

Income Inequality and Health in Canada

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ABSTRACT

Income inequality became an urgent problem for Canada in recent times, since it not only threatens social stability, but also increases the probability of lower health level, which raises the alarm of many economists. This paper examines the association between income inequality, poverty and health in Canada, with the aim to discover the social and economic factors that have an impact on the overall health level of Canadians and make some suggestions to both the government and the population. With the use of data from the Canadian Census and the Canadian Community Health Survey, this paper uses a cross-sectional weighted regression model and a binary logit regression model. Income inequality is proved to significantly negatively affect the health level, and higher level of health and mental health are more likely to be reported by respondents claiming higher income and educational attainment.

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1. Introduction

The influence of income and wealth inequality on economic growth has long been the focus of attention of economists. Income inequality is defined as the degree to which income distribution in a country is unequal. This is an important supplementing figure for per capita income, which measures how much income a country generates, rather than how it is distributed. The income gap of a country is often covered by the national average. If the country does not make full use of the skills and abilities of its citizens, this results in increased social tensions, and a high degree of inequality which will damage the growth of the economy. The Gini coefficient is one of the most commonly used measures of income disparity, measured as a ratio between 0 and 1. Created by the Italian statistician Corrado Gini, the Gini coefficient estimates a country's individual income distribution deviation from equal distribution.

Kuznets (1955) put forward a famous theory called the inverted U-shaped relationship, which concerns the relationship between inequality and economic growth; he expects that the productive forces will inflow into the high-income sectors in the early stages of economic development, and will cause income inequality to increase rapidly. With the development of the economy, income inequality will then decrease. Benabou (1996) thinks that the difference in economic growth between Korea and the Philippines is mainly due to different initial income distributions. He also thinks that income

inequality may undermine future economic growth.

In Canada, income inequality has increased over the past two decades after declining from the World War II to the mid-1970s (Yalnizyan, 2010). In contrast, the market income inequality began to grow in the 1980s, while after-tax income inequality did not. Ten years later, both market and after-tax income inequality grew and this trend continues today (Procyk et al., 2014). Meanwhile, Canada is not the only country suffering from income inequality. Global inequality is on the rise and inequality in most countries is increasing. But inequality in developed countries is not inevitable. For example, income per capita in Austria and Denmark is almost identical to Canada, but income inequality in those two countries is low, as measured by the Gini coefficient, especially in Denmark.

Growing income inequality may pose a serious threat to Canada's future economic growth and social stability, and we must be highly concerned about them. Among the possible consequences of income inequality, health issues are one of the most significant and general heated discussion over the past decades. There is strong evidence that large income differences have negative health and social consequences, and inequality is increasing in most countries. The health and well-being of the population will be improved if the gap could be narrowed (Pickett and Wilkinson, 2015). According to Raphael (2002), income inequality affects the health of all Canadians through the weak institutional infrastructure. Also, it is found that the influence of income inequality on health varies across countries (Chintrakarn et al., 2010).

In the 1990s, many population health studies have started to focus on the relationship between income inequality and population health in industrialized countries with higher average income. In view of the cultural and economic similarities, the cross-country comparative study between Canada and the United States lends help to figure out whether income inequality more generally affects population health. Ross et al. (2002) compared the same data of Canadian provinces and cities, confirming no link between income inequality and the mortality rate, which at first was considered as “the paradox of Canada”. Afterwards, however, there was little or even no association in other rich countries, such as Sweden or Australia (Ross et al., 2002). Therefore, there is a threshold to income inequality that affects the population health.

So, up to now, has the level of income inequality hit the threshold to significantly influence the overall health of Canadians? In this paper, I attempt to answer this question by researching into the relationship between income inequality and health status in Canada. I will examine both rural and urban areas and discuss the different extents of influence. Stata and regression models will be used to test the hypothesis, based on the Canadian Community Health Survey (CCHS) and Canada’s National Population Health Survey (NPHS).

The reasons why this topic is important are as follows. On the one hand, at present, the gap between the poor and the rich has widened. Now, this differentiation is threatening to corrode a precious Canadian value: equality of opportunity for all. Already, mobility between income groups has slowed

– it is much harder to get ahead than it used to be (The Globe and Mail, 2013). On the other hand, good health is a minimum requirement for people to live, work and produce. If this essential factor is threatened, the problem of social instability will arise sooner or later, even trigger a chain reaction and damage economic growth. As a result, we must put an emphasis on this problem, analyze the extent of income inequality, uncover its correlation with health level, and work out a sustainable approach to boost the economy.

The main findings of this paper are as follows. From a cross-sectional perspective, income inequality is proved to significantly affect the health level. From the logit regression model, higher level of health and mental health are more likely to be reported by respondents claiming higher income and educational attainment. Overall, it is found that in Canada, over the latest decade, income inequality does have a significant influence on people's health.

The rest of this paper is organized as follows. Section 2 summarizes the key findings of some earlier studies that have focused on income inequality, health level and their association. Section 3 introduces the data, defines the dependent and independent variables, and summarizes the methodology. Section 4 presents the main econometric model that I use, which examines the relationship between health level, household income, gender, education, region and age. Section 5 provides the empirical results of the regression and their interpretation. Conclusions and related policy suggestions are presented in section 6.

2. Literature Review

British Prime Minister Tony Blair once said in the parliament: "there is no doubt that the published statistics show a link between income inequality, and poor health" shortly after his election (Benzeval and Judge, 2001, p. 7). In this section, I will examine the literature on the impact of income inequality on health, and, in particular, the social and economic effects of income inequality. I will briefly review the literature about the relationship between income and health, and then use four mechanisms, and some relevant empirical analysis to explore the impact of income inequality on health. The four mechanisms are the absolute income hypothesis mechanism, the relative income hypothesis mechanism, the social psychological hypothesis mechanism and the neo-materialistic hypothesis mechanism.

