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ORIGINAL PAPER

Does socioeconomic status affect lengthy wait time in Canada? Evidence from Canadian Community Health Surveys

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Abstract Reasonable access to health services without financial or other barriers is a primary objective of the Canadian health system. Notwithstanding such concern about accessibility of services, long waiting times for health services have been a prominent health policy issue in recent years. Using pooled data from four nationally representative Canadian Community Health Surveys (CCHSs, 2000/01, 2003, 2005 and 2010; $n = 266{,}962$) we examine socioeconomic inequality in lengthy wait time (LWT) to health care among adults (aged 18–65) in Canada. The relative and absolute concentration indices (RC and AC, respectively) are used to quantify income-related inequality in LWT in Canada and for its provinces. Additionally, we decompose the RC and AC indices to identify factors affecting income-related inequality in LWT. Our descriptive results show that, on average, 5% of Canadian adults experienced LWT to access health services in the past 12 months. While 3% of the residents of British Columbia and Saskatchewan reported LWT to access health care services, this figure was 7% in Quebec. Our findings also demonstrated that LWT was mainly concentrated among the poor in Canada [RC = −0.039; 95% confidence interval (CI) −0.049 to −0.028 and AC = −0.067; CI −0.086 to −0.049]. The RC and AC suggested statistically significant pro-rich inequality of LWT in Nova Scotia, New Brunswick, Quebec, Manitoba, Saskatchewan and British Columbia. Decomposition analyses indicate that, besides income itself, health status (measured by a set of 15 chronic condition indicators), immigration status and geographical factors were the most important factors contributing to the concentration of LWT among the poor in Canada. These results provide some evidence that low-income individuals tend to have lengthier wait times for publicly-funded health care in Canada in comparison to their high-income counterparts. The observed negative gradient between income and long waiting time may be interpreted as evidence of socioeconomic inequity within Canadian health care system. Thus, further work is required to understand the mechanisms explaining the concentration of long wait time among the poor in Canada.

Keywords Socioeconomic status · Wait time · Absolute and relative inequalities · Decomposition · Canada

JEL Classification I14 · D63 · I18

Introduction

In publicly funded health care systems, in which services are either free or heavily subsidized, waiting times are used to ration health care services. The underlying logic of such rationing mechanism for access to health care services is that patients should wait to receive health services based on their health care need, regardless of their socioeconomic and other non-need characteristics [1]. Prioritisation rules in public health care systems thus require that patients with the most urgent and potentially life-threatening conditions

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should be treated first, irrespective of their socioeconomic status (SES). The implementation of clinically based prioritisation rules, however, varies across countries. While in the UK, Australia, Sweden and Spain prioritisation is determined by clinical need, systematic prioritisation tools which include both clinical criteria and non-clinical patient characteristics (e.g., inability to work and live independently) were developed to assess patients priority for health services in Canada and New Zealand [2, 3].

Despite the fact that rationing health care by waiting lists is considered to be more equitable because access to care is not based on patients' SES [4], publicly funded health systems face excess demand in the absence of prices and constraints on the supply of health services [5]. This, in turn, leads to long waiting times for health care services, which create dissatisfaction for patients and may lead to deterioration in health [5].

Long waiting times for health care are a major barrier to access for non-emergency surgery and specialist visits in most public health systems [2] and several countries have implemented various initiatives to reduce long waiting times. In Canada, for example, the first ministers committed $5.5 billion in September 2004 to improve timely access in five health care areas over a period of 10 years [6]. Subsequently, the Supreme Court of Canada brought down Quebec's ban on private insurance for medical services covered by Medicare in June 2005 in an effort to reduce wait times. In addition, in April 2007, Canada's federal government announced $612 million to help provinces that would commit to achieve minimum wait times for medical procedures [7, 8]. Despite these initiatives and consistent focus at the federal and provincial levels to reduce waiting times and high levels of health expenditure over the past decade [9], waiting times to receive health care treatments in Canada is longer than what is considered clinically "reasonable" and there is also a significant variation in waiting times across provinces [10].

While there is a significant public concern regarding long waiting lists, relatively little attention has been paid to achieve equitable distribution of waiting times across different social groups [1]. In fact, although equity is regarded as one of the primary policy objective in the health care sector [11–14] and extant work has been conducted to measure socioeconomic inequities in the utilization of health care [15–19], the objective of equity in the process of accessing health care treatments has received less policy and research attention [1].

The current literature on equity in health care is chiefly concerned with receipt of services, rather than the process of accessing care, although it is possible that higher SES patients may wait shorter than lower SES to receive care [20]. There exists a small but growing body of literature that examines socioeconomic gradient in waiting times for health services. The current empirical studies [4, 5, 21–25] provide some evidence that individuals with lower SES tend to wait more for publicly-funded health care than those with higher SES. This negative gradient between SES and waiting time may be interpreted as evidence of socioeconomic inequity within publicly-funded systems [5].

Achieving equity in health care is a primary objective of Canadian health system and "reasonable" access to health services without financial or other barriers is legislated in the Canada Health Act, 1984. Notwithstanding such concern about accessibility of services and the fact that the issue of wait times has been a high priority in Canada over the recent years, there is very little literature [20] that empirically examines socioeconomic gradient in waiting times in Canada. Understanding the existence of socioeconomic inequalities in waiting time will have considerable policy implications as it may indicate a gradient in waiting time attributed to socioeconomic inequalities in society. In the existing literature in Canada, very little is known regarding how inequalities in wait times vary between socioeconomic groups, and what the relative contributions of socioeconomic factors and their interactions explaining inequalities in wait time are. Thus, we aim to measure and decompose socioeconomic inequalities in lengthy wait time (LWT) for access to health care in Canada using pooled data from four nationally representative Canadian Community Health Surveys (CCHSs, 2000/2001, 2003, 2005 and 2010). The decomposition of socioeconomic inequalities provides valuable information for policy makers to design effective strategies to reduce inequality in waiting time in Canada.

