, Vol. 73, No. 223, pp. 314-328.

Kromann, Lene (2009) "Does Employee Body Weight Affect Employers' Behavior?" School of Economics and Management Working Paper 2009-04, University of Aarhus. ftp://ftp.econ.au.dk/afn/wp/09/wp09_04.pdf.

Lynch, John W., George Davey Smith, George A. Kaplan and James S. House (2000) "Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions" *British Medical Journal*, vol. 320, pp. 1200-1204.

Loeppke, Ronald, Michael Taitel, Dennis Richling, Thomas Parry, Ronald Kessler, Pam Humel, and Doris Konicvki (2007) "Health and Productivity as a Business Strategy," *Journal of Occupational and Environmental Medicine*, Vol. 49, pp. 712-721.

Loeppke, Ronald, Michael Taitel, Vince Haufle, Thomas Parry, Ronald C. Kessler, and Kimberly Jinnett (2009) "Health and Productivity as a Business Strategy: A Multiemployer Study," *Journal of Occupational and Environmental Medicine*, Vol. 51, No. 4, pp. 411-428.

MacDonald, Ryan (2008) "The Terms of Trade and Domestic Spending," *Insights on the Canadian Economy*, Statistics Canada, Economic Analysis Division.

Mackenbach, J.P., W.J. Meerding, and A.E. Kunst (2007) Economic Implications of Socio-economic Inequalities in Health in the European Union, European Health and Consumer Protection Directorate-General.

Mankiw, N. Gregory, David Romer and David Weil (1992) "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*, Vol. 107, No. 2, pp. 407-437.

Marcotte, Dave E., Virginia Wilcox-Gök, and D. Patrick Redmon (2000) "The Labor Market Effects of Mental Illness: The Case of Affective Disorders," in D. Salkever (ed.) *The Economics of Disability* (Greenwich, CT: JAI Press).

Marmot, Michael G. (2003) Understanding Social Inequalities in Health", *Perspectives in Biology and Medicine*, Vol. 46, No. 3 supplement, pp. s9-s23.

Marmot, M., A. Feeney, M. J. hipley, F. North and S. Syme (1995) "Sickness Absence as a Measure of Health Status and Functioning: From the UK Whitehall II Study," *Journal of Epidemiology and Community Health*, Vol. 49, No. 2, pp. 124-130.

Meltzer, David (1992) "Mortality Decline, the Demographic Transition and Economic Growth," Ph.D. Dissertation, University of Chicago.

Mental Health Foundation (2009) *In the Face of Fear.* www.mentalhealth.org.uk/EasySiteWeb/GatewayLink.aspx?alID=71720

Mocan, Naci H., and Erdal Tekin (2009) "Obesity, Self-esteem and Wages," National Bureau of Economic Research, Working Paper 15101, June.

Munro, Daniel (2008) *Healthy People, Healthy Performance, Healthy Profits. The Case for business Action on the Socieoeconomic Determinants of Health*. The Conference Board of Canada. Ottawa.

Nicholson, Sean, Mark V. Pauly, Daniel Polsky, Claire Sharda, Helena Szrek and Marc L. Berger (2006) "Measuring the Effects of Work Loss on Productivity with Team Production," *Health Economics*, Vol. 15, pp. 111-123.

North, F., S. Syme, A. Feeney, J. Head, M. J. Shipley, and M. Marmot (1993) "Explaining Socioeconomic Differences in Sickness Absence: The Whitehall II Study," *British Medical Journal*, Vol. 306, pp. 361-366.

Norton, Edward C., and Euna Han (2008) "Genetic Information, Obesity, and Labor Market Outcomes," *Health Economics*, Vol. 17, No. 9, pp. 1089-1104.

OECD (2008) *Employment Outlook.* Directorate for Employment, Labour and Social Affairs.

Okunade, Albert A., Andrew J. Hussey, and Mustafa C. Karakus (2009) "Overweight Adolescents and On-Time High School Graduation: Racial and Gender Disparities," *Atlantic Economic Journal*, Vol. 37, no. 3, pp. 225-242.

Olsson, Martin (2009) "Employment Protection and Sickness Absence," *Labour Economics*, Vol. 16, No. 2, pp. 208-214.

Pauly, Mark V., Sean Nicholson, Judy Xu, Dan Polsky, Patricia M. Danzon, James F. Murray and Marc L. Berger (2002) "A General Model of the Impact of Absenteeism on Employers and Employees," *Health Economics*, Vol. 11, pp. 221-231.

Pauly, Mark V., Sean Nicholson, Dan Polsky, Mark L. Berger and Claire Sharda (2008) "Valuing Reductions in On-the-Job Illness: 'Presenteeism' from Managerial and Economic Perspectives," *Health Economics*, Vol. 17, pp. 469-485.

Priest, Lisa (2010) "Canada's reputation for low infant mortality takes stunning decline," *The Globe and Mail*, May 22. http://www.theglobeandmail.com/news/politics/canadas-reputation-for-low-infant-mortality-takes-stunning-decline/article1578103/

Public Health Agency of Canada (2009) *Investing in Prevention: The Economic Perspective: Key findings from a Survey of the Recent Evidence*, May.