2.1 Relationship Between Income and Health

The argument of income redistribution is the same as in almost all the literature on epidemiology and public health, suggesting that an increase in absolute and/or relative income can lead to improved health and a reduction in mortality.

Some papers have looked at the impact of family income on children's health, and find a positive and causal effect of income on health. In addition, most of the economic literature emphasize the causality from health to higher incomes, and poor health to the causal relationship with inability to

work. While these arguments are clearly corrected in some cases, no one will seriously challenge that poor health often causes early retirement, which, many non-economists, especially British non-economists insisted on. MacIntyre (1997) discussed these debates in-depth under the political context. Economists also argue that income is correlated with other factors, especially education (Grossman, 1972), as well as the discount rate and other priority factors (Fuchs, 1993). Those who are impatient or lack self-control may not be able to invest in protecting their health or gaining higher education and skills. This argument also focuses on the impact of unhealthy activities, such as smoking, overeating or lack of exercise, which are associated with low incomes and health status.

In private or partially private systems, more expensive medical expenses have to be paid for by patients, but this method is discounted from time to time, sometimes because of the general suspicion that health care may delay death, more specifically because of the high cost rather than the relative effectiveness of basic health care. In countries with and without public health care, the "gradient" between income and mortality also exists for European countries (Kunst et al., 1998). McKeown (1976) famously proved that the introduction of effective prevention before the disease is not the main driving force behind the mortality decline in history, and his persuasiveness has been accepted, at least by medical sociologists and historian demographers.

The divergence in mortality across different population groups is mainly due to the differences in health care access or quality differences. However, McKeown's argument, even if historically true, is

not necessarily true in the current situation, and health care is far from mature. In fact, many of current studies suggest that the differences of health care are the main reason of differences in outcomes, such as the "unequal treatment of blacks and whites in the United States" (Smedley et al., 2002). Early doubts were raised by Garber (1989). Full discussion of income and health related theories and evidence will be reviewed, at least during this period. Even so, there are still some points worth mentioning. Lessons from economics record hundreds of cases of health-related cases that are positively related to socioeconomic conditions. The "Modern" literature covers the eighteenth century, ancient Rome and ancient China (Krieger, 2001).

One of the leading studies is the Whitehall study of British civil servants, which lists significant differences in morbidity and mortality at the executive level (Marmot et al., 1984; Marmot et al., 1991; Marmot, 2002). This kind of literature tends to regard income as the "mark" of the basic concept of socioeconomic status and or the inexplicit reasons of health differences. Income is just one such mark, which is usually associated with wealth (such as housing or vehicle ownership) or consumption, or even with rank, power, social or professional class, education, and even race and geography. Such a framework may not be helpful for regarding social policy as a health policy. For instance, a higher marginal tax rate in a simple tax system will change disposable income, but usually has no effect on the rank in the income distributions – since it redistributes income, not wealth, nor power. In other words, more and more studies try to separate the different effects. In particular, there are pieces of

research that examine the impact of education and income separately. Elo and Preston (1996), Deaton and Paxson (2001) and Backlund et al. (1999) agree that the protective effects of income have limited influence on education, which is similar to the findings of Kitagawa and Hauser (1973) and Rogers et al. (2000).

Income and education also independently affect the self-reported health status (Nielsen, 2002). Economists' skepticism of the direct impact of income is reinforced by the relationship between the mortality rate, income and educational level (Godwin-Austen et al., 1969; Newhouse and Friedlander, 1980; Ruhm, 2000; Deaton and Lubotsky, 2003).

The conflict concerning the individual and the overall data is still unsettled. The possible influence of income on health is weakened, but not entirely eliminated, by controlling behavioral risk factors and unemployment. One of the most difficult problems is to sort out the double causal relationship between income and health. In underdeveloped areas where undernourishment remains a serious problem, a direct causality between income and health, in addition to good evidence about the effect of the generous social pension in South Africa is found in Case (2001). Many rich countries are also highlighting the damages of poverty, and poor housing, as well as the positive impact of the state in which people do not have to spend time worrying about money. Doblhammer and Vaupel (2001) and Doblhammer (2002) found that people born in the last months of the year are better off than those born in the spring, though the periodic pattern of the Southern hemisphere (barring death in the South and birth in the North) seems not to be

that evident, and this situation is explained by the effect of intrauterine nourishment over five decades ago, especially by the seasonal supply of nutrition contained in fruits and vegetables. The theoretical mechanism of this influence was advanced by Barker (1995). The Fetal origin (“womb with a view”) hypothesis states that “fetal undernutrition in mid to late gestation, which leads to disproportionate fetal growth, later causes coronary heart disease” (Barker, 1995). A wide range of empirical evidence support these points, including those of long-term (or deferred) consequences on population health.

Studies of birth cohorts, especially in the UK, have found out that there is a vibrant relationship between health and income. Health and income dynamics are corrected by the current UK group data (UK Family Group Survey, BHPS) and the US (Health and Retirement Survey, HRS). In BHPS, Benzeval and Judge (2001) found that control of the self-reported health, the initial data, was reduced, but this control could not exclude the effects of current income or health condition. Adams et al. (2002) used HRS data to adopt more sophisticated methods that are closely related to the Granger causality test; they found that there was no causal link between wealth and health. Mealli and Rubin (2002) conducted a special analysis of this, as well as the "post hoc ad hoc" reasoning ability of the overall ability. Obviously, both income and health have an impact, and it may last a lifelong. Under such circumstance, the establishment of a clear causal model is a big difficulty.