An overview of Canada's health care system

Since the Second World War, Canada's health care system has undergone substantial transformations. In 1947, the province of Saskatchewan introduced a universal hospital service plan; the first of its kind in Canada [26]. This plan was implemented because of poor commitment from the federal government in providing funding for health care services. The plan aimed to provide health services to citizens living in the province through collective effort. Many provinces followed this stride which resulted in the federal government passing the Hospital Insurance and Diagnostic Services Act (HIDS) in 1957 [27]. The HIDS outlined the common conditions provinces were required to meet in order to receive federal transfers. The latter document was then adjusted to include coverage for physician services outside the hospital, thus the Medical Care Act (MCA) of 1966 was introduced. By 1971, all provinces and territories in Canada had universal coverage for all hospital

and physician services. In 1984, the federal government replaced both documents with the Canada Health Act (CHA) [28]. This piece of legislation puts in place criteria each province and territory must adhere in order to receive federal funding for health service; known as the Canada Health Transfer (CHT). The five criteria included in the CHA are:

1. Public administration: The province's health insurance must be administered and operated on a not-for-profit basis by a public authority accountable to the provincial/territorial government.
2. Comprehensiveness: Provinces and territories must provide medically necessary hospital and physician services.
3. Universality: Provincial and territorial health insurance must provide eligible residents with insured health services on uniform basis.
4. Portability: Citizens from different regions can travel across Canada and remain eligible for coverage in all provinces and territories.
5. Accessibility: The province and territory must provide reasonable access to insured health services on a uniform basis. This criterion particularly states that extra billing is prohibited.

Health care in Canada is primarily a publicly funded health care system (i.e., Medicare), with 70% of health care being financed through taxation [29]. Health care services that are publically funded and insured by the government are known to be "medically necessary" services. The remaining 30% of health care spending come from private sources (private insurance and out-of-pocket payments). Private expenditures mostly cover health care services not covered or partially covered by Medicare such as dental care, vision care, home care, pharmaceuticals and services provided by non-physicians such as chiropractors or physiotherapists [30].[1] Although the Canadian health care system is mainly publicly funded, most of the services are delivered privately by a mixture of for-profit small businesses (e.g., physician services), not-for-profit (e.g., most hospitals) and for-profit corporations (e.g., pharmaceuticals) [31].

The governance and delivery of health care in Canada are separated into the two levels of government: federal and provincial [27]. Each level of government has different set of responsibilities to ensure adequate health care across Canada. In both levels of government, physicians serve as independent contractors and bill the government for their services. The federal government holds a range of responsibilities for health care in Canada. Their key responsibility is establishing standards for hospital, diagnostic and medical care services through the CHA and CHT; the federal government monitors and ensures all provinces and territories are following the five criteria of the CHA [27]. The federal government also provides primary and supplementary health services (i.e., "non-insured health services" by Medicare) to specific populations including the Indigenous populations, federal police, military workforce, and prisoners [28]. Moreover, the federal government is responsible for regulating therapeutic products such as pharmaceuticals, medical devices and natural health products [27] as well as providing funding for health research along with collecting and providing health data to Canadians. Each province and territory in Canada has legislation that dictates how health insurance should be governed and administered [27]. Provinces and territories are responsible for the payment of hospital care, negotiating with the provincial medical association to set rates of remuneration for physicians, long term care services and subsidies, and degree of coverage for prescription drug plans [28]. They are responsible for the laws and regulations regarding universal coverage and determining what services the province views as "medically necessary".

Data and variables

To analyze socioeconomic inequality in LWT for access to health care, we used pooled data from four confidential master files of the CCHSs (2000/01, 2003, 2005 and 2010) conducted by Statistics Canada. Pooling the CCHSs yielded an adequately large sample of observations, enabling us to analyze socioeconomic-related inequalities in LWT in Canada as a whole and for its provinces separately. Each CCHS is a nationally representative survey of individuals aged 12 and older from all provinces and territories in Canada, except those living on Crown lands and Indian reserves, on Canadian Forces bases, in institutions (prisons, hospitals, universities), and in some remote areas. We excluded the regions of Northwest Territories, Nunavut and Yukon from the analysis because access to services is different in territories compared to provinces and requires additional considerations that CCHS cannot offer.

Our outcome variable of interest is a binary variable for LWT. If respondents reported that there was a time when they felt that they needed health care (e.g., treatment of a physical health problem, an emotional or mental health problem, a regular check-up, care of an injury and so on) but did not receive it due to LWT during the last 12 months, they were coded as individuals with the experience of LWT. Since the perception of time is different between older and younger adults [32] and older adults are

[1] Approximately two-thirds of Canadians have private insurance for health services not covered by Medicare [55].

more likely to underestimate lengthy durations [33, 34], we restricted our analysis to working-age adults (18–65 years, $n = 266{,}962$).

Consistent with the existing literature (e.g., [23]), a wide variety of demographic (age, sex and marital status) and socioeconomic (income, education level, employment status and immigration status) factors were used as determinants of LWT in the decomposition analysis.

We used household income as the main indicator of SES because it has been demonstrated that income measured at the household level is a better measure of SES, especially for women [35, 36]. Due to the personal nature of household income questions, some respondents in the CCHSs only answered the income range question. To include these observations in the analysis, as per Statistic Canada suggestion [37], we imputed a random household income for each respondent within their reported household income range. For the highest household income range, we used median of total household income for the highest income range in each province and imputed total household income for the respondents. Total household income is adjusted for inflation using the Consumer Price Index (CPI) for the year and province of residence (2002 as the base year) [38]. Similar to recent the Organization for Economic Cooperation and Development (OECD) publications (e.g., [39]), household annual income was equivalised using the square root scale, which divides household income by the square root of household size.

We used a set of 15 chronic condition indicators to capture respondents' health status. In addition, the basic characteristics of the residence areas were adjusted by including urban/rural variable and a set of province dummy variables, with Ontario as the base category. Survey year dummies were included in the decomposition regression to control for time trends, using the first survey cycle in 2000/01 as the reference category. Table 1 presents the definition of all variables used in the analysis.

Methods

The concentration index approach was used to quantify the degree of income-related inequalities in LWT in Canada and its provinces. As argued by Wagstaff et al. [40] the concentration and slope/relative index of inequality are the most appropriate measures of socioeconomic inequality in health because they satisfy three qualities for a favorable socioeconomic inequality index, namely that the index should: (1) reflect the health inequalities that arise from the socioeconomic characteristics; (2) be representative of the whole population; and (3) be sensitive to the subpopulation group sizes. There is a broad discussion on whether to use relative (invariance to multiplicative transformations) or absolute (invariance to additive transformations) measure of health inequalities [41]. As there is general agreement on the use of both measures to explain social inequalities in health [41, 42], we employed both relative and absolute measures of the concentration index to quantify and decompose income-related inequalities in LWT.

