

The economic benefits of risk factor reduction in British Columbia:

Excess weight, physical inactivity and tobacco smoking

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Lydia Drasic, Executive Director, British Columbia Centre for Disease Control (BCCDC) Operations and Chronic Disease Prevention, BCCDC and Provincial Health Services Authority

Silas Brownsey, Executive Director, Population Health Surveillance and Public Health Planning, Ministry of Health

Authors:

Dr. Hans Krueger, H. Krueger & Associates Inc.

Dr. Drona Rasali, Director, Population Health Surveillance & Epidemiology, PHSA (Project Lead)

Mike Pennock, Senior Epidemiologist, Population Health Surveillance, Ministry of Health

Sarah Gustin, Knowledge Translation and Communications Manager, PHSA

PHSA contact:

The report can be found at www.phsa.ca/populationhealth

For further information, contact:

Provincial Health Services Authority
Population and Public Health Program
700 – 1380 Burrard Street
Vancouver, BC V6Z 2H3
pph@phsa.ca

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Executive summary

Chronic diseases have a substantial impact on the health of British Columbians, leading to reduced well-being and quality of life as well as considerable deaths, disability and suffering each year. The increasing burden of chronic diseases results in rising health care costs and economic effects across all sectors. Many of these chronic conditions share common lifestyle, behavioural, or environmental risk factors. By reducing the prevalence of these avoidable risk factors in a population, we can reduce the rate of many chronic diseases and thereby reduce economic costs.ⁱ

Of the modifiable risk factors, excess weight (overweight and obese),ⁱⁱ physical inactivityⁱⁱⁱ and tobacco smoking^{iv} are among the leading contributors to chronic disease in BC. Together, these three risk factors are associated with approximately 30 different chronic conditions, and for many conditions their impact is striking. For example, we estimate that seven out of every 10 cases of chronic lung disease and type 2 diabetes, over half of all heart disease, one-third of all colorectal cancers, and one-quarter of all chronic back pain is caused by these three risk factors.

Excess weight, physical inactivity and tobacco smoking are strongly influenced by a variety of social, environmental and economic factors where we live, learn, work and play. Stressful, or even harmful, conditions, policies or practices in our homes, schools, workplaces and communities can exacerbate these risk factors. Not everyone has an equal opportunity to make healthy choices, and we recognize that the living and working conditions for many people limit the choices they have or can make. Compounding the complexity is that the relationships between factors such as excess weight, health and disease are interdependent with other risk factors such as physical activity and still not totally understood. Any population-level interventions to reduce the prevalence of these chronic disease risk factors should acknowledge the role of the broad social determinants of health.

The purpose of this report is to provide insight into the impact these three specific risk factors have on current and future health care expenditures and associated indirect costs, in order to inform intersectoral and health policy- and decision-making at the provincial, health authority, and health service delivery area (HSDA) levels in BC. Understanding the current costs of these risk factors for a given region, as well as how we can expect these costs to change in coming years can be beneficial for both immediate and long-term planning and prioritization. Using a refined scientific methodology and the most recent data available, our study provides the most accurate and updated information on the economic burden attributable to excess weight (obesity and overweight), physical inactivity and tobacco smoking in BC.

This report estimates the economic burden caused by these risk factors for each health authority and HSDA in BC by using an economic model.^{1,2} We estimate the cost of these risk factors for 2013 and 2036, and calculate the costs that could be avoided if each region were to reduce the prevalence of these risk factors by a relative 1% annually over that time. We also estimate how much of the total cost of each risk factor is associated with various chronic disease types.

i For the purpose of this report, we define the "costs" of a given risk factor as its combined direct costs (i.e., health care costs) and indirect costs (i.e., loss of economic productivity due to short and long-term disability and premature mortality).

ii For individuals older than 17, self-reported body mass index (BMI) greater than 25kg/m² (including overweight [25-30 kg/m²] and obese [>30 kg/m²]). For adolescents aged 12 to 17, self-reported BMI above the age-specific threshold defined by Cole et al.

iii An individual is considered physically inactive if their daily leisure time energy expenditure is less than 1.5 kcal/kg/hr (equivalent to approximately half an hour of walking).

iv Self-reported daily or occasional cigarette smoking

Our study estimates that across BC in 2013, the annual economic burden attributable to excess weight, physical inactivity, and tobacco smoking is \$5.6 billion. Of this \$5.6 billion, about \$1.8 billion is due to direct health care costs and a further \$3.8 billion is due to disability and premature death. We estimate that if we could reduce the prevalence of each of these three risk factors by a relative 1% annually until 2036, British Columbia could avoid a cumulative \$15.0 billion in direct and indirect costs.

