Priority Health Equity Indicators for British Columbia

Preventable and Treatable Premature Mortality

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Foreword

At BCCDC, we believe that every British Columbian should be able to achieve their best possible level of health and wellbeing. However, factors that determine our health are not currently distributed equitably within our population. Health equity among people is influenced by geography, culture, experience of colonization, religion, gender, age, socioeconomic status and other circumstances.

The BC Centre for Disease Control (BCCDC), a part of the Provincial Health Services Authority (PHSA), has a mandate to promote health and health equity; prevent, monitor and reduce communicable disease, chronic disease and injury; and mitigate environmental health risks to British Columbians. Our Population and Public Health Program (PPH) conducts population health surveillance including a focus on health equity. Since 2012, the PPH team has created indicators that can inform health equity analyses across the province.

This report illustrates how two premature mortality indicators vary across geographic, demographic and socio-economic factors. Both preventable and treatable premature mortality show evidence of disparity within the sub-populations of B.C. I hope readers will find this report useful in informing evidence-based health equity promotion strategies.

I thank the project team and partners for their contribution to this report.

Dr. David Patrick

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Executive Summary

Health equity exists when all are able to reach their full health potential and are not prevented from doing so because of their race, culture, religion, sex, gender, age, socioeconomic status, or other socially determined circumstances. Health inequity is an avoidable or preventable health disparity that is unjust or unfair across geographic, demographic, or socio-economic dimensions.

In 2013, PHSA's PPH team led a collaborative process with health sector partners that resulted in 52 prioritized health equity indicators for use in B.C. This was the first step towards setting targets and creating future action on equity.[1] In the ongoing series of reporting on these indicators, this report provides data on health inequities in B.C. based on preventable and treatable premature mortality as health equity indicators, covering the period from 2009 to 2013.

The premature mortality indicators encompass a comprehensive and extensive list of diseases and conditions that are diagnosed by the health care system (i.e., they are composite indicators). Both preventable and treatable premature mortality indicators are a result of avoidable causes of death before the age 75. Using data from BC Vital Statistics, premature death data were analyzed across socio-economic dimensions (income, education, employment, social and material deprivation indices), local health areas (LHAs), and regional health authorities (RHA). Disparity ratios are reported to compare the preventable and treatable premature mortality between the areas or groups with the highest to lowest categories of stratifier dimensions. Higher disparity ratios (>1) may indicate inequities existing between the groups being compared.

Key Findings

Premature mortality: number of deaths before age 75 from avoidable causes per 100,000 population.

- Overall, the provincial age-standardized rates of premature mortality, preventable and treatable, were 143.2 and 37.7 deaths per 100,000 population, respectively, averaged over the period 2009-2013.
- Males had significantly higher preventable premature mortality (194.8 deaths per 100,000 population) than females (93.9 deaths per 100,000 population), whereas females had significantly higher treatable premature mortality (40 deaths per 100,000 population) than males (35.3 deaths per 100,000 population).
- Preventable premature mortality rates varied across the LHAs, with the Vancouver area having both the highest (Vancouver-Downtown Eastside, 397.3 deaths per 100,000 population) and lowest rates (Vancouver-Westside, 68.4 deaths per 100,000 population), giving a disparity ratio of 5.8.
- Treatable premature mortality rates were highest in the Central Coast LHA (98.5 deaths per 100,000 population) and lowest in the Golden LHA (13.1 deaths per 100,000), giving a disparity ratio of 7.5.
- Interior Health, Vancouver Island Health Authority, and Northern Health had relatively higher rates than Fraser Health and Vancouver Coastal Health among health authorities.

- Analysis of rates by income (quintiles), education (four categories), employment (five percentile categories), social deprivation (quintiles), and material deprivation (quintiles) showed declines in preventable premature mortality as socio-economic conditions improve (disparity ratios for the above five dimensions are 2.9, 1.7, 1.4, 2.4, and 2.0 respectively). Rates for treatable premature mortality showed a similar pattern, except having smaller disparity ratios for the socio-economic dimensions.

Conclusions and Future Considerations

The equity analysis of premature mortality provides insight into health inequities by sex, geography and several socio-economic factors. Premature mortality rates appeared to be lower with positive improvements in income, education and employment, social deprivation, material deprivation. Caution should be used to interpret disparities in premature mortality rates between geographic regions with drastic differences in demographics (e.g., population size, density). Generally, patterns seen in this report are not new, but the equity analysis and data provides a baseline for these indicators at a provincial level and allows for informed dialogue and further exploration. Monitoring them as a part of regular population health surveillance across the province can inform targets and track progress on strategies for prevention, health promotion and health system performance improvement in the province.