The relative concentration index is calculated with reference to the standard concentration curve, which plots the cumulative share of a health variable of interest (LWT), on its y-axis, against the cumulative share of the population, ranked in ascending order of socioeconomic status (e.g., income), on its x-axis. Based on the concentration curve we can, for example, make statements such as "30% of LWTs are concentrated among the poorest 20% of the population. If all the population, ranked by income, experienced an equal share of LWT, the curve would coincide with the "line of perfect equality" (i.e., 45°). The relative concentration index is defined as twice the area between the concentration curve and the line of perfect equality. The index is negative (positive) if the curve lies above (below) the line of perfect equality, suggesting that LWT is concentrated among the poor (rich). The value of the index ranges from -1 to $+1$, with a value of zero indicating "perfect equality" [43].

The "convenient regression" method can be used to compute the relative concentration index as follows [44]:

$$2\sigma_r^2\left(\frac{y_i}{\mu}\right) = \alpha + \varphi r_i + \varepsilon_i, \tag{1}$$

where y_i is the outcome variable (i.e., LWT) for individual i, μ is the mean of the outcome variable for the whole sample, $r_i = i/N$, is the fractional rank of individual i in the distribution with $i = 1$ for the poorest and $i = N$ for the richest individual, and σ_r^2 is the variance of fractional rank. The ordinary least squares (OLS) estimate of φ is the relative concentration index [14]. As Wagstaff [45] demonstrated, the minimum and maximum of the index are not -1 and $+1$ and depend on μ when the outcome variable is binary. In this case, multiplying the estimated relative concentration index, φ, by $1/1-\mu$ can normalize the index. As the outcome variable in our analysis is binary, we used the normalized concentration index (RC_n) to summarize income-related inequalities in LWT.

The standard concentration curve can be generalized in such a way that reflects absolute differences in the outcome variable between socioeconomic groups. The generalized concentration curve is the standard concentration curve multiplied by the μ and indicates the cumulative share of population, ranked based on income, against the cumula-

Table 1 The description of the variables used in the study

Variables	Description
Outcome variable	
Lengthy wait time (LWT)	1 = if respondent reported LWT to access for health care over the past 12 months, 0 otherwise
Demographic variables	
Age	Respondent's age (years)
Sex	
Male	1 = if respondent is male, 0 otherwise
Female (*Ref.*)	1 = if respondent is female, 0 otherwise
Marital status	
Married	1 = if respondent is married or *de facto* married, 0 otherwise
Divorced or widowed	1 = if respondent is divorced or widowed, 0 otherwise
Single (*Ref.*)	1 = if respondent is single, 0 otherwise
Socioeconomic variables	
Equivalised household income	Household income divided by the square root of household size
Education level	
No secondary education	1 = if respondent has not completed secondary education, 0 otherwise
Secondary education	1 = if respondent has completed secondary education, 0 otherwise
Completed Diploma	1 = if respondent has completed a Diploma, 0 otherwise
Completed Bachelor degree (*Ref.*)	1 = if respondent has completed a Bachelor degree, 0 otherwise
Employment status	
Employed (*Ref.*)	1 = if respondent is employed, 0 otherwise
Unable to work	1 = if respondent is unable to work, 0 otherwise
Student	1 = if respondent is a full time student, 0 otherwise
Other	1 = if respondent has other occupation status, 0 otherwise
Immigration status	
Canadian birthplace (*Ref.*)	1 = if respondent is Canadian born, 0 otherwise
$\leq$10 years	1 = if respondent is migrated to Canada within last 10 years, 0 otherwise
>10 years	1 = if respondent is migrated to Canada more than 10 years ago, 0 otherwise
Health care need variables	
Health status	
Asthma	1 = if respondent has asthma, 0 otherwise
Fibromyalgia	1 = if respondent has fibromyalgia, 0 otherwise
Arthritis or rheumatism	1 = if respondent has arthritis or rheumatism, 0 otherwise
Back problems	1 = if respondent has back problems excluding fibromyalgia and arthritis, 0 otherwise
High blood pressure	1 = if respondent has high blood pressure, 0 otherwise
Migraine headaches	1 = if respondent has migraine headaches, 0 otherwise
Diabetes	1 = if respondent has diabetes, 0 otherwise
Epilepsy	1 = if respondent has epilepsy 0 otherwise
Heart disease	1 = if respondent has heart disease, 0 otherwise
Cancer	1 = if respondent has cancer, 0 otherwise
Stomach or intestinal ulcers	1 = if respondent has stomach or intestinal ulcers, 0 otherwise
Effects of a stroke	1 = if respondent suffers from the effects of astroke, 0 otherwise
Bowel disorder/Crohn's or colitis	1 = if respondent has bowel disorder/Crohn's or colitis, 0 otherwise
Fatigue syndrome	1 = if respondent has chronic fatigue syndrome, 0 otherwise
Multiple chemical sensitivities	1 = if respondent has multiple chemical sensitivities, 0 otherwise
Geographical variables	
Geographical region	
Rural	1 = if respondent resides in rural area, 0 otherwise
Urban (*Ref.*)	1 = if respondent resides in urban area, 0 otherwise

Table 1 continued

Variables	Description
Province	
Newfoundland and Labrador (NL)	1 = if respondent resides in Newfoundland and Labrador, 0 otherwise
Prince Edward Island (PE)	1 = if respondent resides in Prince Edward Island, 0 otherwise
Nova Scotia (NS)	1 = if respondent resides in Nova Scotia, 0 otherwise
New Brunswick (NB)	1 = if respondent resides in New Brunswick, 0 otherwise
Quebec (QC)	1 = if respondent resides in Quebec; 0, otherwise
Ontario (ON) (*Ref.*)	1 = if respondent resides in Ontario, 0 otherwise
Manitoba (MB)	1 = if respondent resides in Manitoba, 0 otherwise
Saskatchewan (SK)	1 = if respondent resides in Saskatchewan, 0 otherwise
Alberta (AB)	1 = if respondent resides in Quebec, 0 otherwise
British Columbia (BC)	1 = if respondent resides in British Columbia, 0 otherwise
Time fixed-effects	
Survey year 2000/1 (*Ref.*)	1 = if respondent surveyed in 2000/01 cycle, 0 otherwise
Survey year 2003	1 = if respondent surveyed in 2003 cycle, 0 otherwise
Survey year 2005	1 = if respondent surveyed in 2005 cycle, 0 otherwise
Survey year 2010	1 = if respondent surveyed in 2010 cycle, 0 otherwise