The largest proportion of this economic burden can be attributed to overweight and obesity (i.e., excess weight). In 2013, 41.6% of British Columbians had excess weight, resulting in an annual economic burden of \$2.6 billion (\$772 million in direct and \$1.8 billion in indirect costs). A 1% annual relative reduction until 2036 would reduce the prevalence of excess weight to 33.7%. As a result of this reduction, we could avoid a cumulative \$7.8 billion in estimated costs between 2013 and 2036.

The economic burden attributable to physical inactivity was lower than that of excess weight, at approximately \$1.0 billion. In 2013, 38% of British Columbians were inactive, leading to \$350 million in direct health care costs and \$673 million in costs related to disability and premature mortality. A 1% annual relative reduction until 2036 would reduce the prevalence of physical inactivity to 31.2%. As a result of this reduction, we could avoid a cumulative \$3.1 billion in estimated costs between 2013 and 2036.

In contrast to excess weight and physical inactivity, rates of tobacco smoking among British Columbians have markedly declined in the past half-century. In 2013, 13.2% of British Columbians smoked, which resulted in an annual economic burden of \$2.0 billion (\$724 million in direct and \$1.3 billion in indirect costs). This is primarily because the cost per individual who smokes is much higher than the cost per individual with excess weight or individual who is physically inactive. A 1% annual relative reduction until 2036 would reduce the prevalence of smoking to 9.6%. As a result of this reduction, we could avoid a cumulative \$4.0 billion in smoking-related costs between 2013 and 2036.