Purpose

This report presents the rates of preventable and treatable premature mortality for the province and covers the data for the period from 2009 to 2013. These indicators provide a way to measure the extent of inequities in the province and show patterns of inequalities within geographic, demographic and socio-economic stratifiers. The goal of health equity indicator analysis is to identify population groups and show patterns in socio-economic stratifiers where health inequities exist. This report is a part of a series of reports on Priority Health Equity Indicators for BC.[2]

Introduction

British Columbians are considered among the healthiest in Canada and worldwide. However, like in other nations around the world, there are observable differences and disparities in health status and outcomes throughout B.C.[2, 3] In addition to life expectancy[1], indicators of mortality are vital measures of equity in the health and well-being of the population. PHSA[1] and Statistics Canada[3] assert that British Columbians continue to enjoy the highest life expectancy at birth in Canada, for both men (80.4 years) and women (84.4 years) in 2011/2013. In 2013, 33,200 deaths in B.C. (crude death rate of 7.2 per 1,000 population) made up 13% of total deaths in Canada[3]. While the annual total number of deaths continues to increase, mainly owing to population growth and aging, mortality rates have gradually declined over the last 30 years.[3]

In the context of health equity in B.C., the Health Officers Council of BC (HoC BC) released a report in 2008, Health Inequities in British Columbia: Discussion Paper.[4] The report contributed to a better understanding of health inequities and the extent to which they exist in B.C. It also promoted policy approaches to tackle health inequity and enabled an informed discussion about the issue amongst a broad range of stakeholders.[4] In 2011, the Provincial Health Services Authority (PHSA) report, Towards Reducing Health Inequities: A Health System Approach to Chronic Disease Prevention. A Discussion Paper[5], recommended a framework to incorporate health equity in the design and delivery of health care, including the need for developing health equity targets and plans.

In 2013, the HoC BC released a second report describing the situation of health inequities in B.C. based on the analysis of life expectancy, socio-economic status (SES) and causes of premature mortality across SES.[6] The same year, PHSA's PPH program started the process of developing priority health equity indicators that would serve as the basis for setting health equity targets in the province.

In 2014, PPH released a suite of 52 health equity indicators prioritized for B.C. These indicators were developed in consultation with the BC Ministry of Health, health authorities, and other stakeholders. PPH is reporting on these indicators in a phase-wise manner depending upon the availability of data. In 2016, PPH released a report on 16 indicators relating to life expectancy, early childhood development, adolescent health, and general health status in the series. The report highlighted health inequalities in various stages of life across geographic demographic, and socioeconomic dimensions.[7] Other reports in the series such as food security,[8] injury mortality, and injury hospitalization followed.

Premature Mortality Indicators

Premature mortality gained attention as an important indicator of a population's health status when the United States Centers for Disease Control and Prevention emphasized this indicator in 1982 to reduce unnecessary mortality.[9] It is a measure of unfulfilled life expectancy that gives more weight to the death of younger people than to older people (i.e. greater loss of the productive life when younger people die).

Avoidable premature mortality can be useful measures for health care when they are divided into two subgroups for analysis: those from preventable causes and treatable causes.[10] This is in contrast to unavoidable premature mortality not covered in this report.

Definition

"Premature mortality refers to deaths that occur at a younger age than a selected cut-off. The age below which deaths are considered premature can vary depending on the purpose of the analysis and the population under investigation. Average life expectancy may be used as, or inform, the selected cut-off or an arbitrary age may be set."

-Australian Institute on Health and Welfare (2017)

Preventable premature mortality refers to deaths from preventable causes before the age of 75 that could have been prevented through effective primary prevention strategies such as using seatbelts when driving, healthy eating, and immunization (i.e., incidence-reducing causes). It is expressed as age-standardized mortality rate per 100,000 population.[10] Preventable premature mortality is generally considered the best proxy of overall population health. Monitoring preventable premature mortality across different equity dimensions will help identify areas to focus for upstream public health policies or programs.

Treatable premature mortality refers to deaths from treatable causes before the age of 75 that could be averted by effective secondary or tertiary-level prevention strategies, including screening and chronic disease management programs (i.e., fatality-reducing causes). It is expressed as the age-standardized mortality rate per 100,000 population.[10] Monitoring treatable premature mortality across different equity dimensions will help inform meaningful and effective measures for clinical care interventions.

For several decades, rates for both preventable and treatable premature mortality have been declining in Canada.[11] In 1996, the age-standardized rates of preventable and treatable premature mortality were 171.5 and 91.3 per 100,000 population in B.C. (188.3 and 110.6 per 100,000 population in Canada), respectively.[11] In 2016, the age-standardized rates of preventable and treatable premature mortality were 127.9 and 58.9 per 100,000 population in B.C. (127.5 and 66.9 per 100,000 population in Canada), respectively.[11]

Analysis of Preventable and Treatable Premature Mortality

Using methodology developed by the Canadian Institute for Health Information (CIHI), data on preventable and treatable premature mortality was extracted from the BC Vital Statistics database.[10] Preventable causes and treatable causes are identified by diagnoses of a series of diseases or conditions (See Appendix A for the list of conditions). In general, the premature mortality rate (PMR) has the number of deaths before the age of 75 in a population of residents as the numerator and the corresponding census population of residents in the denominator.

In this report, the PMR was calculated using five-year data for avoidable premature mortaltiy extracted from BC Vital Statistics for the period from 2009 to 2013. The numerator was the total number of deaths due to preventable (or treatable) causes, averaged over the period from 2009 to 2013 (five years). The denominator was the mid-interval population of B.C. (using CensusPlus 2011 data). The PMR was age-standardized and expressed per 100,000 population. **Disparity Ratios were calculated with the least disadvantaged being the reference group.** Details of methodology are presented in Appendix 1.