Ref reference category

tive amount of the outcome variable. The absolute concentration index is defined as twice the area between the line of perfect equality and the generalized concentration curve and can be calculated by multiplying the relative concentration index by μ [40]. The value of the absolute concentration index is not invariant to permissible scale transformations of health variables. To overcome this deficiency, Erreygers [46] suggested a modification to the absolute concentration index. The modified absolute concentration index, AC_m, when the outcome variable is binary can be formulated as:

$$AC_m = 4\mu \times RC \tag{2}$$

This index ranges from -1 to $+1$, with zero representing "perfect equality" [47].

We decomposed the relative and absolute concentration indices to quantify and compare the extent to which observed determinants of LWT (age, sex, and marital status, income, education, health care need, geographical factors) contributed to the socioeconomic inequality in LWT in Canada. If we have a linear regression model linking our LWT variable, y, to a set of k explanatory factors, x_k, such as:

$$y = \propto + \sum_k \beta_k x_k + \varepsilon. \tag{3}$$

Wagstaff et al. [48] demonstrated that the relative concentration index of y, RC, can be decomposed into the contribution of factors that explain LWT as follows:

$$RC = \sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) RC_k + \frac{AC_\varepsilon}{\mu}. \tag{4}$$

According to Eq. (4), the RC is equal to a weighted sum of the relative concentration index of the explanatory variables, RC_k. The weight for the RC_k is the elasticity of y with respect to x_k ($\beta_k(\bar{x}_k/\mu)$, where $\bar{x}_k$ indexes the mean of x_k). Thus, each of these determinants will contribute to income-related inequality in LWT if: (1) it has a significant elasticity; and (2) it is unequally distributed by income. The AC_ε is the absolute concentration index for the error term defined as $AC_\varepsilon = \frac{2}{n}\sum_{i=1}^{n} \varepsilon_i r_i$, where r_i is the fractional rank of the individual i in the population distribution based on income [48]. The error term reflects income-related inequality in LWT that is not determined by differences in x_k across income groups [14]. Using Wagstaff's normalization to the decomposition of the RC yields:

$$RC_n = \frac{RC}{1-\mu} = \frac{\sum_k \left(\frac{\beta_k \bar{x}_k}{\mu}\right) RC_k}{1-\mu} + \frac{\frac{AC_\varepsilon}{\mu}}{1-\mu}. \tag{5}$$

The decomposition of the AC_m can be formulated as:

$$AC_m = 4\mu \times RC = 4\sum_k (\beta_k \bar{x}_k) RC_k + 4AC_\varepsilon. \tag{6}$$

According to Eq. (6) the degree of each factor's (x_k) contribution to the AC_m in LWT depends on the β_k and the $\bar{x}_k \times RC_k$ (i.e., the AC_k). A factor that affects the probability of LWT and is distributed unequally by income can contribute to income-related inequality in LWT.

In our analysis, LWT is a binary variable taking the value of one or zero, depending on whether the individuals reported LWT or not in the past 12 months. Thus, we used marginal effects obtained from the non-linear logit model in the decomposition analysis.[2] We employed sampling weights in all the analyses to produce estimates that are representative of the Canadian population. As per Statistics Canada suggestion [49], we adjusted the sampling weight for each observation in the pooled sample by a constant based on the number of cycles included (i.e., four).

Results

Descriptive statistics

Weighted descriptive statistics of all variables used in the study are reported in Table 2. Over the study period, the average age of individuals in the pooled sample was 41.25 (standard deviation [SD] = 12.5). The sample was evenly distributed by sex and a higher proportion of individuals reported to be married or common-law. The mean of equivalised household income was 40,633 CAD (SD = 29,236) in Canada over the period between 2000 and 2010. While 13% of individuals had no secondary education, 45.75 and 23.09% of respondents had a Diploma and Bachelor degree as their highest level of education attainment, respectively. Most individuals in the sample were employed (77.34%). Twenty-one per cent of respondents were immigrants, including long-term (those in Canada 10 years or more) and recent (those in Canada less than 10 years) immigrants. There were large differences in the prevalence of chronic conditions in the sample. While the prevalence of migraine headaches, high blood pressure, arthritis or rheumatism and back problems conditions were more than 10%, the prevalence of effects of a stroke, epilepsy, cancer, fatigue syndrome and fibromyalgia conditions were less than 2%. Based on the descriptive results 82.11% of individuals lived in urban areas.

On average, 4.58% of adult Canadians experienced LWT as a barrier to access health care in the past 12 months. There is, however, variation among the provinces in LWT in Canada. While almost 3% of the residents of British Columbia and Saskatchewan reported LWT as a barrier to access to health care, this figure was around 7% in Quebec (see Table A.1 in the Appendix). As illustrated in Fig. 1, the proportion of residents who reported LWT as a barrier to access for health services was greater in Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec and Manitoba compared to other provinces.

Income-related inequality in LWT

Figure 2 shows the relative and absolute concentration indices for LWT in access to health care services in Canada and in its provinces over the study period. The findings suggested that LWT was mainly concentrated among the poor in Canada ($RC_n = -0.039$; 95% confidence interval [CI] -0.049 to -0.028 and $AC_m = -0.067$; CI -0.086 to -0.049). These indices suggested statistically significant inequality in the LWT in favour of the rich in Nova Scotia ($RC_n = -0.087$ and $AC_m = -0.155$), New Brunswick ($RC_n = -0.131$ and $AC_m = -0.233$), Quebec ($RC_n = -0.030$ and $AC_m = -0.074$), Manitoba ($RC_n = -0.046$ and $AC_m = -0.091$), Saskatchewan ($RC_n = -0.077$ and $AC_m = -0.10$) and British Columbia ($RC_n = -0.040$ and $AC_m = -0.049$).