2.2 Income Hypothesis

As equality and income issues become more and more important to social development, scholars carried out extensive research on this issue, and formed a relatively mature theoretical system. Economists proposed several income hypotheses and mechanisms to explain income inequality.

The first mechanism is the absolute income hypothesis (Laporte, 2002; Deaton, 2003; Babones, 2008), which held the view that the transfer of one unit of income from the high-income group to the low-income group would improve overall well-being. This hypothesis contends that higher income level will guarantee people have a higher health level, however, income inequality does not directly impact health. According to the absolute income hypothesis, the absolute level of income determines consumption. Thus, the relationship between consumption and income could be summarized as the short-run consumption function, and income has a direct impact on health consumption. The poverty hypothesis supports the relationship between illness and income. This hypothesis emphasizes that low income and poverty will lead to ill health, and when income increases, health will improve. Leigh (2016) mentioned that “raising the minimum wage will improve the health of many Americans, especially low-income Americans, and this improvement should help bend the cost curve for medical care”. Preston (1975) finds that increases in additional income have great impact on mortality among the poor, which means higher income will lead to a decrease in mortality and an increase in the health level. Alternatively, the line between income and health is concave. To be more specific, in the poorest

countries, the growth of average income is closely related to the growth of life expectancy, but with the growth of per capita income, the relationship is weaker, and the relationship for the richest countries is weak or even disappears. As Preston (1975) originally pointed out, there will be a negative correlation between income inequality and life expectancy between countries, if such finding is applied to describe the link between death rate and income levels within countries. The reallocation of income from the rich to the poor, no matter within or between countries, increases the health of the low-income group more than it undermines that of the high-income group, thereby increasing the national average or the world's health.

The second mechanism is called the relative income hypothesis mechanism, which states that in a certain range, the absolute level of income of individual residents remains unchanged, but when the average income changes, their health will be affected (Wilkinson, 1996). This implies that the effect of economic inequality largely depends on the relative position of the rich and the poor (Mayer and Sarin, 2005). If people assess their income level in comparison to their neighborhood, their health status and health cost would also be indirectly affected by others' income (Wilkinson, 1992). Meanwhile, this kind of relative position in income would also stimulate low-income groups to work harder, and the middle class would be "relatively satisfied".

The third mechanism is the social psychological hypothesis mechanism. It states that income inequality would further exacerbate health inequality. Inequality will reduce social capital, trust and

efficiency, so as to affect people's health (Kawachi et al., 1997; Mayer and Sarin, 2005).

The fourth mechanism is the neo-materialistic hypothesis. Income inequality affects health by its effect on the distribution of social resources (Lynch, 2000). The view is that the increase in income inequality will reduce the government's use of medical products and services for the poor, thus affecting the overall health level. However, the corresponding empirical studies are far from reaching an agreement with this view. Lynch et al. (2004) concluded that most studies did not support income inequality to be a major and general factor in explaining differences in health among countries. However, income inequality may directly affect health through crime, for example, murder. Mayer and Sarin (2005) reviewed ten empirical papers using panel data, and nine papers indicated that the higher income inequality in the country, the higher the mortality rate of adolescents. Wilkinson and Pickett (2006) classified and summarized 168 empirical results in 155 empirical studies, and 87 empirical results supported that the impact of income inequality on health was statistically significant, while 44 empirical results showed that the impact of inequality on health was either positive or negative, depending on the situations, and 37 empirical results showed that there was no relationship between income inequality and health. The above differences and inconsistencies are largely due to the differences in samples, control variables, and other ignored factors. In China, economists focus on the use of micro-data to analyze the relationship between income inequality and health (Xie, 2010; Qi and Li, 2011).

2.3 Income Inequality Hypothesis

There is also another hypothesis --- the income inequality hypothesis, which says that what matters is the size of the gap of the income between the high-income group and the low-income group, irrespective of the individual belonging to either group. This hypothesis supposes that income inequality could damage the health of the individual. This hypothesis particularly emphasizes the direct relationship between income inequality and health. That means no matter what is the individual's income level, we only focus on the aggregate effect of income inequality on health. To a certain extent, the income inequality hypothesis means that the higher the degree of income inequality, the higher the number of low-income residents, so the overall health of residents worsens. If the government does not properly deal with income inequality, it will cause a series of serious problems, and will also have an impact on the health level. For example, high level of inequality might cause social instability and increase social conflict, further leading to crime, and damaging the individual health level. Income inequality and health are closely related.

Meanwhile, in addition to income inequality, the impact of relative deprivation on individual health cannot be ignored. The core of the exploitation hypothesis is that the income gap is based on the degree of exploitation, and plays a decisive role in the residents' health. Relative deprivation will have a negative impact on people's physical and mental health. It not only explains the relationship between income inequality and health at the individual level, but also provides an impact mechanism at the

population level. The impact of relative deprivation on health has been paid more and more attention by scholars. Studying this topic involves not only the mechanism of relative deprivation of health, but also the large number of empirical studies that verify the relative deprivation of health.

Public health scholars think that income is a critical social determinant of health outcomes, and it's also the basic social determinant of other sociological factors, such as housing, education, and job opportunities. Income has a significant effect on health outcomes, because income has a close relationship with healthy food and sanitary conditions. For example, babies born in low-income families are twice as likely to have a low birth weight as babies born in higher-income families. The main mechanisms of income inequality affecting health are as follows. Firstly, the social services facilities for medical, health and physical resources are all affected, which in turn affect the health of residents. Secondly, income inequality affects the health of residents through the social atmosphere and deterioration of the social environment. Third, people's psychological feelings deteriorate. Both developed and developing countries face income inequality. So, we cannot ignore the relationship between income and health.