Equity Dimensions

Equity dimensions (stratifiers) to detect inequity in health indicators may be geographic (rural/urban, health service jurisdictions), socio-demographic (sex, gender, ethnicity, aboriginal status, specific vulnerable populations, immigrant status) and socio-economic (education, employment, income and neighbourhood area-based deprivation). Based on the availability of data for these dimensions in B.C., this report considers geography (health service areas), sex, income, education, employment and socio-economic deprivation.

Definition

Area-based socio-economic deprivation index:[12]

"Area-based measure of socio-economic deprivation is widely used in population, public health and epidemiology with the following possible applications: When the data describing socio-economic status cannot be collected at the individual level; When we need to know the distribution of health care services resources (e.g. primary care, community health services and hospital services); When the possible socio-economic confounding should be controlled in ecological studies examining the effects of local environmental conditions of health; When the main analytic interest lies in the effects of characteristics of place of interest on health."

When data to determine the socio-economic status of an individual is unavailable, the deprivation index may be used.[14] The deprivation index is an area-based measure of socio-economic status widely used in population public health and epidemiology. We used the social and material deprivation index developed by PHSA[14] at the census dissemination area (DA) or local health area (LHA) levels in our analysis.

Results

Overall Rates

For 2009-2013, the overall average age-standardized rates of preventable premature mortality and treatable premature mortality in B.C. were 143.2 (95% CI: 141.6,144.8) and 37.7 (95% CI: 36.9, 38.6) deaths per 100,000 population, respectively. As these rates are based on the analysis of underlying causes of death in the vital statistics data, they are somewhat lower than the corresponding rates reported by Statistics Canada which were based on both underlying and contributing causes.

Table 1. Overall average age-standardized rates of premature preventable and treatable mortality across health authorities and BC, 2009-2013.

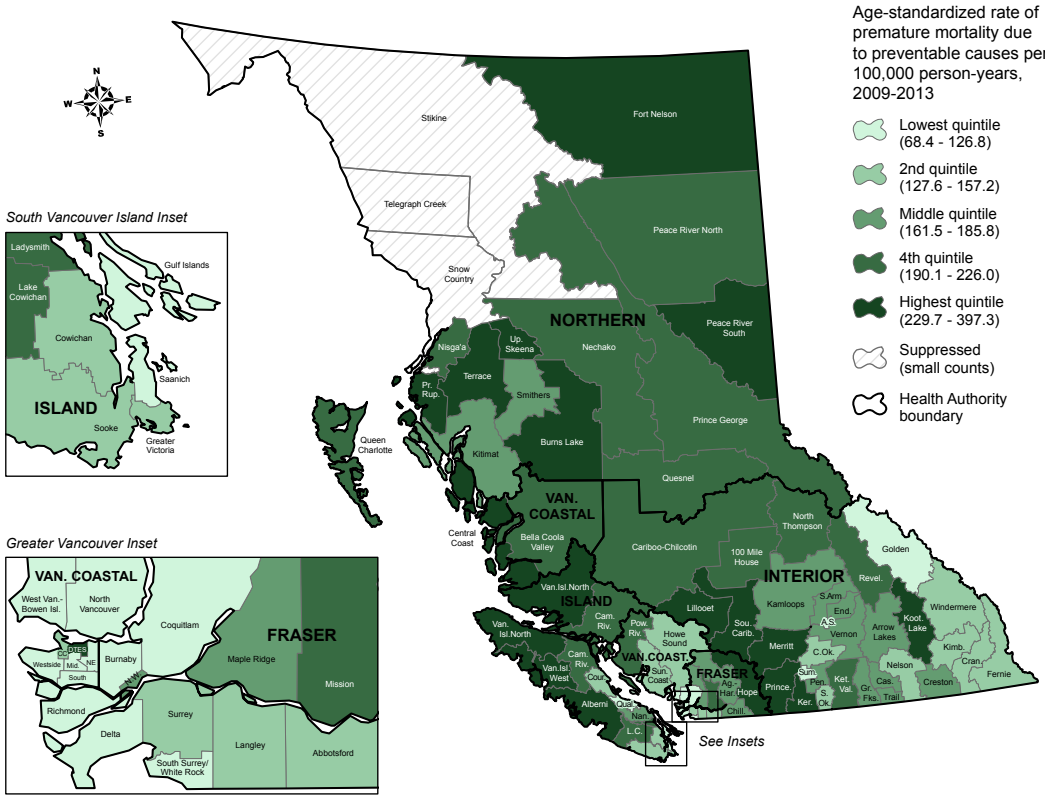
Health Authority	Age-standardized rate per 100,000 population (95% CI)	
	Preventable premature mortality rate	Treatable premature mortality rate
Interior Health	164.5 (159.8,169.4)	39.8 (37.2,42.5)
Fraser Health	95.6 (93.5, 97.9)	29.1 (27.8,30.5)
Vancouver Health	70.1 (67.9, 72.4)	19.5 (18.2, 20.8)
Island Health	152.5 (147.7, 157.5)	39.8 (37.3, 42.5)
Northern Health	194.5 (186.2, 203.1)	45.7 (41.5, 50.3)
Overall B.C.	143.2 (141.6, 144.8)	37.7 (36.9, 38.6)

- Vancouver Coastal Health had the lowest rate of both preventable and treatable premature mortality in B.C. (70.1 and 19.5 deaths per 100,000 population, respectively). Northern Health had the highest rate of both preventable and treatable premature mortality in B.C. (194.5 and 45.7 deaths per 100,000 population, respectively).