Determinants of income-related inequality in LWT

Table 3 contains results of the decomposition analysis of income-related inequality in LWT in Canada, including: (1) the coefficients estimating the effect of each explanatory factor on the probability of LWT, (2) the elasticities of LWT with respect to explanatory variables (3) the RC_k, which shows income-related inequalities for each explanatory variable, and (4) the "contribution" of each factor to the RC_n and AC_m for LWT.

Among demographic characteristics, younger age was associated with higher probability of LWT. Compared to women, men significantly had 0.6% lower probability of having LWT in the past 12 months. Being single was associated with 0.8% lower probability of having LWT as a barrier for access to health care. With respect to SES, higher educational attainment was associated with the higher probability of reporting LWT. Recent immigrants (who landed 10 or less years earlier) reported 0.9% more LWT problem compared to non-immigrants. Additionally, the lower a person's health status (i.e., have chronic health conditions), the more likely they were to experience LWT. Whereas individuals residing in the provinces of NL, NS, NB, QC, MB and AB had a significantly higher likelihood of having LWT as compared to ON, the probability of having long wait time was 0.7% lower in BC than ON. The probability of respondents reporting a LWT was 0.4% greater in 2010 than in 2000/01.

Table 3 also shows the relative concentration indices for all explanatory variables, RC_x. A negative (positive) value of the RC_x shows that the explanatory variable x is concentrated among the poor (rich). Based on the RC_x individuals who were older, male, reported completion of a

[2] Using a linear probability model (LPM) in the decomposition analysis yielded similar results.

Table 2 Descriptive statistics of variables used in the study

Variables	Proportion (%)/mean	Standard deviation
Outcome variable		
Lengthy wait time (LWT)	4.58	20.90
Demographic variables		
Age	41.25	12.50
Sex		
Male	50.54	50.00
Female (*Ref.*)	49.46	50.00
Marital status		
Married (*Ref.*)	67.54	46.82
Divorced or widowed	9.65	29.52
Single	22.82	41.96
Socioeconomic variables		
Equivalised household income[a]	40,633	29,236
Education level		
No secondary education	13.00	33.63
Secondary education	18.17	38.56
Completed Diploma	45.75	49.82
Completed Bachelor degree (*Ref.*)	23.09	42.14
Employment status		
Employed (*Ref.*)	77.34	41.87
Unable to work	2.15	14.49
Student	2.91	16.82
Other	17.60	38.08
Immigration status		
Canadian birthplace (*Ref.*)	78.55	41.05
$\leq$10 years	7.02	25.54
>10 years	14.40	35.11
Health care need variables		
Health status		
Asthma	8.04	27.20
Fibromyalgia	1.48	12.08
Arthritis or rheumatism	12.84	33.45
Back problems	19.84	39.88
High blood pressure	11.57	31.99
Migraine headaches	11.37	31.75
Diabetes	3.83	19.19
Epilepsy	0.57	7.56
Heart disease	2.83	16.57
Cancer	1.15	10.68
Stomach or intestinal ulcers	3.00	17.06
Effects of a stroke	0.54	7.30
Bowel disorder/Crohn's or colitis	3.25	17.72
Fatigue syndrome	1.21	10.91
Multiple chemical sensitivities	2.36	15.19
Geographical variables		
Geographical region		
Rural	17.89	38.33
Urban (*Ref.*)	82.11	38.33
Province		
NL	1.74	13.06

Table 2 continued

Variables	Proportion (%)/mean	Standard deviation
PE	0.43	6.53
NS	2.97	16.98
NB	2.39	15.28
QC	24.59	43.06
ON (*Ref.*)	38.79	48.73
MB	3.41	18.15
SK	2.85	16.64
AB	10.13	30.18
BC	12.69	33.29
Time fixed-effects		
Survey year 2001 (*Ref.*)	25.47	43.57
Survey year 2003	24.75	43.15
Survey year 2005	24.83	43.20
Survey year 2010	24.95	43.27

Ref reference category

[a] We used log transformed equivalised household income in our decomposition analysis. The mean and standard deviation of the log-transformed variable were 10.37 and 0.79, respectively