Renna, Francesco (2008) "Alcohol Abuse, Alcoholism, and Labor Market Outcomes: Looking for the Missing Link," *Industrial and Labor Relations*, Vol. 62, No. 1, pp. 92-103.

Rice, D. P., and L. A. Miller (1993) "The Economic Burden of Affective Disorders," in R. Scheffler (ed.) *Advances in Health Economics and Health Services Research*, Vol. 14 (Greenwich, CT: JAI Press).

Rodriguez, Francisco (2007) "Cleaning Up the Kitchen Sink: Growth Empirics when the World is Not Simple," Wesleyan Economics Working Paper 2006-004, Wesleyan University.
http://frrodriguez.web.wesleyan.edu/docs/working_papers/cleaning_up_the_kitchen_sink.pdf.

Ross, Christopher, and Alexander Murray (2010) "Aggregate Measures of Income and Output in Canada and the United States: Implications for Productivity and Living Standards," *International Productivity Monitor* Number 19, Spring, pp. 20-39.

Schreyer, Paul (2010) *OECD Manual: Toward Measuring the Volume of Health and Education Services* (Paris: OECD).

Sharpe, Andrew (2007) "Three Policies to Improve Productivity Growth in Canada," Centre for the Study of Living Standards Research Report 2007-05, December. Also published in J. Leonard, C. Ragan, and F. St-Hilaire (eds.) *A Canadian Priorities Agenda: Policy Choices to Improve Economic and Social Well-being*, (Montreal: Institute for Research in Public Policy and Ottawa: Centre for the Study of Living Standards). http://www.csls.ca/reports/csls2007-05.pdf.

Sharpe, Andrew (2010) "Unbundling Canada's Weak Productivity Performance: The Way Forward," Centre for the Study of Living Standards Research Report 2010-02, February. http://www.csls.ca/reports/csls2010-02.pdf.

Sharpe, Andrew and Jill Hardt (2006) "Five Deaths A Day: Workplace Fatalities in Canada," CSLS Research Report 2006-06, December.

Sharpe, Andrew, Celeste Bradley and Hans Messinger (2007) "The Measurement of Output and Productivity in the Health Care Sector in Canada: An Overview," CSLS Research Report 2007-06, December. http://www.csls.ca/reports/csls2007-06.PDF.

Sharpe, Andrew, Jean-Francois Arsenault and Peter Harrison (2008) "Why Have Real Wages Lagged Productivity Growth in Canada?" *International Productivity Monitor*, Fall, Number 17.

Simon, G., C. Barber, H. G. Birnbaum, R. Frank, P. E. Greenberg, R. M. Rose, P. Wang, and R. C. Kessler (2001) "Depression and Work Productivity: The Comparative Costs of Treatment and Nontreatment," *Journal of Occupational and Environmental Medicine*, Vol. 43, No. 1, pp. 2-9.

Skoczylas, Les and Bruno Tissot (2005) "Revisiting Recent Productivity Developments across OECD Countries," Bank of International Settlements Working Paper Series, No. 182, October.

Smith, James (2005) "Unraveling the SES-Health Connection," *Population and Development Review*, Vol. 30, supplement: *Aging, Health, and Public Policy: Demographic and Economic Perspectives*, pp. 108-132.

Smith, James P. (2009) "The Impact of Childhood Health on Adult Labor Market Outcomes," *Review of Economics and Statistics*, Vol. 91, No. 3, pp. 478-489.

Smith, Jeremy (2004) "Aggregate Labour Productivity Growth in Canada and the United States: Definitions, Trends, and Measurement Issues," Centre for the Study of Living Standards Research Report 2004-04.

Soares, Rodrigo R. (2005) "Mortality Reductions , Educational Attainment, and Fertility Choice," *American Economic Review*, Vol. 95, No. 3, pp. 580-601.

Solow, Robert (1956) "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*. Vol. 70 (1) pp. 65-94.

Stephens, Thomas and Natacha Joubert (2001) *The Economic Burden of Mental Health Problems in Canada.*

Suhrche, Marc, and Dieter Urban (2006) "Are Cardiovascular Diseases Bad for Growth?" CESIFO Working Paper no. `845, November.

Suhrcke, Marc & all (2008) *The Economic cost of Ill Health in the European Region*. Background Document, WHO European Ministerial Conference on Health Systems. "Health Systems, Health and Wealth'. Tallinn, Estonia. 25-27 June.

Swan, Trevor (1956) "Economic Growth and Capital Accumulation", *Economic Record*, Vol. 32, No. 2, p.334-61.

Tompa, Emile (2002) "The Impact of Health on Productivity: Empirical Evidence and Policy Implications," in A. Sharpe, F. St-Hilaire and K. Banting (eds.) *The Review of Economic Performance and Social Progress: Towards a Social Understanding of Productivity* (Montreal: Institute for Research on Public Policy; Ottawa: Centre for the Study of Living Standards).

Van Ours, Jan C. (2004) "A Pinta Day Raises a Man's Pay; but Smoking Blows that Gain Away," *Journal of Health Economics,* Vol. 23, No. 5, pp. 863-886.

Zarkin, Gary A., Michael T. French, Thomas Mroz, and Jeremy W. Bray (1998) "Alcohol Use and Wages: New Results from the National Household Survey on Drug Abuse," *Journal of Health Economics,* Vol. 17, No. 1, pp. 53-68.