Geography

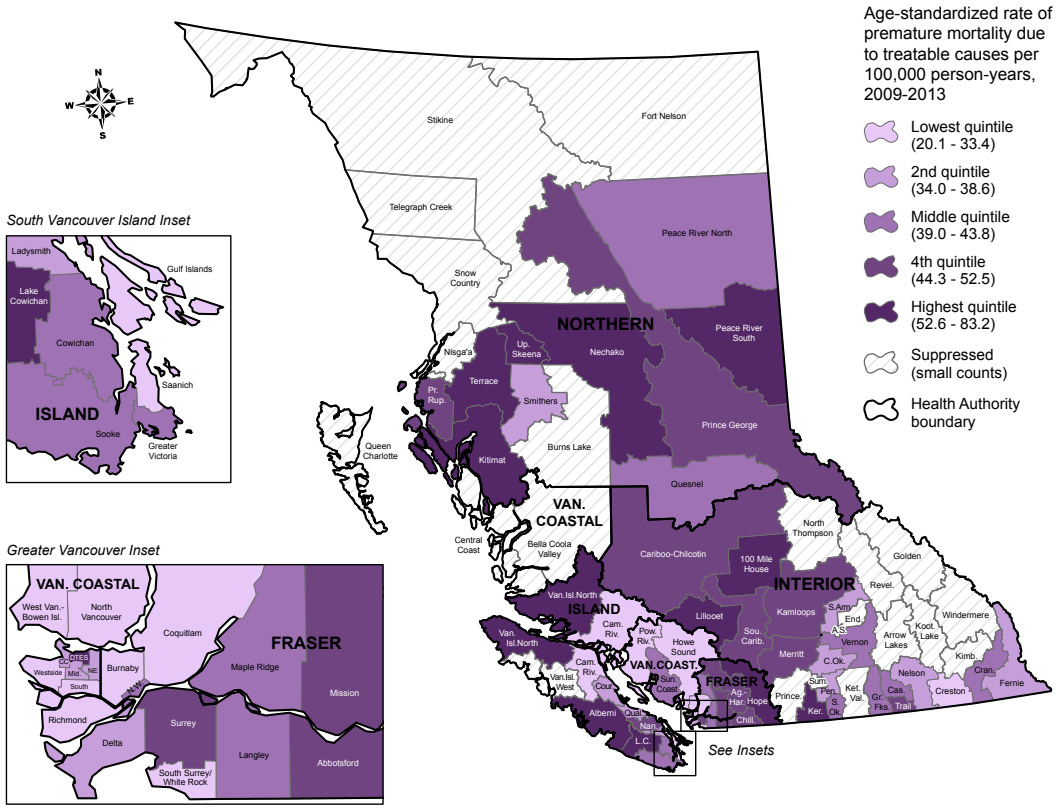
The age-standardized rates of preventable (Figure 1) and treatable (Figure 2) premature mortality among LHAs provide the distribution of the rates across the province.

Figure 1. Preventable premature mortality rate by local health area (LHA), BC, 2009-2013 (combined).



- The rate ratio between the LHA with the highest mortaltiy rate compared to the LHA with the lowest mortality rate is almost 6.
- The two LHAs with the highest preventable premature mortality rates were Vancouver-Downtown Eastside (397.3 deaths per 100,000 population) and Central Coast (357.9 deaths per 100,000 population).
- The two LHAs with the lowest preventable premature mortality rates were Vancouver-Westside (68.4 deaths per 100,000 population) and West Vancouver-Bowen Island (71.2 deaths per 100,000 population).

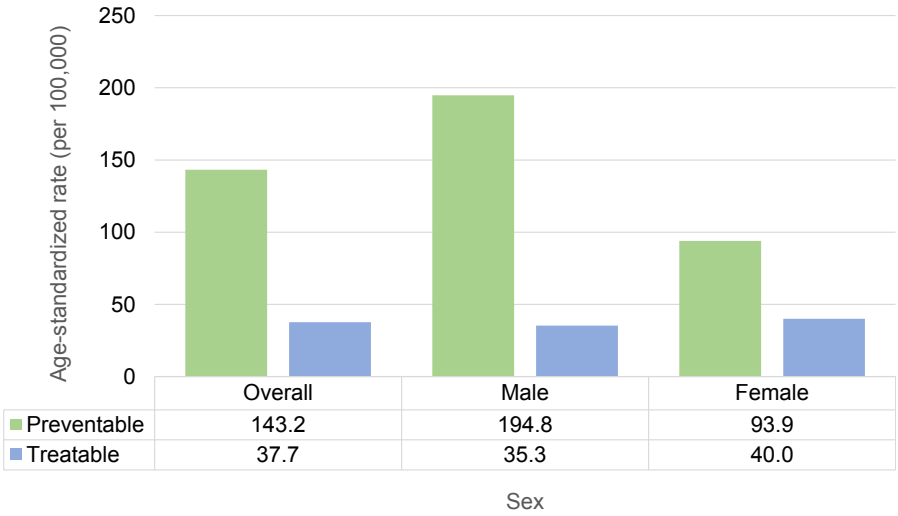
Figure 2. Treatable premature mortality rate by local health area (LHA), BC, 2009-2013 (combined)



- The rate ratio between the LHA with the highest treatable premature mortality rate compared to the LHA with the lowest mortality rate is almost 9.
- The two LHAs with the highest treatable premature mortality rates were Central Coast (98.5 deaths per 100,000 population) and Lillooet (83.2 deaths per 100,000 population).
- The two LHAs with the lowest treatable premature mortality rates are Golden (13.1 deaths per 100,000 population) and Vancouver-Westside (20.1 deaths per 100,000 population).