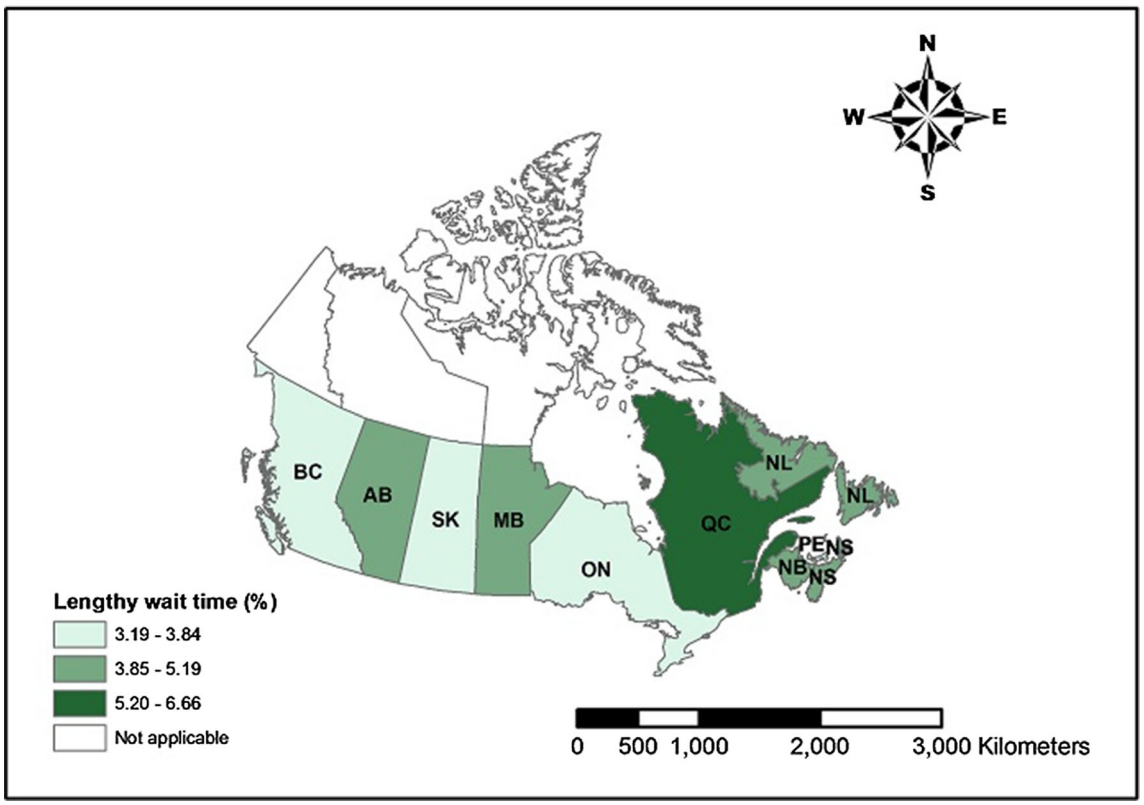

Fig. 1 Proportion of self-reported LWT as a barrier for access to any health care across provinces in Canada: 2000–2010

Diploma or a Bachelor degree and residing in AB and BC were relatively richer in Canada. In contrast, individuals who were single, divorced or widowed, unable to work, student, immigrant (both recent and established), having chronic conditions and living in rural areas were relatively poorer in Canada.

Based on the RC_x and the regression coefficients on each explanatory variable, we computed the contribution of

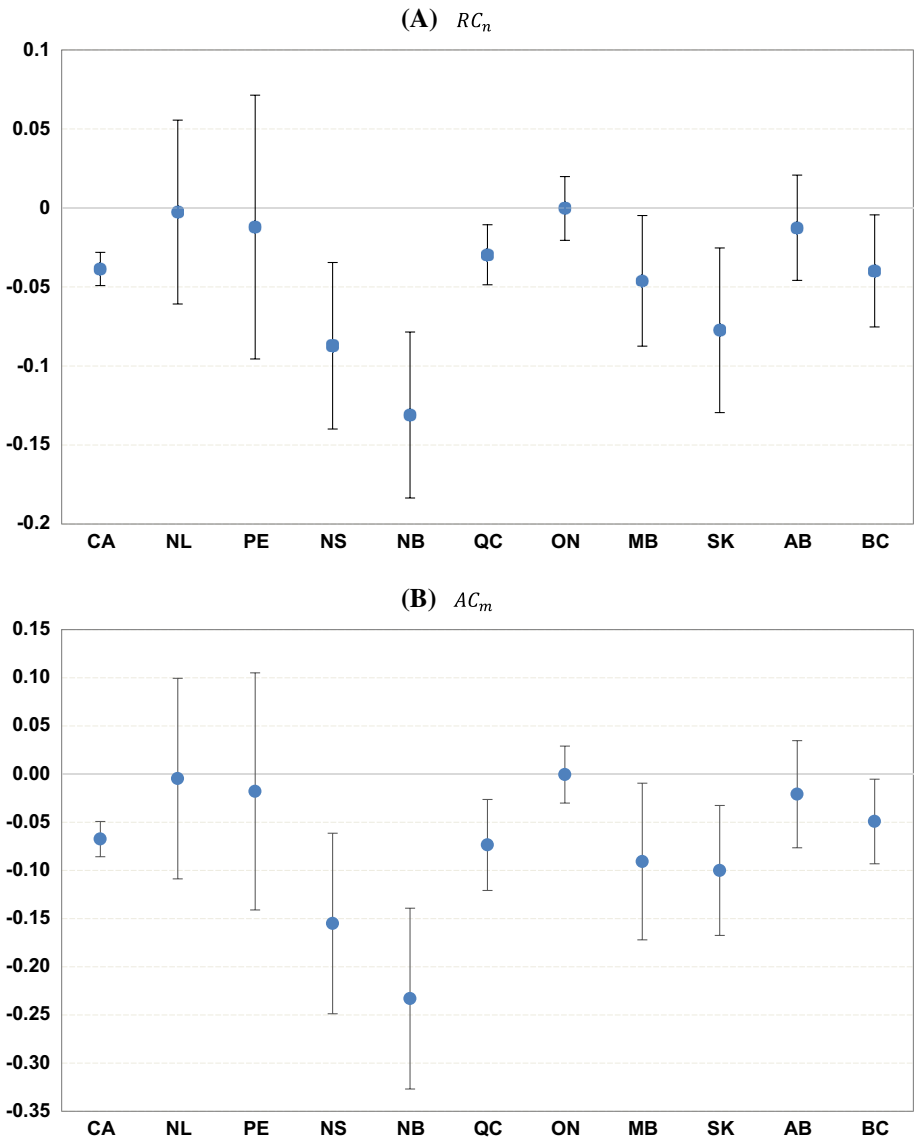

Fig. 2 Income-related inequalities in LWT for access to health care services across the Canadian provinces: 2000–2010 with 95% confidence interval; the AC_m s are multiplied by 10 for ease of interpretation

each factor to the RC_n and AC_m as $\left(\frac{\beta_k \bar{x}_k}{\mu}\right) RC_k / 1 - \mu$ and $4(\beta_k \bar{x}_k) RC_k$, respectively. The term "contribution" indicates how much the variation of an explanatory factor among different income groups can explain the observed association between income and LWT. A positive (negative) contribution of a given explanatory factor to the RC_n/AC_m suggests that the income-related distribution of the factor and the relationship between the relevant factor and LWT (i.e., elasticity) contribute to a higher likelihood of LWT among the rich (poor).

Table 3 and Fig. 3 show the contribution of explanatory factors to the income-related inequality in LWT in Canada. According to the contribution results, income was associated negatively with long wait time, independently of the other determinants of socioeconomic-related inequality. In other words, income increased the concentration of long wait time among the poor and made a significant contribution to the observed pro-rich inequality in LWT in Canada (31.04%, calculated as its contribution divided by the total the RC_n/AC_m and multiplied by 10). Apart from income, demographic factors such as age and being male also contributed to socioeconomic inequality in LWT in Canada. Other factors that contributed to the relative and absolute concentration of LWT among socioeconomically disadvantaged Canadian were health status and immigration status.