2.4 Empirical Analysis

In the perspective of empirical research, early scholars have mainly used cross-country data. Later on, with the increase of people's doubt on the comparability of transnational data, scholars have turned

to applying cross-regional data within one country to conduct research. The following review summarizes previous research on this topic.

2.4.1 Empirical research using transnational data

Preston (1975) examined the relationship between per capita national income and life expectancy at birth in 30 countries in the 1900s, 1930s, and 1960s, and found that these two variables did not have a linear relationship. He concluded that the difference in income distribution was important for the explanation of the difference in life expectancy across developed countries. Rodgers (1979) studied three health-based indicators (life expectancy at birth, life expectancy at age 5 and infant mortality) and income inequality (Gini coefficient measure) in 56 countries. He found that “income inequality had a negative impact on the overall population health level, both for the whole sample and for less developed countries” (Rodgers, 1979). The study of Flegg (1982) led to a similar conclusion to Rodgers. The empirical results showed that, after controlling for income, illiteracy and availability of medical services, no matter which indicator is used to measure income inequality, income inequality always had a negative impact on population health. Waldmann (1992) used data from 47 countries to estimate a logarithmic linear regression equation and found that no matter we used the developed and the developing countries, or only used developing countries as sample, as long as we controlled for the actual income level of the poor, the available medical services for the poor and other explanatory

variables, the higher the proportion of the income from the rich to the total income, the higher the infant mortality rate. Waldman pointed out that income level was not a good measure of social welfare. When a country's income distribution is unfair, the benefits to the poor may be less than those measured by real income.

Wilkinson (1992) also obtained a similar conclusion using OECD countries. With the survey data from the Luxembourg Income Study (LIS), he found that even after controlling for the income differences in different countries, income of the 70% lowest income people still had a significant positive correlation with expected life expectancy. Wilkinson argued that with the increase in overall income level in a country, the main reason for the difference in mortality after a change in epidemics would shift from material deprivation to social disadvantages. Material deprivation could result in poor and infectious diseases, and social disadvantage could lead to stress and chronic illnesses. From the study of transnational data, most of the measures such as average life expectancy, infant mortality rate and low birth weight rate are used to measure the health level of the population. The sample countries include both developed and developing countries. Most of the studies in this period have come to the conclusion that income inequality is not conducive to improvement in the overall population health level.

However, due to the comparability of transnational data, economists previously have raised some doubts about the above research and found that by using the updated data, in most cases they could not

reach the same conclusion as previous studies. Lynch and Smith (2004) firstly questioned Rodgers's (1979) findings that empirical results from cross-country data were sensitive to the selection of countries, time windows, and income inequality data sources. Wilkinson (1992) did not point out which 56 countries he used in his paper, and the income data for these countries came from different years, so they were less comparable. Lynch and Smith used data from 16 countries, such as Australia, Canada, and the United Kingdom. Their study found that there was no link between income inequality and life expectancy, as Wilkinson claimed. In contrast, there was a significant correlation between the health level of infants, measured by birth weight and income inequality. In addition, Deaton (2003) also pointed out that neither the LIS data nor the World Bank's data can lead to Rodgers' regression results. Judge (1995) recalculated Wilkinson's results with new data and found that the conclusions drawn from transnational data were very sensitive to the use of different income inequality variables and income level variables. Deaton (2003) pointed out that although the use of LIS data could prove the negative relationship between Wilkinson's selected sample countries, this relationship did not exist when new countries were added to the sample. Thus, Wilkinson's conclusions lacked robustness.

It is well known that, as Deaton (2003) pointed out, the vast majority of developing countries have a very poor measure of adult mortality due to the lack of effective and complete registration system, so life expectancy measures are often inaccurate. In contrast, in these developing countries, the registrations of infant mortality and child mortality are relatively complete. In conclusion, the

credibility of the conclusion that there is a negative correlation between income inequality and life expectancy drawn from transnational studies from Rodgers (1979) and Wilkinson (1992) is yet to be further validated.

2.4.2 Empirical studies using cross-regional data from one country

Many scholars have recognized that there is a close link between national health and the specific situation of each country. For example, there are differences in eating habits, lifestyles, environmental conditions, and medical services in different countries, which will have different impacts on the health status of the residents. So, when economists conduct research on the relationship between income inequality and health, the scope of the study should be as small as possible.

With the increase in the doubts in the use of transnational data to study the relationship between income inequality and health, scholars have begun to use data in one country, especially the United States, mainly on the relationship between income inequality and various measurements of mortality. Lynch et al. (1998) used the data of 282 metropolitan cities in the United States in 1990 to study the effect of income inequality on age-adjusted mortality and found that either using Gini coefficient, or the Theil index, or Atkinson index to measure income inequality, high income inequality was always closely linked to higher mortality rates, among which the most close relationship was between income inequality and infant mortality, and between income inequality and mortality rate of the population

aged 15-64. Kaplan and Francois (1996) used the cross-sectional data of 50 states in 1960 and 1980 as sample, and the proportion of income with the lowest income of 50% of the population was used as the measure of inequality of income. He found that income inequality and population mortality were significantly associated with health-related variables such as infant mortality, low birth weight, and so on.

Kennedy et al. (1996) used cross-sectional data from 50 states in the United States to measure income inequality with the ROBINHOOD index, which is the index to measure the proportion of money to be transferred from the rich to the poor to achieve equality, and Gini coefficients, respectively. He found that even after the inclusion of poverty rate variables, income inequality still correlated with age-adjusted mortality. The rise in the ROBINHOOD index by one percentage point would lead to an increase in population mortality of 21.68 cases (per 100,000 people). In addition, there was a significant positive correlation between income inequality and infant mortality, coronary heart disease morbidity and homicide rates. In addition, scholars have found that there is a significant relationship between higher income inequality and higher infant mortality rate, but in Canada, this relationship is not established. A common thread of the above research is that scholars agree that there is still a significant link between income inequality and population health, even after controlling for the average income level of each region.