Sex

Figure 3. Age-standardized preventable and treatable premature mortality rates by sex, BC, 2009-2013 (combined).

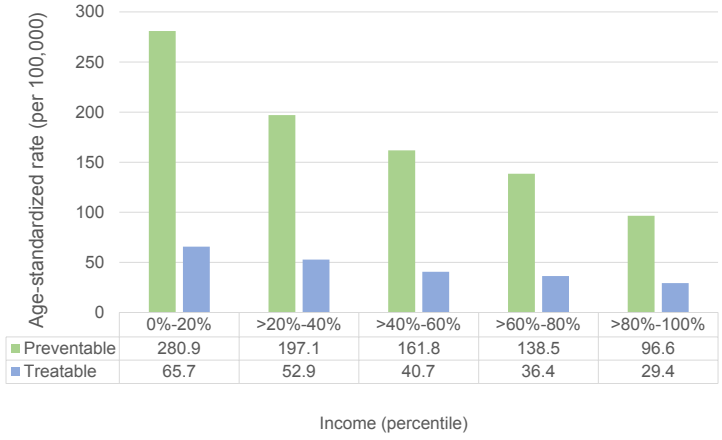


	Overall	Male	Female
Preventable	143.2	194.8	93.9
Treatable	37.7	35.3	40.0

■ Males had two times higher preventable premature mortality (194.8 deaths per 100,000 population) than females (93.9 deaths per 100,000 population). However, females had a slightly higher treatable premature mortality (40.0 deaths per 100,000 population) than males (35.3 deaths per 100,000 population), with a disparity ratio of 1.1.

Income

Figure 4. Age-standardized preventable and treatable premature mortality rates by income level, BC, 2009-2013 (combined).



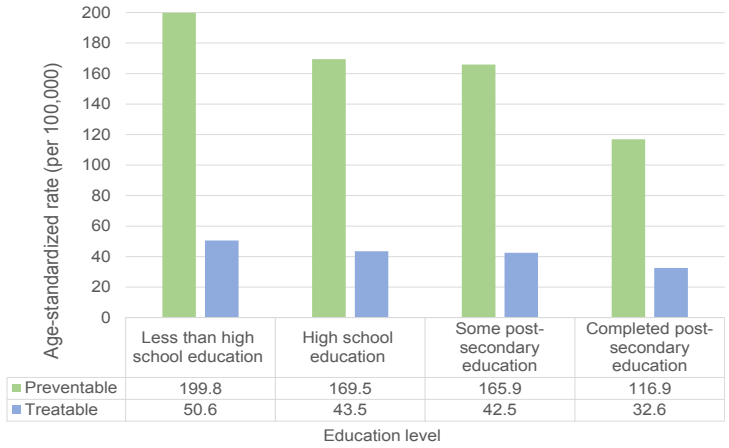
	0%-20%	>20%-40%	>40%-60%	>60%-80%	>80%-100%
Preventable	280.9	197.1	161.8	138.5	96.6
Treatable	65.7	52.9	40.7	36.4	29.4

■ Preventable premature mortality was almost three times higher among people in the lowest income group (first quintile, 280.9 deaths per 100,000 population) compared to people in the highest income group (fifth quintile, 96.6 deaths per 100,000 population). The rate decreased with higher income groups following a pattern of declining gradient.

■ Treatable premature mortality rates followed a similar pattern as preventable premature mortality. The lowest income group had over two times higher treatable premature mortality compared to the highest income group.

Education

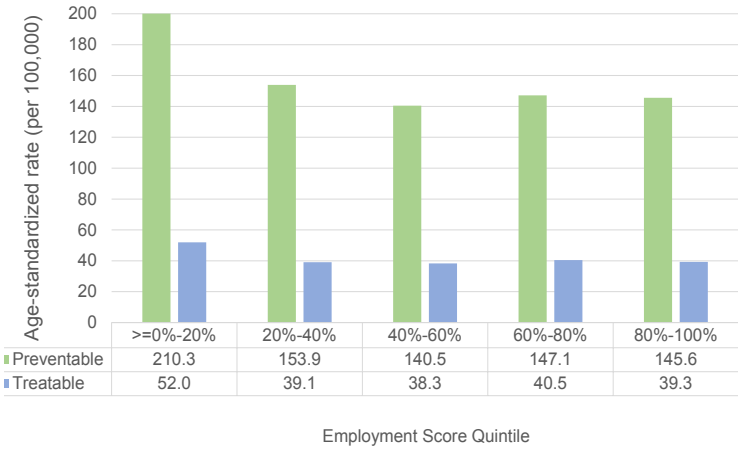
Figure 5. Age-standardized preventable and treatable premature mortality rates by education level, BC, 2009-2013 (combined).