Health status (measured by 15 chronic health conditions) made negative contribution to income-related inequality because chronic health conditions are concentrated among the poor (see the RC_k for all 15 chronic health conditions) and this factor has a positive elasticity (i.e.,

Table 3 Decomposition of income-related inequality for LWT in Canada

	Contribution									
	Marginal effects	Elasticities	RC_k	AC_k	RC_n		AC_m^b		RC_n/AC_m	
					Absolute value	Sum	Absolute value	Sum	Percentage	Sum percentage
Demographic variables										
Age	−0.001***	−0.523	0.010	0.427	−0.006		−0.010		14.70	
Sex										
Male	−0.006***	−0.067	0.051	0.026	−0.004		−0.006		9.28	
Marital status										
Divorced or widowed	0.0003	−0.001	−0.199	−0.019	0.000		0.000		−0.37	
Single	−0.008***	−0.038	−0.085	−0.019	0.003	−0.006	0.006	−0.010	−8.77	14.84
Socioeconomic variables										
Equivalised household income (log)	−0.001	−0.293[a]	0.039	0.404	−0.012	−0.012	−0.021	−0.021	31.04	31.04
Education level										
No secondary education	−0.019***	−0.055	−0.345	−0.045	0.020		0.035		−51.65	
Secondary education	−0.015***	−0.059	−0.091	−0.017	0.006		0.010		−14.63	
Completed Diploma	−0.007***	−0.070	0.003	0.001	0.000	0.025	0.000	0.044	0.59	−65.69
Employment status										
Unable to work	0.004	0.002	−0.547	−0.012	−0.001		−0.002		2.81	
Student	−0.006	−0.004	−0.299	−0.009	0.001		0.002		−3.00	
Other	−0.003	−0.011	−0.284	−0.050	0.003	0.003	0.006	0.006	−8.36	−8.55
Immigration status										
≤10 years	0.009***	0.014	−0.330	−0.023	−0.005		−0.008		12.47	
>10 years	0.002	0.008	−0.020	−0.003	0.000	−0.005	0.000	−0.009	0.43	12.90
Health care need variables										
Health status										
Asthma	0.010***	0.017	−0.062	−0.005	−0.001		−0.002		2.79	
Fibromyalgia	0.011*	0.004	−0.170	−0.003	−0.001		−0.001		1.64	
Arthritis or rheumatism	0.017***	0.048	−0.100	−0.013	−0.005		−0.009		13.16	
Back problems	0.023***	0.100	−0.047	−0.009	−0.005		−0.009		12.83	
High blood pressure	0.004*	0.009	−0.051	−0.006	0.000		−0.001		1.23	
Migraine headaches	0.014***	0.035	−0.072	−0.008	−0.003		−0.005		6.79	
Diabetes	0.006*	0.005	−0.165	−0.006	−0.001		−0.002		2.25	
Epilepsy	0.004	0.001	−0.273	−0.002	0.000		0.000		0.38	
Heart disease	0.010***	0.006	−0.156	−0.004	−0.001		−0.002		2.55	
Cancer	0.020***	0.005	−0.043	0.000	0.000		0.000		0.59	
Stomach or intestinal ulcers	0.015***	0.010	−0.172	−0.005	−0.002		−0.003		4.61	
Effects of a stroke	0.015**	0.002	−0.293	−0.002	−0.001		−0.001		1.38	
Bowel disorder/ Crohn's or colitis	0.013***	0.009	−0.033	−0.001	0.000		−0.001		0.84	
Fatigue syndrome	0.012***	0.003	−0.302	−0.004	−0.001		−0.002		2.64	
Multiple chemical sensitivities	0.012***	0.006	−0.157	−0.004	−0.001	−0.022	−0.002	−0.038	2.56	56.24
Geographical variables										
Geographical region										
Rural	−0.002*	−0.010	−0.062	−0.011	0.001		0.001		−1.60	
Province										

Table 3 continued

	Contribution									
	Marginal effects	Elasticities	RC_k	AC_k	RC_n		AC_m^b		RC_n/AC_m	
					Absolute value	Sum	Absolute value	Sum	Percentage	Sum percentage
NL	0.011***	0.004	−0.216	−0.004	−0.001		−0.002		2.56	
PE	0.003	0.000	−0.195	−0.001	0.000		0.000		0.15	
NS	0.007**	0.004	−0.134	−0.004	−0.001		−0.001		1.55	
NB	0.010***	0.005	−0.168	−0.004	−0.001		−0.002		2.44	
QC	0.027***	0.145	−0.084	−0.021	−0.013		−0.022		32.93	
MB	0.014***	0.011	−0.039	−0.001	0.000		−0.001		1.13	
SK	−0.003	−0.002	−0.023	−0.001	0.000		0.000		−0.12	
AB	0.006**	0.013	0.093	0.009	0.001		0.002		−3.35	
BC	−0.007***	−0.018	0.002	0.000	0.000	−0.014	0.000	−0.024	0.10	35.80
Time fixed-effects										
Survey year 2003	0.0004	−0.002	−0.004	−0.001	0.000		0.000		−0.03	
Survey year 2005	0.0003	0.002	0.014	0.003	0.000		0.000		−0.06	
Survey year 2010	0.004*	0.019	0.043	0.011	0.001	0.001	0.001	0.002	−2.22	−2.31
Sum						−0.029		−0.050		74.17
Residual (total RC_n/AC_m − sum)						−0.010		−0.017		25.83
Total RC_n/AC_m						−0.039		−0.067		100

Reported estimates are marginal effects calculated at the means of the independent variables

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

[a] "Elasticity" is not a fully correct term for the income variable because it is measured in log rather than level