3. Data and Summary Statistics

This section introduces the data sources and describes the variables that will be used in the following econometric models in section 4.

3.1 Data Sources

3.1.1 Income-related Data

The income related data I use include the Gini coefficient, absolute income and income quintile. Income quintile data are from the CCHS, which will be introduced in the next part. Gini coefficient and absolute income data are mainly from the Canadian Income Survey (CIS).

“The CIS is a cross-sectional survey developed to provide a portrait of the income and income sources of Canadians, with their individual and household characteristics” (Statistics Canada, 2017). The survey targets all Canadian individuals, excluding residents of some areas¹, institutional residents, and military residents. These exceptions account for only few percent of the entire populace.

3.1.2 Health-related Data

The CCHS collects cross-sectional data of “health status, healthcare utilization and health determinants” in Canada (Statistics Canada, 2015). It delivers reliable estimations at the regional level

¹ The Yukon, the Northwest Territories and Nunavut, and reserves and other Aboriginal settlements in the provinces.

thanks to a large number of respondents.

In ten provinces and three territories, the CCHS investigates residents older than twelve years old with private housing. The exclusion of this survey includes individuals in Indian Reserves or Crown lands and other remote areas, institutional residents, and soldiers. In 2001, Statistics Canada and Health Canada began the first survey and repeated it every two years until 2005. Since 2007, data for the CCHS started to be collected annually. The sample size shank greatly from 130,000 in 2001, 2003, and 2005 to 65,000 respondents each year from 2007. However, the CCHS is still representative of around 98 percent of Canadians older than twelve.

3.2 Variables

In this part, I present both the dependent and independent variables in my two models (which will be illustrated in detail in section 4).

3.2.1 Dependent Variables

Mortality Rate

“Mortality rate is a measure of the number of deaths (in general, or due to a specific cause) within a particular population range, scaled to the size of the total population, per unit of time” (Porta, 2014, p. 69). Typically, mortality rate is expressed in units of deaths per 1,000 individuals per year. For

example, a mortality rate of 8 implies 0.8 percent of deaths out of the total population. From Statistics Canada, the data of mortality rate dating from 1991 to 2013 can be obtained. In addition, the data are categorized by age, gender and region.

Perceived Health Level

Perceived health level data are obtained from the CCHS, which indicates general health status. It is selected since it can “reflect aspects of health not captured in other measures, such as incipient disease, disease severity, aspects of positive health status, physiological and psychological reserves and social and mental function” (Statistics Canada, 2015). This indicator refers to the perceptive view on one’s health status by oneself, or by the responding person in the proxy response case. Here, health is observed from physical, mental and social perspectives. Typically, the survey respondents were asked the following question: “In general, would you say your health is?” There are four possible responses: excellent, very good, fair and poor. The interviewer should record all those that applied among the available responses. Having collected and recorded all the survey results, the responses are re-categorized as “very good or excellent” and “fair or poor” in the final spreadsheet.

Perceived Mental Health Level

Mental health suggests no mental illness and a relatively high level of psychological well-being with comfort, happiness, and satisfactory. According to the World Health Organization (WHO), mental

health includes "subjective well-being, perceived self-efficacy, autonomy, competence, inter-generational dependence, and self-actualization of one's intellectual and emotional potential, among others." (WHO, 2014). The well-known mental health specialist Freud defined it as the capacity "to work and to love" (Freud, 1962).

Similar to perceived health level, perceived mental health is measured as follows: "In general, would you say your mental health is? Is it excellent, very good, good, fair or poor?" In the positive psychology, good mental health means that individual views life as enjoyable, and is able to achieve psychological resilience. Also, the responses are re-categorized as "very good or excellent" and "fair or poor" in the final spreadsheet.

3.2.2 Independent Variables

Gini Coefficient

The Gini coefficient, scaled from zero to one, measures income inequality in a society. A zero Gini coefficient implies that each person receives exactly the same amount of adjusted household income (equally distributed) in a population so it is the minimum inequality. In contrast, maximum inequality with Gini coefficient equal to one suggests that one person receives all the adjusted household income in a population. Interpretation of a single Gini coefficient is not simple, but it is straightforward to compare the Gini coefficients over time or between populations: a higher coefficient suggests higher income distribution inequality.

Absolute Income

Absolute income data are acquired from the CIS. It basically has three measurements, including market income, total income and after-tax income. Market income is the aggregate of income from employment, net revenue from investment, and retirement pension. Therefore, market income is also known as income before taxes and transfers. Income before tax but after transfers refers to total income, which sums income from all sources. Government transfers and deduction of income taxes are included. Namely, after-tax income is the total income minus federal or provincial income tax.

Income Quintile

Data of income quintile and highest education level are from CCHS. They are both used to assess class standing. Respondents were asked the following question to collect data for the household income: “What is your best estimate of the total income, before taxes and deductions, of all household members from all sources in the past 12 months?” If the respondents could not provide a precise number of household income, they may choose among the suitable household income ranges. There are five categories for the income range: 0 - \$19,000, \$20,000 - \$39,999, \$40,000 - \$59,999, \$60,000 - \$79,999, and \$80,000 or more. When summarizing the survey results, these five categories are converted into five quintiles.