- Preventable premature mortality was almost two times higher among people with less than high school education (199.8 deaths per 100,000 population) compared to people who completed post-secondary education (116.9 deaths per 100,000). The rates decreased with higher education levels following a pattern of declining gradient.
- Treatable premature mortality rates followed a similar pattern as preventable premature mortality. People with less than high school education had the highest rate (50.6 deaths per 100,000 population), while those who completed post-secondary education had the lowest rate (32.6 deaths per 100,000 population).

Employment Scores

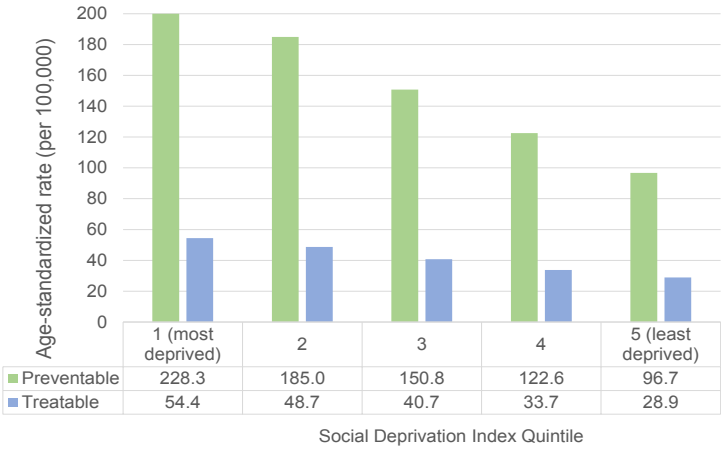
Figure 6. Age-standardized preventable and treatable premature mortality rate by employment scores, BC, 2009-2013 (combined).



- Preventable premature mortality was over 1.4 times higher among people living in areas with the lowest employment score quintile (first quintile, 210.3 deaths per 100,000 population) compared to people living in areas with the highest employment score quintile (fifth quintile, 145.6 deaths per 100,000 population). The rate decreased as employment level improved.
- Treatable premature mortality rates followed a similar pattern to preventable premature mortality. The lowest employment score quintile areas had the highest rate (first quintile, 52.0 deaths per 100,000 population), while the highest employment score areas had the lowest rate (fifth quintile, 39.3 deaths per 100,000 population).

Social Deprivation Index Scores

Figure 7. Age-standardized preventable and treatable premature mortality rates by social deprivation score at the dissemination area level, BC, 2009-2013 (combined).

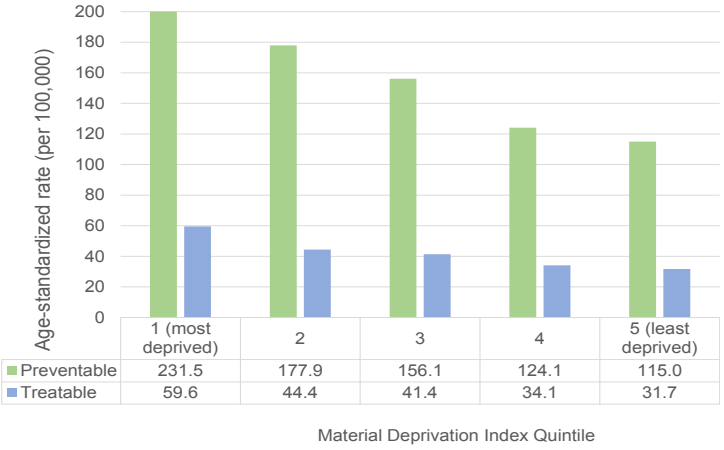


	1 (most deprived)	2	3	4	5 (least deprived)
Preventable	228.3	185.0	150.8	122.6	96.7
Treatable	54.4	48.7	40.7	33.7	28.9

- Preventable premature mortality was over two times higher among people living in areas with the most social deprivation (first quintile, 228.3 deaths per 100,000 population) compared to people living in areas with the least social deprivation (fifth quintile, 96.7 deaths per 100,000 population). The rate decreased as social deprivation scores positively improved.
- Treatable premature mortality rates followed a pattern similar to premature preventable mortality. The most deprived areas had the highest rate (first quintile, 54.4 deaths per 100,000 population), while the least deprived areas had the lowest rate (fifth quintile, 28.9 deaths per 100,000 population).

Material Deprivation Index Scores

Figure 8. Age-standardized preventable and treatable premature mortality rates by material deprivation score at the dissemination area level, BC, 2009-2013 (combined).



	1 (most deprived)	2	3	4	5 (least deprived)
Preventable	231.5	177.9	156.1	124.1	115.0
Treatable	59.6	44.4	41.4	34.1	31.7

- Preventable premature mortality was two times higher among people living in areas with the highest material deprivation (first quintile, 231.5 deaths per 100,000 population) compared to people living in areas with the lowest material deprivation (fifth quintile, 115.0 deaths per 100,000 population). The rate decreased as material deprivation scores positively improved.
- Treatable premature mortality rates followed a similar pattern as preventable premature mortality. The most deprived areas had the highest rate (first quintile, 59.6 deaths per 100,000 population) while the least deprived areas had the lowest rate (fifth quintile, 31.7 deaths per 100,000 population).