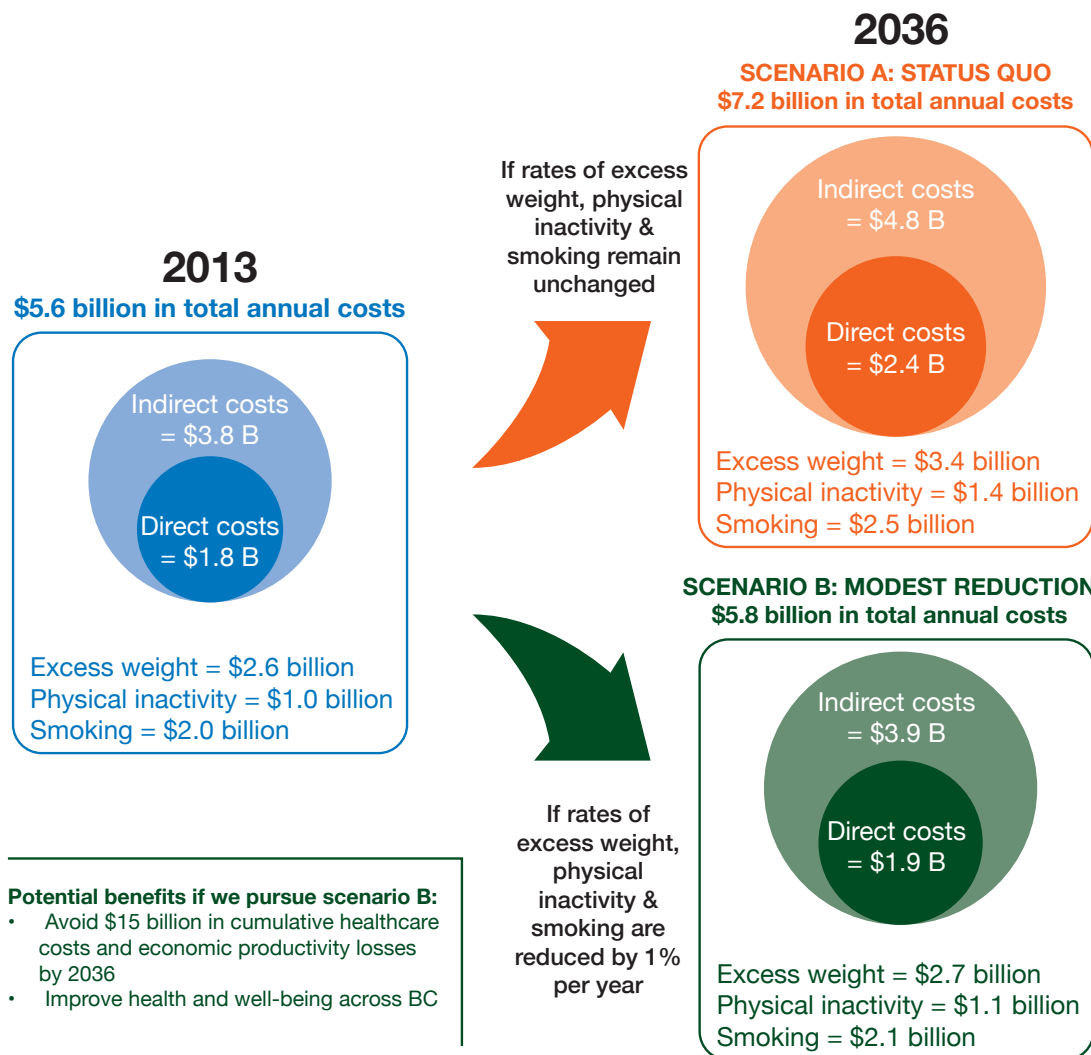
As this study examined the prevalence of each risk factor individually in all 16 HSDAs and five health authorities, we identified notable differences between regions. Regions with higher risk factor rates, in turn, also had higher risk factor-attributable costs. Rates of excess weight were much lower in Vancouver Coastal Health than all other health authorities. Physical inactivity levels were typically higher in regions with a higher population density (particularly in the Fraser North, Fraser East, Vancouver, and Richmond HSDAs). Conversely, smoking rates were typically highest in the HSDAs within Northern and Interior Health, and lowest in Vancouver Coastal Health. Prevalence rates for all three risk factors were almost always higher than the provincial average in the Northwest, Northern Interior, and Northeast HSDAs.

After considering some lessons learned from past health promotion initiatives, we propose that widespread changes in the behaviours of a population are not only feasible, but have resulted in real and tangible effects on population health. Rates of tobacco smoking have decreased dramatically in recent years, and this progress should reinforce that similar successes are possible for other modifiable risk factors as well. We have learned from tobacco control that real results require a comprehensive, multipronged approach. We cannot solely attribute the reduction in smoking to one or two interventions; rather it was the result of a variety of initiatives that include public education and awareness-building, increased prevention activities and an emphasis on policy change and organizational and environmental interventions. We have also learned that a long-term approach is required to see a meaningful reduction in risk factor prevalence. The problem of tobacco smoking was not solved by a 'quick-fix', and it is unlikely that other modifiable risk

factors will be either. Instead, interventions require a multigenerational approach that spans beyond the immediate political cycle.

The results of our analysis suggest that the economic impact of these three risk factors is immense. Activities that promote healthy behaviours and reduce prevalence rates will lessen the rate of chronic disease in the long-term. In turn, the future direct and indirect costs associated with chronic disease can be dramatically reduced. With this knowledge, prioritization of prevention initiatives should be at the forefront of system- and community-level changes. In addition, the cost estimates in this report provide insight into which areas for prevention or intervention are of primary importance, and can be used to inform both immediate and long-term planning.