Highest Education Level

There are also some questions concerning to educational attainment in Statistics Canada which can

be used in this study to generate the education variables. Such survey questions include “What is the highest grade of elementary or high school you have ever completed?”, “Did you complete a high school diploma or its equivalent?”, “Have you received any other education that could be counted towards a certificate, diploma or degree from an educational institution?”, “What is the highest certificate, diploma or degree that you have completed?”. In this paper, I use the highest level of education as the indicator of educational attainment, and the results are categorized as “less than secondary school graduation”, “secondary school graduation, no post-secondary education”, and “post-secondary certificate/diploma or university degree”.

Age

Age is categorized into five groups, 12 to 17 years old, 18 to 34 years old, 35 to 49 years old, 50 to 64 years old and 65 years old and over.

Gender

Gender is categorized into male and female.

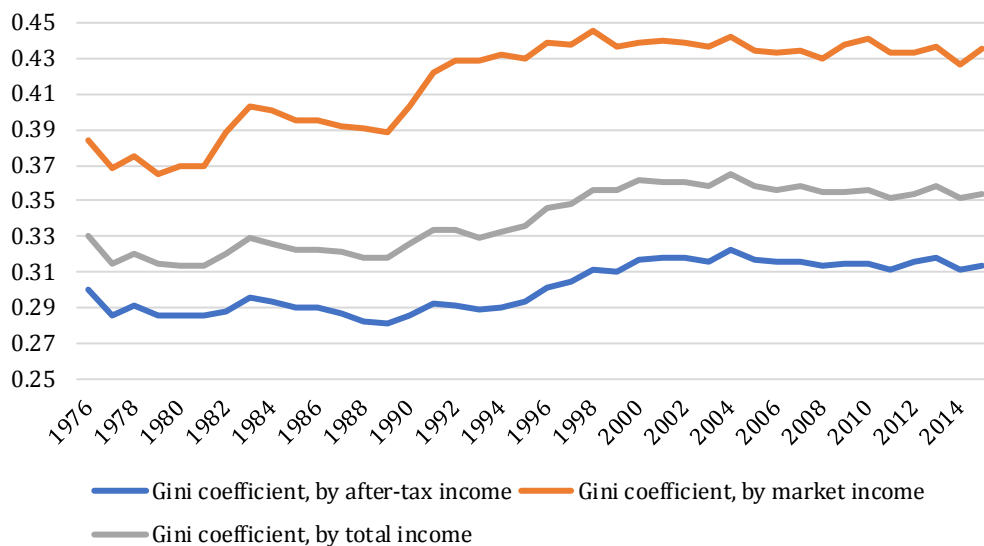
Region

Region means the ten Canadian provinces, Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia.

3.3 Descriptive Statistics

During the past few years, income inequality captured by the Gini coefficient in Canada has increased as shown in Figure 1. The level of inequality in Canada declined in the 1980s, with after-tax income Gini coefficient dropping to 0.28 in 1989. It rose gradually in the 1990s, but has remained stable around 0.32 after 2000.

Figure 1: Gini coefficient in Canada from 1976 to 2014



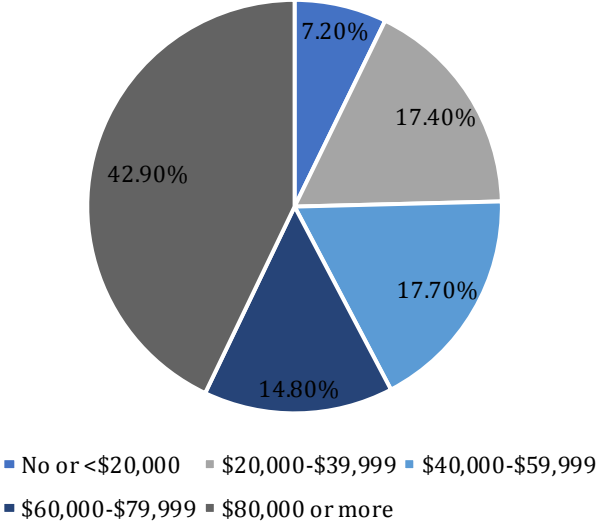
Source: Census

Income inequality can also be tracked by dividing the population into five groups (quintiles) from the poorest (bottom quintile) to the richest (top quintile), as illustrated in the previous section, and then reckon the share of income in each group. The income distribution is equal if each group enjoys one fifth of the total national income.

Figure 2 illustrates the proportion of total national income in each quintile in 2014. The top quintile

accounts for the greatest proportion of this economic pie (42.9 percent). And this top quintile is the only one whose share rose over the past two decades—from 36.5 percent in 1990 to 42.9 percent in 2014. The shares of the other quintile groups, including middle-income groups, have declined.

Figure 2: Share of national income going to each quintile in 2014 in Canada



Source: Census

Table 1 is a summary of the variables that I use in the weighted regression model.