Conclusions and Future Considerations

The knowledge of health inequities in B.C. is not new.[4] However, this report provides evidence on the extent to which British Columbians are dying prematurely based on their sex, geography and several socio-economic factors. There are consistent patterns of health inequalities in preventable and treatable premature mortality rates in B.C. Overall, these findings support the intuitive concept where higher rates of premature mortality are seen among those with higher levels of deprivation in income, education, employment, and composite socio-economic indices (social and material deprivation scores). The evidence of geographic and sex disparities in preventable premature mortality are notable.

This report also demonstrates the use of provincial equity analysis and surveillance to support population health status reporting and to inform targets and actions to reduce inequities. Both preventable and treatable premature mortality are composite indicators that are derived from numerous avoidable causes of death. Population level surveillance of these indicators on a regular basis at the provincial, regional and local community levels can inform strategies for prevention, health promotion and health system performance improvement in the province.

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Appendix 1: Technical Notes and Methodology

Data Sources

1. Vital Statistics

The data used for all of the premature mortality rate analyses were obtained from the Vital Statistics data received from the BC Vital Statistics Agency through Public Health Reporting Data Warehouse (PHRDW) of the BCCDC. The Vital Statistics dataset originally received by PPH contained line-by-line data of 414,971 records from January 1, 2004 to October 30, 2016 with the following variables: Study ID, month of birth, sex, month of death, underlying cause of death, contributing causes of death, location of death city, location of death postal code, residential address postal code, and residential local health area code.

Deaths are recorded by online requests from funeral home directors for burial/funeral permits. Information from the permit populates the basic information in the death record (age, sex, geographic location) and this information is available to Vital Statistics about 2-3 days from the date of death. Evaluations done by the BC Ministry of Health have shown that by 4-5 days from the date of death, almost 100% of records are complete for all-cause mortality.

The next step is for the medical certificate of death to be completed by a physician, returned to the funeral home and sent to Vital Statistics. Once the notice is received, ICD10 codes are applied by trained personnel at Vital Statistics and the death record is updated with the underlying cause of death. This medical coding usually takes a week to process for an uncomplicated death. Therefore, adding both times together, the estimated average lag time from death to receipt of complete mortality information in the extract (for an uncomplicated death without coroner involvement) is about 10 days from the actual date of death. Each line of data represents an aggregation by these factors. For example, if 2 individuals were to have died on the same day of the same underlying cause, in the same local health area, etc., then a count of 2 would be indicated rather than repeating the record twice. Given the number of variables involved, this typically means that each line represents a single individual.

Table A1. Data Elements of BC vital statistics used for premature mortality analysis.

Label	Description
ID	A system generated surrogate key
Event_date	Date of death, including year, month and day (yyyymmdd)
Reg_date	Date death achieved registered status in the VISTA system (yyyymmdd)
Age	Years of age attained by the decedent
Age group	Derived Standard age group (from Age)
UCOD	Underlying cause of death ICD10 code (International Version)
Gender	Decedent's gender at death
LHA_code	Local Health Area Code for decedent's usual residence
LHA_descr	Label for LHA_code
UCOD_other	All contributing cause of death ICD10 code (concatenated string)
Death_place	Place of death
Postal_code	Postal code for decedent

2. 2011 CensusPlus

Due to changes in Census methodology, Statistics Canada was not officially releasing dissemination area (DA) data from the 2011 National Household Survey (NHS), which replaced the long-form Census. CensusPlus 2011 offers enhanced data for the most important NHS themes for all DAs in Canada, fills in missing values by imputation, and eliminates random rounding in both NHS and Census data.

CensusPlus 2011 provides extensive socioeconomic and demographic profiles of Canadian consumers for small and custom areas for the census year 2011, including DAs. The NHS variables in CensusPlus were adjusted to match the Census household and household population universes. The 2011 Census universes are higher quality than those in the NHS because of the latter's smaller sample size and voluntary nature. Canada Revenue Agency files were used along with 2006 Census and other sources to model 2011 CensusPlus income data. NHS immigration themes and visible minority data based on 2011 Census mother tongue counts, Citizenship and Immigration Canada statistics, and Statistics Canada's published intercensal statistics.

Table A2. Data Categories: 2011 CensusPlus.

Aboriginal identity	Male population by single, five, ten year age and sex
Mobility status	Female population by single, five, ten year age and sex
Labour force status	Household population by age
Labour force by occupation, industry and place of work	Marital status
Labour force by model of transportation	Census families by family size and structure
Occupied private dwellings by period of construction and tenure	Census family households by family size and structure
Households by maintainer age	Total children at home by age
Religion	Households by living arrangement
Household income (current year)	Households by household type
Population 15 years or over by educational attainment	Occupied private dwellings by structure type
Population by visible minority status	Households by size of household
Population by citizenship	Detailed mother tongue
Population by period of immigration	Knowledge of official languages
Total immigrant population by place of birth	First official language spoken
Recent immigrant population by place of birth	Detailed language spoken most often at home
Total population by single, five, ten year age and sex	

Social and Material Deprivation Indices

Model-based approach was used to identify and understand deprivation-related constructs that were treated as latent or unobserved variables, which were derived from measured variables in the 2011 CensusPlus dataset. Six latent deprivation-related sub-constructs were linked to 16 observed 2011 CensusPlus variables in a micro-model. Then, a macro-level model was built that linked five of the six sub-constructs to two broad latent variables representing material deprivation comprising employment, income and education sub-constructs and social deprivation comprising lone parenting, living alone, and stability sub-constructs.