Figure 1. Potential economic benefits of risk factor reduction by 2036 in BC



Background

Chronic disease in BC

Chronic diseases represent the largest health burden in British Columbia, both now and in the foreseeable future. Over half of British Columbians have at least one chronic condition,³ and chronic diseases are responsible for the majority of deaths in the province. The three leading causes (cancer, cardiovascular disease and cerebrovascular disease) collectively result in 55% of all deaths in BC.⁴

The burden of chronic disease on individuals and society spans farther than disability and premature mortality. Quality of life can be reduced considerably for those living with chronic conditions, most notably for those living with arthritis, chronic lung disease, and congestive heart failure.⁵ Chronic diseases also commonly impact on the lives of other family members, affecting social and leisure activities, time commitments, stress levels and personal relationships.⁶

It is also important to consider the impact these chronic diseases have on health care, and the burden of health care costs consumed by these conditions. In 2005/06, chronic health conditions consumed approximately 80% of the province's Medical Services Plan, PharmaCare, and acute care budgets.⁷ However, the economic burden of chronic disease includes more than simply health care costs. Most chronic diseases have an underappreciated indirect cost associated with a loss of earning potential stemming from short- and long-term disability, as well as premature mortality. In addition to this, and often much harder to quantify, is the intangible value that individuals attribute to good health,⁸ the costs of caregiver time and personal costs incurred with illness (e.g., transportation costs).⁹

Modifiable risk factors

Many chronic conditions share common lifestyle, behavioural, or environmental risk factors. However, it is important to acknowledge that behavioural risk factors are often shaped or constrained by the family, economic and societal context in which people make choices. In addressing behavioural risk factors, we must also simultaneously recognize and confront these upstream barriers to good health. In addition, the complex relationships between these broader determinants can both increase health disparities that perpetuate poor health, as well as reduce accessibility to services.^{10,11,12}

A large number of the common risk factors for chronic diseases are considered 'modifiable', in that they can be subject to change through intervention at various levels. The role of modifiable risk factors is greater in some diseases than in others. A limited number of modifiable risk factors, for example, are associated with approximately 40% of all cancers and up to 80% of cardiovascular diseases.¹³⁻¹⁶ By reducing the prevalence of modifiable risk factors in a population, we can subsequently reduce the prevalence, and thereby the overall burden, of many chronic diseases.

In North America, excess weight (including obesity and overweight), physical inactivity and tobacco smoking are among the leading risk factors associated with the causation of chronic disease.¹⁷ However, these three risk factors are also avoidable. This means that investing in targeted prevention efforts can improve health behaviours which, in turn, have a considerable impact on health outcomes, quality of life, and the sustainability of health care in the future.¹⁸ In addition to reducing disease incidence, many interventions and

prevention activities have proven to be cost-effective, or even cost-saving.^{19,20} In other words, investing in prevention-oriented initiatives that combat chronic disease risk factors may be less costly than dealing with the future healthcare and societal burden incurred by chronic disease treatment.

The current rates of these risk factors in the British Columbian population underscore a need for prioritizing prevention. Of particular concern is the increasing rate of obesity, which has tripled in Canada during the last 25 years.²¹ On the other hand, rates of daily tobacco smoking among Canadian males have decreased from 55% in the mid-1960s to just 13.2% in 2012. The decline for Canadian females has been from approximately 30% during the 1970s and 80s to 10.5% in 2012. While tobacco is still a significant problem, our successes in curbing its prevalence can serve as a reminder to what may be possible for excess weight and physical inactivity.

These risk factors also need to be considered in the context of broader structural and social determinants that shape our health. Groups that often experience poorer health in BC include those living in poverty, those with mental health or substance abuse issues, Aboriginal people, immigrants, and refugees.²² Health inequities can also arise between populations across different geographic regions, genders, ages, and ethnicities, for example. Groups that experience inequities may be at greater risk of adopting behavioural or lifestyle-related risk factors, which can lead to higher rates of chronic disease among these groups. While interventions that aim to modify individual behaviour or lifestyles can be effective, approaches that target the upstream causes of poor health are better able to promote health equity and foster opportunities for everyone to make healthy choices. Policy- and community-level changes can help create supportive environments that encourage healthy choices.