Table 1: Raw data for weighted regression model

Area	Population	Income (million)	Income Share	Health (%)	Mental Health (%)
St. John's (N.L.)	91,100	208.8	0.94%	0.65	0.765
Halifax (N.S.)	82,510	410.3	1.84%	0.623	0.728
Saint John (N.B.)	73,600	127.8	0.57%	0.555	0.679
Saguenay (Que.)	75,360	160.4	0.72%	0.592	0.767
Québec (Que.)	84,160	790.5	3.55%	0.628	0.766
Sherbrooke (Que.)	70,710	209.6	0.94%	0.655	0.793
Trois-Rivières (Que.)	68,430	155.2	0.70%	0.59	0.735
Montréal (Que.)	73,250	3980.8	17.89%	0.618	0.707
Kingston (Ont.)	82,950	167	0.75%	0.608	0.683
Oshawa (Ont.)	87,400	379	1.70%	0.622	0.737
Toronto (Ont.)	72,830	5967.2	26.81%	0.593	0.712
Hamilton (Ont.)	82,290	758	3.41%	0.613	0.726
St. Catharines–Niagara (Ont.)	69,500	405.2	1.82%	0.539	0.701
Kitchener-Cambridge-Waterloo (Ont.)	82,160	502.5	2.26%	0.615	0.719
London (Ont.)	75,980	498.1	2.24%	0.623	0.681
Windsor (Ont.)	73,440	332.6	1.49%	0.591	0.718
Greater Sudbury / Grand Sudbury (Ont.)	86,080	166	0.75%	0.56	0.712
Thunder Bay (Ont.)	82,690	125.2	0.56%	0.546	0.632
Winnipeg (Man.)	77,770	770.5	3.46%	0.593	0.71
Regina (Sask.)	93,670	230.9	1.04%	0.61	0.714
Saskatoon (Sask.)	90,840	290.7	1.31%	0.659	0.727
Calgary (Alta.)	101,260	1353.9	6.08%	0.652	0.725
Edmonton (Alta.)	98,480	1282.2	5.76%	0.633	0.737
Abbotsford-Mission (B.C.)	68,310	178.5	0.80%	0.547	0.67
Vancouver (B.C.)	73,390	2444.3	10.98%	0.574	0.676
Victoria (B.C.)	84,500	358.3	1.61%	0.626	0.742

Source: CCHS

Table 2 is a summary of the variables that I use in the logit model.

Table 2: Summary of the variables

Variable	Categories	Report Health	Report Mental Health
Gender	male	85.84%	93.71%
	female	84.68%	91.29%
Age	12 to 17 years	95.51%	94.95%
	18 to 34 years	92.52%	92.10%
	35 to 49 years	88.52%	91.98%
	50 to 64 years	81.43%	92.07%
	65 years and over	69.41%	93.40%
Highest level of education	less than secondary school graduation	59.74%	84.66%
	secondary school graduation, no post-secondary education	77.94%	89.19%
	post-secondary certificate/diploma or university degree	88.61%	93.52%
Income quintile	No or <\$20,000	71.98%	85.74%
	\$20,000-\$39,999	81.09%	90.39%
	\$40,000-\$59,999	87.39%	93.97%
	\$60,000-\$79,999	90.85%	94.79%
	\$80,000 or more	93.36%	96.41%
Geography	Newfoundland and Labrador	79.61%	93.00%
	Prince Edward Island	84.28%	93.69%
	Nova Scotia	81.19%	89.83%
	New Brunswick	75.89%	88.19%
	Quebec	87.45%	94.65%
	Ontario	84.62%	92.09%
	Manitoba	83.70%	91.73%
	Saskatchewan	84.00%	90.35%
	Alberta	88.02%	92.40%
British Columbia	84.45%	91.60%	

Source: CCHS

4. The Model

4.1 Cross-sectional Weighted Regression Model

To examine the impact of the income level in different cities in Canada on the health status, I replicate the methodology proposed by Ross et. al (2000). In Ross's model, he held the view that since the credibility of the estimated mortality is related to the populations of metropolitan areas, it was necessary to use weighted regression of population size as the weight. Meanwhile, he used mortality as the dependent variable and indicator of health level, and the share of total household income received by the less affluent half of households as an independent variable and measurement of income inequality. Correspondingly, I use the "rate of health", i.e., perceived health level of very good or excellent from CCHS as the indicator of health level, and median total income share as the independent variable, which reflects income inequality across 26 cities within Canada. Also, for the same reason, I use population size as the weight in the weighted regression.

I use the data of 2013, which are obtained from CCHS and Census.

4.2 Logit Regression Model

In the final data table of CCHS, perceived health was dichotomized, so that responses of fair and poor showed a different picture with responses of good, very good, and excellent. Therefore, binary

logistic regression model is appropriate to predict the health level.

From Statistics Canada, it's stated that the responses were re-organized and summarized as specific groups. As a result, each nominal independent variable in my regression model will be treated as a set of dummy variables with one (missing) dummy variable serving as the reference. In my regression, "first quintile" will be assigned the reference category for income, and "less than secondary school graduation" will be assigned the reference category for education. In addition, "12 to 17 years" will be assigned the reference category for age, and "male" will be assigned the reference category for gender. "Newfoundland and Labrador" will be assigned the reference category for provinces.

In a logistic regression model, the regression coefficient (b_1) is the estimated per unit increase in the outcome in terms of log odds when there is an increase per unit in the value of the exposure. "In other words, the exponential function of the regression coefficient (e^{b_1}) is the odds ratio associated with a one-unit increase in the exposure. $OR=1$ means that exposure does not affect odds of outcome. $OR>1$ means exposure is associated with higher odds of outcome, and $OR<1$ means exposure is associated with lower odds of outcome." (Park, 2013)

5. Empirical Results

Tables 3, 4 and 5 show the results for the cross-sectional weighted regression model and the logit regression model. Both models use the CCHS data and the Census, and the results were obtained through Stata. The following tables provide the coefficient estimates with robust standard errors, and 95% confidence interval.

5.1 Cross-sectional Weighted Regression Model

Table 3 indicates that we have 95% confidence ($P < 0.05$) that the degree of income inequality measured by the percentage of total household income received by the less well-off 50% of households has a significant influence on health.