Data Linkage

Geocoding and Linkage of Vital Statistics data and Census Data

In Vital Statistics data, each participant's 6-digit postal code for residence were translated into Dissemination Areas (DAs). The 2011 Census data denominators for HAs and LHAs were used for calculating age-standardized premature mortality rates, which are standardized to Canada's 2011 standard population. Population sizes at various geographic levels were extracted from BC Stats online database.[3] Vital Statistics data were linked to the 2011 CensusPlus data by DA for calculating age-standardized mortality rates by income, education, and employment. Vital Statistics data were linked to social and material deprivation data by DA for the analyses.

Data Analysis

Premature Mortality Rate

Mortality data from January 1, 2009 to December 31, 2013 were extracted from Vital Statistics and analyzed. The Canadian Institute for Health Information's definitions of preventable premature mortality and treatable premature mortality were adopted to categorize mortality status for each individual. Premature mortality was defined as those who died before the age of 75 years old. Only underlying cause for mortality as defined in the Vital Statistics database was analyzed.

Completely preventable causes included in the analysis were enteritis and other diarrhoeal disease, vaccine-preventable diseases, sexually transmitted infections, except HIV/AIDS, viral hepatitis, HIV/AIDS, lip, oral cavity and pharynx cancer, esophageal cancer, stomach cancer, liver cancer, lung cancer, melanoma skin cancer, non-melanoma skin cancer, rheumatic heart disease, aortic aneurysm, venous thromboembolism, chronic obstructive pulmonary disorders, lung disease due to external agents, chronic liver disease (excluding alcohol-related disease), complications of perinatal period, transport accidents, falls, other external causes of accidental injury, drowning, fires and flames, accidental poisonings, injuries of undetermined intent, suicide and self-inflicted injuries, assault, alcohol-related diseases, excluding external causes, drug use disorders, nutritional deficiency

anaemia, drugs, medicaments and biological substances causing adverse effects in therapeutic use, misadventures to patients during surgical and medical care, medical devices associated with adverse incidents in diagnostic and therapeutic use, and surgical and other medical procedures as the cause of abnormal reaction.

Completely treatable causes included in the analysis were tuberculosis, selected invasive bacterial infections, sepsis, malaria, meningitis, cellulitis, pneumonia, colorectal cancer, malignant neoplasm of breast, cervical cancer, uterus cancer, testicular cancer, bladder cancer, thyroid cancer, Hodgkin's disease, leukemia (age <45), benign neoplasms, hypertensive disease, asthma and bronchiectasis, acute lower respiratory infections, upper respiratory infections, adult respiratory distress syndrome, pulmonary oedema, abscess of lung and mediastinum/pyothorax, other pleural disorders, other respiratory disorders, peptic ulcer disease, diseases of appendix/hernia/disorders of gallbladder/ biliary tract and pancreas, nephritis and nephrosis, renal failure, obstructive uropathy, urolithiasis and prostatic hyperplasia, inflammatory diseases of genitourinary system, disorders resulting from impaired renal tubular function, complications of perinatal period, congenital malformations/deformations and chromosomal anomalies, pregnancy/childbirth and the puerperium, thyroid disorders, adrenal disorders, congenital metabolic disorders, epilepsy, and osteomyelitis.

Fifty-percent preventable and 50% treatable causes included in the analysis were cerebrovascular diseases, ischaemic heart disease, other atherosclerosis, and diabetes mellitus. People with a study number in the first 50% were assigned a status of preventable, while those with a study number in the second 50% were assigned a treatable status.

Age-standardized preventable and treatable mortality rates per 100,000 population by overall, sex, HA, HSDA, LHA, social and material deprivation indices, income, education, and employment were calculated for years 2009 to 2013 combined, using 2011 Census and 2011 CensusPlus data. DA-level social and material deprivation quintile scores were used.

Table A3. Average household income by DA in quintiles, 2011 CensusPlus are as follows:

Quintile	Income Percentile	Income ($)
1	0 to 20	$0 to $47,790
2	>20 to 40	$47,803 to $61,251
3	>40 to 60	$61,267 to $74,227
4	>60 to 80	$74,259 to $91,683
5	>80 to 100	$91,684 to $1,213,552

Education level by DA was divided into four groups: Percentage of people with less than high school education is above B.C. average, percentage of people with high school education is above B.C. average, percentage of people with some post-secondary education is above B.C. average, and percentage of people with completed post-secondary education is above B.C. average. In this analysis, the B.C. averages used for less than high school, high school, some post-secondary, and completed post-secondary education were 16.7%, 27.7%, 33.6%, and 22.1%, respectively.

Table A4. Overall employment rates in BC by DA quintiles, 2011 CensusPlus are as follows:

Quintile	Income Percentile	Income ($)
1	0 to 20	0.00% to 86.53%
2	>20 to 40	86.54 % to 91.21%
3	>40 to 60	91.22% to 94.86
4	>60 to 80	94.87% to 97.74%
5	>80 to 100	97.75% to 100.00%

HA, LHA, and DA-level populations for 2011 Census were extracted from BC Stats and used as denominator populations.[5]