The purpose of this report

The first aim of this report is to provide insight into the economic costs associated with excess weight,^v physical inactivity^{vi} and tobacco smoking,^{vii} across the province, in each health authority and health service delivery area (HSDA) in BC. These costs are determined by using an economic model that estimates: (1) how much disease in BC arises because of one or more of these risk factors; and (2) the economic burden of these risk factors.^{1,2} We express a risk factor's *economic burden* as the sum of the direct costs (that is, health care costs^{viii}) and indirect costs (that is, the loss of earning potential due to short and long-term disability and premature mortality) incurred for each of the risk factors, based on disease-specific economic data.

The second aim of this report is to describe the costs that each region could avoid if we were to reduce the rates of these three risk factors. We use our model to depict a scenario in which the proportion of individuals with each risk factor is reduced by 1% each year until 2036 (referred to as a *1% annual relative reduction* in the prevalence of each risk factor). For example, a 1% annual relative reduction would reduce the provincial prevalence of excess weight (41.6% in 2013) by 0.416% (to 41.2%) in 2014. By 2036, a 1% annual relative reduction would reduce the prevalence of excess weight from 41.6% to 33.7%. We then

v For individuals older than 17, excess weight is defined as a body mass index (BMI) greater than 25kg/m². Within this range, overweight individuals are defined as those with a BMI between 25 kg/m² and 30 kg/m² and obese individuals are defined as those with a body mass index greater than 30 kg/m². For youth aged 12 to 17, obesity and overweight is defined by age-specific thresholds used by Cole et al to classify individuals as overweight and obese.

vi An individual is considered physically inactive if their daily leisure time energy expenditure is less than 1.5 kcal/kg/hr (equivalent to approximately half an hour of walking).

vii All individuals who smoke daily or occasionally are considered tobacco smokers. Tobacco smokers were further classified as light (<10 cigarettes per day), moderate (10-19 per day) and heavy (≥20 per day) smokers.

viii This includes hospital care, physician services, other health care professionals (but excluding dental services), drugs, health research and "other" health care expenditures as classified by the Canadian Institute for Health Information.

used our model to estimate the projected future costs that each region could avoid if we reduced the rates of excess weight, physical inactivity and smoking by 1% annually.

In terms of major behavioural changes at the population level, a 1% reduction in risk factor prevalence is a conservative and highly feasible goal. In comparison, between 2003 and 2012, the rate of tobacco smoking among Canadian males decreased by a relative average of 4.0% annually, and in females by an average of 3.5%. The evidence that such a reduction is possible for tobacco smoking should prompt similar goals for other behavioural risk factors. Although rates of excess weight and physical inactivity are currently increasing, reversing this trend with a 1% annual reduction is certainly realistic. BC's Guiding Framework for Public Health, *Promote, Protect, Prevent: Our Health Begins Here*,²³ proposes a target for physical activity rates in BC to reach 70% by 2023 (or an inactivity rate of 30%). This could be achieved with a 2.0% annual relative reduction in physical inactivity rates from the 2009/10 baseline. The same framework aims to reduce smoking rates (for ages 15+) to 10% by 2023. This is equivalent to an approximate 2.8% annual relative reduction from the 2011 baseline.

Using a refined scientific methodology and the most recent data available, our study provides the most accurate and updated information on the direct and indirect costs attributable to the chronic disease risk factors of excess weight, physical inactivity and tobacco smoking in BC. Although the relationships between these risk factors, health and disease are complex and not entirely understood,²⁴ the economic model used for this analysis incorporates the best scientific evidence currently available.

The goal of presenting the economic burden of excess weight, physical inactivity and tobacco smoking is to indicate the degree of impact these risk factors have on current and future health care expenditures and associated indirect costs, and to prioritize prevention efforts accordingly.

We estimated the 2013 economic burden using a method that incorporates risk factor prevalence rates from the Canadian Community Health Survey (CCHS) and published relative risk values. In addition, this model uses a unique approach to ensure that costs are not double-counted. Any one individual may have one, two, three or none of the risk factors we investigated; we therefore adjusted costs to account for this possible overlap in risk factors. A detailed explanation of the methods used are available in a companion report.