Table 3: Result for weighted regression model, with dependent variable of health

. Reg H Income [pw=Pop] (sum of wgt is 2.2254e+04)						
Linear regression						
					Number of obs =	26
					F(1,24) =	24.12
					Prob > F =	0.0001
					R-squared =	0.4533
					Root MSE =	0.01959
H	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
Income	1.85E-06	3.77E-07	4.91	0.000	1.07E-06	2.63E-06
_cons	0.4605321	0.0337211	13.66	0.000	0.3909351	0.530129

5.2 Logit Regression Model

Table 4 summarizes the effect of different variables on people's health and mental health. With regards to income, Table 4 indicates that higher income is significantly more likely to help people maintain a higher health and mental health level, which is very intuitive. What's worth mentioning is that income has stronger influence on health compared to mental health. This could mean that mental health is affected by more complicated factors than health is, so that the effect of income is not that evident. As for educational level, it's proved that higher education results in better health. Similarly, the influence of education attainment on health is more significant than that on mental health. In terms of gender, male's health is pretty close to female's according to this model, while male's mental health is slightly better than female's. It would seem that gender is not significantly related to health. As for geography, people in Alberta are more likely to report better health, and people in Quebec are more like to report better mental health.

According to Table 5, comparisons of odds ratio and McFadden's R^2 values indicate that income and education are the strongest predictors of health and mental health. In other words, according to this model, inequality variables have the most significant effect on the discrepancy in people's health.

Table 4: Result for logit regression model

	Health				Mental Health			
	OR	Std. Err.	95% CI		OR	Std. Err.	95% CI	
Income								
First quintile	1.0000				1.0000			
Second quintile	1.6692	0.0028	1.6638	1.6747	1.5647	0.0033	1.5582	1.5713
Third quintile	2.6972	0.0048	2.6878	2.7067	2.5919	0.0062	2.5799	2.6040
Fourth quintile	3.8648	0.0076	3.8499	3.8797	3.0240	0.0075	3.0092	3.0388
Fifth quintile	5.4750	0.0118	5.4520	5.4981	4.4597	0.0124	4.4354	4.4841
Education								
Less than secondary school graduation	1.0000				1.0000			
Secondary school graduation	2.3816	0.0056	2.3707	2.3926	1.4937	0.0048	1.4844	1.5031
Post-secondary education	5.2417	0.0105	5.2211	5.2624	2.6133	0.0072	2.5992	2.6275
Age								
12 to 17 years	1.0000				1.0000			
18 to 34 years	0.5810	0.0023	0.5765	0.5856	0.6201	0.0023	0.6155	0.6247
35 to 49 years	0.3624	0.0014	0.3596	0.3653	0.6095	0.0023	0.6050	0.6141
50 to 64 years	0.2060	0.0008	0.2045	0.2076	0.6176	0.0023	0.6131	0.6222
65 years and over	0.1066	0.0004	0.1058	0.1074	0.7531	0.0030	0.7472	0.7591
Gender								
Male	1.0000				1.0000			
Female	0.9118	0.0011	0.9096	0.9139	0.7042	0.0011	0.7020	0.7064
Geography								
Newfoundland and Labrador	1.0000				1.0000			
Prince Edward Island	1.3733	0.0137	1.3467	1.4004	1.1164	0.0165	1.0846	1.1492
Nova Scotia	1.1050	0.0060	1.0934	1.1167	0.6642	0.0053	0.6539	0.6747
New Brunswick	0.8058	0.0044	0.7972	0.8145	0.5620	0.0046	0.5531	0.5710
Quebec	1.7842	0.0079	1.7687	1.7998	1.3309	0.0093	1.3127	1.3492
Ontario	1.4092	0.0061	1.3972	1.4212	0.8755	0.0060	0.8638	0.8873
Manitoba	1.3149	0.0070	1.3014	1.3286	0.8347	0.0066	0.8218	0.8477
Saskatchewan	1.3443	0.0073	1.3300	1.3588	0.7043	0.0056	0.6935	0.7153
Alberta	1.8806	0.0087	1.8636	1.8979	0.9150	0.0065	0.9023	0.9278
British Columbia	1.3912	0.0063	1.3789	1.4037	0.8207	0.0058	0.8094	0.8322

Table 5: Number of Observations and McFadden's Pseudo R²

	Health		Mental Health	
	Obs	McFadden's pseudo-R ²	Obs	McFadden's pseudo-R ²
Income	22,003,900	0.0534	23,079,800	0.0356
Education	21,050,800	0.0419	22,065,100	0.0127
Age	22,004,000	0.0651	23,079,700	0.0022
Gender	22,004,000	0.0003	23,079,800	0.0040
Geography	22,004,000	0.0047	23,079,900	0.0055

6. Conclusion

During the last few decades, income has had a great impact on health and mortality. Many studies have been conducted to analyze the impact of income inequality on health. Preston (1975) stressed that increasing income would affect health and mortality. Kawachi et al. (1997), Mayer and Sarin (2005) also highlighted that income inequality will reduce social capital, trust and efficiency, so as to affect people's health. So, we cannot ignore the relationship between income and health, and the government must pay more attention to this phenomenon.

In this paper, we used the absolute income hypothesis mechanism, the relative income hypothesis mechanism, the social psychological hypothesis mechanism and the neo-materialistic hypothesis mechanism, and some relevant empirical analysis to explore the impact of income inequality on health. The logit regression model indicates that higher income is significantly more likely to help people maintain a higher health and mental health level. Higher education results in better health. The

conclusion is that income is a critical social determinant of health outcomes, and income inequality is not conducive to improvement in the overall population health level.

From a cross-sectional perspective, income inequality is proved to significantly affect health. From the logit regression model, higher levels of health and mental health are more likely to be reported by respondents claiming higher income and educational attainment. To be more specific, income and educational levels have more influence on health compared to mental health. It can be estimated that mental health should be explained by sociological factors, as well as by income and education. For example, the rich might have to deal with more work and have more stress. Overall, I conclude from these results that in Canada, over the latest decade, income inequality does have a significant negative influence on people's health.

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