[b] The AC_m is multiplied by 10 for ease of interpretation

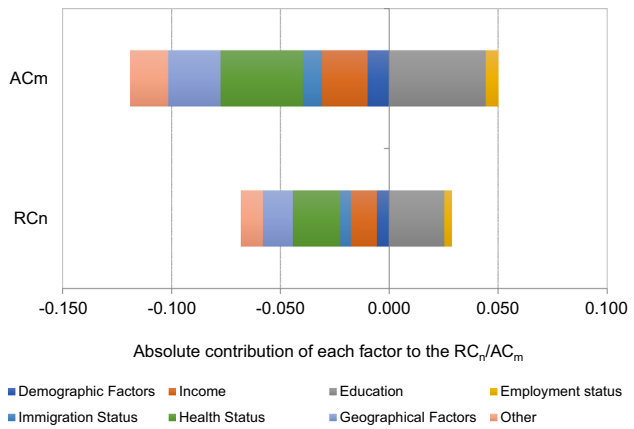

Fig. 3 Contribution of each factor to the inequality for LWT in Canada

having chronic conditions were positively associated with the probability of having LWT in the past 12 months). The product of these two effects led to the negative contribution of health status to the overall RC_n and AC_m. Similarly, immigration status increased the concentration of LWT among the poor because on the one hand immigrants are generally poorer than their Canadian born counterparts (see the RC_k for both recent and established immigrants) and on the other hand they were more likely to experience LWT compared to the Canadian born.

With regard to the geographical factors, Quebec contributed negatively to the observed income-related inequality in LWT in Canada. The negative contribution of Quebec to the inequality is because the probability of having LWT was higher in this province compared to Ontario, and Quebecers generally had a lower equivalised household income than residents of other provinces (see the RC_k for this province).

In contrast, the education factor contributed to the concentration of LWT among the rich in Canada. Education factor made a positive contribution to the income-related inequality because this factor has a negative elasticity (i.e., a decrease in educational attainment decreases probability of reporting LWT in the past 12 months) and lower education attainments are mainly concentrated among the poor (see the negative signs of the RC_k for no secondary and secondary education in Table 3). In other words, since income and education are positively correlated and highly educated Canadians are more likely to

report unaccepted wait time (perhaps due to their lower overall satisfaction with the health care system and/or different expectations about wait times for care [50]), the education factor contributed to the concentration of LWT among the rich. This implies that actual pro-rich inequalities in LWT in Canada would have been even greater if the education factor did not affect self-reported LWT.

Discussion and conclusions

Notwithstanding concern about accessibility of health services without financial or other barriers, waiting for care is a reality in the Canadian health care system, precluding Canadians from having timely access to health services [51]. Although waiting times continue to be a great public and political concern in Canada [52], empirical studies on socioeconomic inequalities in waiting time are scarce. Using pooled data from four CCHSs and concentration index approach we summarized income-related inequalities in LWT for health care among adult population in Canada over the period between 2000 and 2010. Furthermore, we decomposed income-related inequality to determine factors that explain inequality in LWT.

Our findings revealed that 5% of adult Canadians experienced LWT as a barrier to receive health services in the past 12 months. There was also a variation in LWT across provinces. We found statistically significant pro-rich inequalities in LWT in NS, NB, and SK and Canada as a whole. The negative income gradient in wait time was also found in Norway in a study by Monstad et al. [23]. Similarly, using data from the Survey of Health, Ageing and Retirement in Europe (SHARE) Siciliani and Verzulli [4] showed that waiting times for specialist consultation and non-emergency surgery were higher among the poor in Germany and Greece, respectively. In contrast, however, a latter study found a positive association between income and waiting times for specialist consultation and non-emergency surgery in Sweden.

Our decomposition results indicated that income, independently of other factors, had negative contribution to the pro-rich inequality in LWT. This is consistent with the result of an earlier study by Carrière and Sanmartin [53] that suggested men in the lowest household income quintile in Canada were less likely to see a specialist within a month than their counterparts in the highest household income quintile. The negative association that we found between income and LWT can probably be explained by unobserved factors that correlate with income that influence on waiting time. For example, better-off individuals may face lower search costs due to their better-informed networks. Socioeconomically advantaged patients may be more persistent individuals who follow their wait lists by making an extra call to the hospital to inquire about their waiting time or have their family doctor do it. In addition, they may convince health care personnel about their need for a shorter wait by having better and more effective communication skills [23]. The decomposition of the observed income-related inequality in LWT suggested that, besides income itself, health status, immigration status and geographical factors were the main drivers of the concentration of LWT among the poor in Canada. In contrast, education contributed to the concentration of LWT among the rich.

There were several limitations to this study. First, since the CCHSs do not contain any information about LWT for different types of health care services (e.g., GP and medical specialist appointments, elective surgeries, diagnostic tests), we could not measure income-related inequalities in wait time for different health services, separately. The CCHSs, however, reported LWT for three general types of health care services viz. physical/mental health care, injury care, and other health services. The proportion of self-reported LWT for access to these three services over the past 12 months were 3.7, 0.45 and 0.62%, respectively, in Canada (see Table A.1 in the Appendix). To get a better insight into income-related inequalities in LWT, we calculated RC_n and AC_m for physical/mental health care, injury care and other health services, separately. The results indicated that LWT for physical/mental health care and other types of health services were mainly concentrated among the poor in Canada (see Figures A.1 and A.2 in the Appendix). In contrast, LWT for injury care was concentrated among the better offs (see Figure A.2 in the Appendix). Second, while it would be ideal to use clinically unacceptable wait time as our main outcome variable in the analysis, we used self-reported LWT in our study due to data availability. Although studies in Canada [50] and Europe [54] have identified the length of the wait time as the main determinant of wait time unacceptability, self-reported measure of LWT could be an issue in our study if SES was associated with under- or over-reporting of LWT. For example, if the financially better-offs were more likely to report LWT because they are better-informed patients and have higher expectations from health care system, we may have under-estimated the concentration of LWT among the poor. Due to the issue of under- or over-reporting in self-reported measure of LWT, administrative waiting time data would be preferred to the self-reported LWT indicator for our analysis. To the best of our knowledge, there is unfortunately no administrative data on wait time in Canada that can be used to measure socioeconomic inequality in wait time. The findings of this study can be supplemented with an objective measure of wait time using administrative data that may become available in the future.

Caveats considered, our findings provide evidence that low-income individuals tend to have more issues with LWT for publicly-funded health care in Canada than their better-off counterparts. The observed negative gradient between income and LWT may be interpreted as evidence of socioeconomic inequity within the Canadian health care system. Therefore, further work is required to better understand the mechanisms explaining the concentration of LWT among the poor in Canada.

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Compliance with ethical standards

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