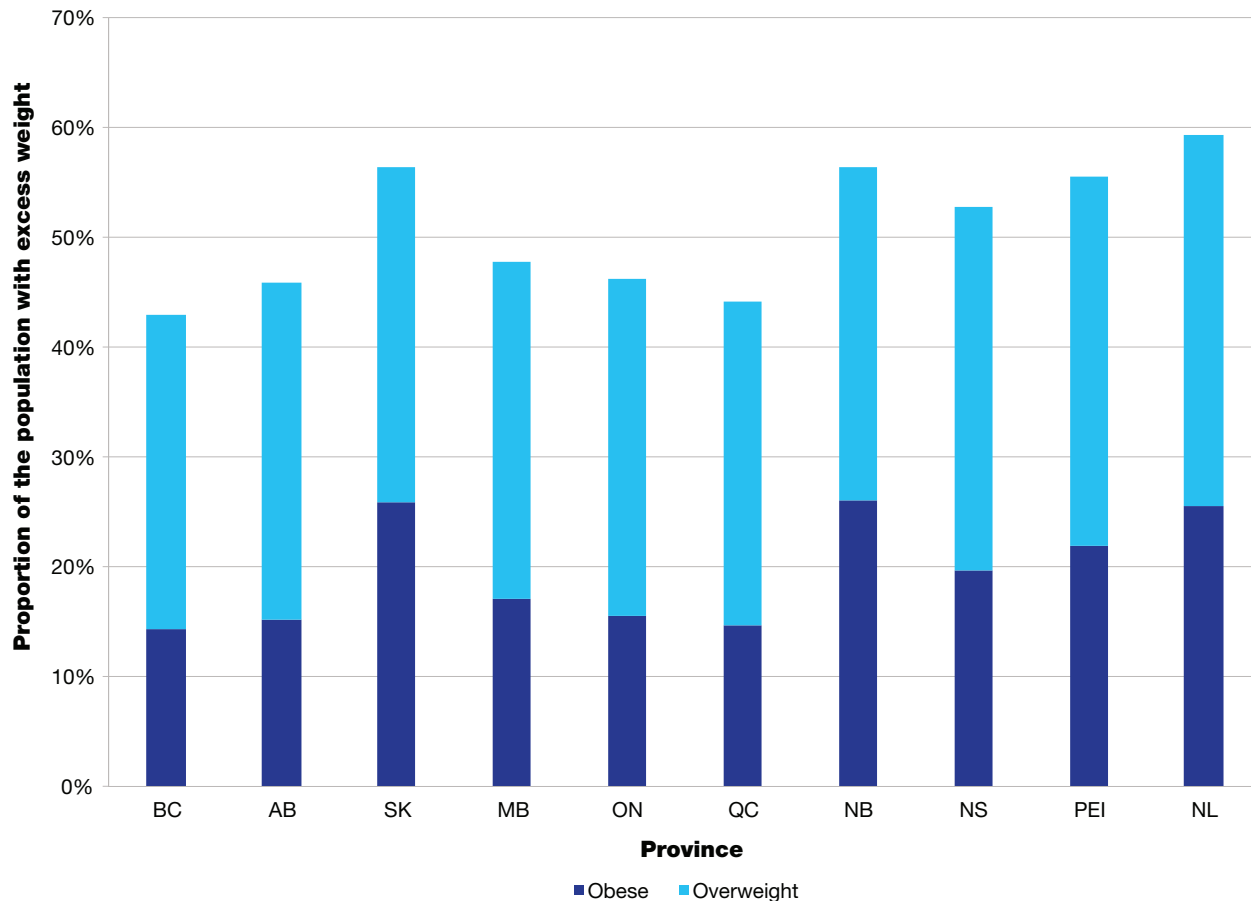
Excess weight

What is the extent of excess weight in British Columbia?

We estimate that 41.6% of the 2013 British Columbian population carries excess weight, based on self-reported data used to calculate body mass index (BMI) values. In comparison to the rest of the country, BC has the lowest prevalence of excess weight (see figure 2). In some provinces, over half of the population is overweight or obese. Even so, rates of excess weight in BC are a significant concern given the known association between obesity/overweight and many chronic diseases.

Figure 2. Prevalence of excess weight in Canada

By excess weight category and province, 2012



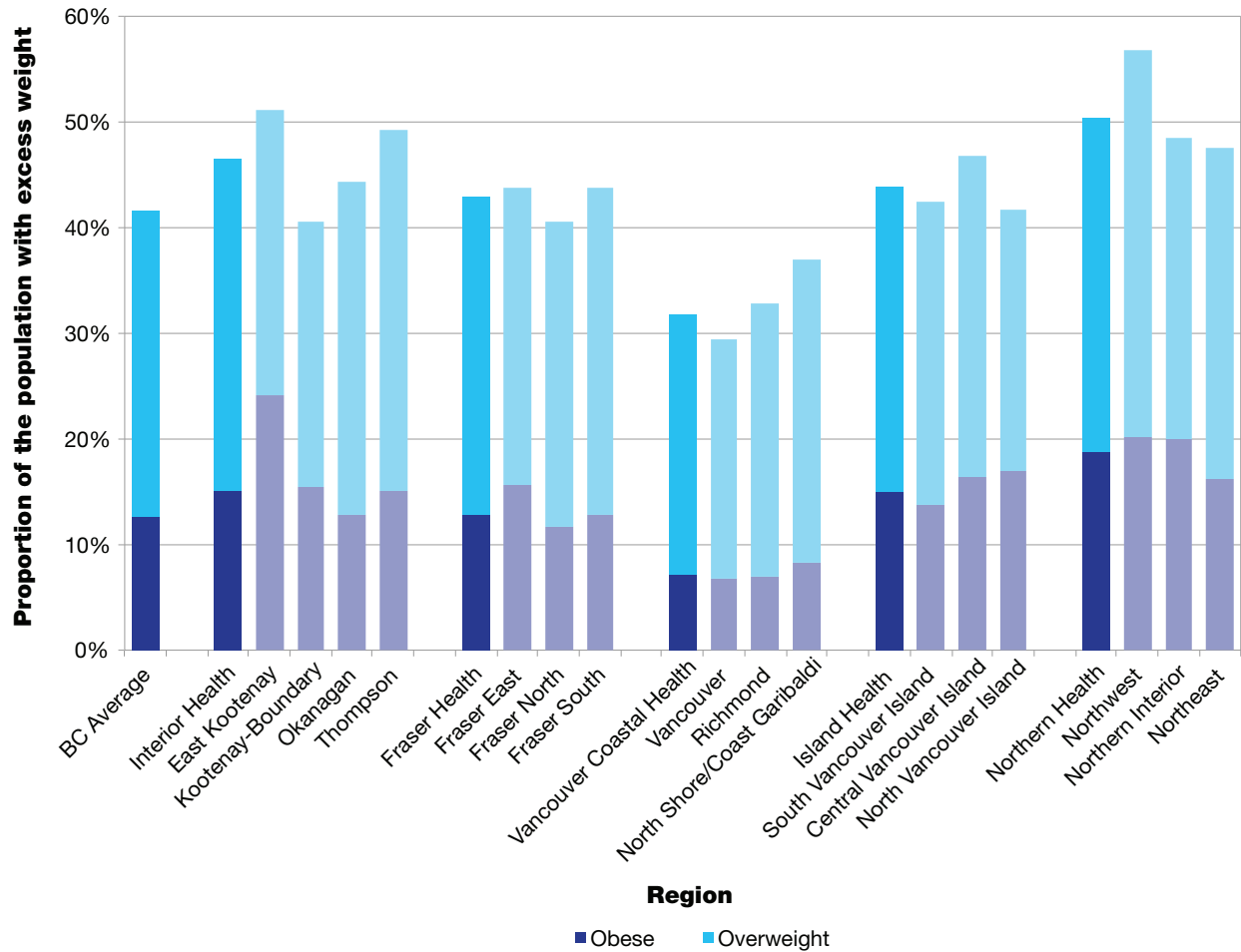
Individuals are considered to have excess weight if they are overweight (that is, those with a body mass index, between 25 kg/m² and 30 kg/m²) or obese (that is, those with a BMI that is greater than 30 kg/m²). In BC, we estimate that 29.0% of the population is overweight, and a further 12.6% of the population is obese.

Overall, males have a significantly higher rate of excess weight than females (49.2% vs. 34.0%, respectively). However, among those who have excess weight, the distribution of BMI is much different for males than it is for females. Females who have excess weight are more likely than males to be obese, and more than twice as many females as males have a BMI greater than 40 kg/m². This is noteworthy, as the risk of developing many chronic diseases increases dramatically for obese and morbidly obese individuals.

Rates of excess weight vary considerably across the province, from a high of 56.7% in the Northwest HSDA to a low of 29.5% in the Vancouver HSDA. The lowest rates of excess weight are found in the three HSDAs within Vancouver Coastal Health (Vancouver, Richmond and North Shore/Coast Garibaldi). Overall, the prevalence of excess weight in Vancouver Coastal Health is almost 25% lower than the provincial average (see figure 3).

Social, economic and environmental factors may influence this geographic variation and other variation between or within groups. As a result, achieving rates of excess weight similar to Vancouver may be more challenging for some populations. However, prevention efforts should also recognize this variability in order to design interventions that consider these extrinsic factors and promote health equity.

Figure 3. Prevalence of excess weight in British Columbia
By excess weight category and health authority/HSDA, 2011-12



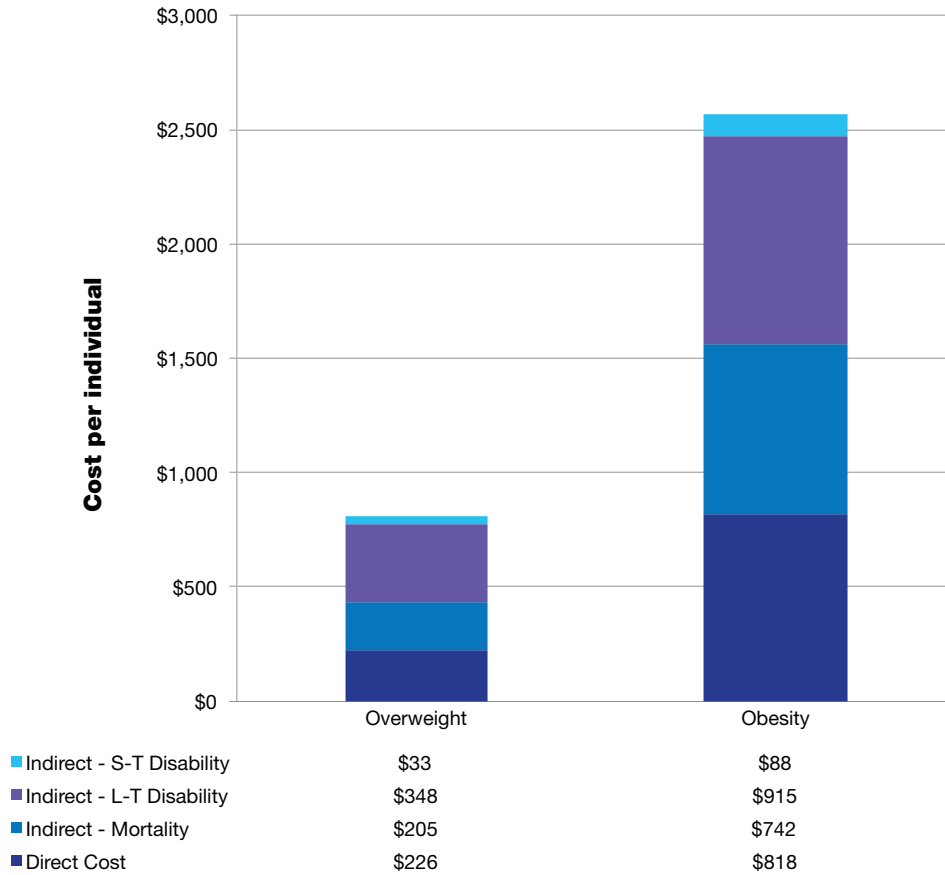
What is the economic burden of excess weight?

We estimate the annual economic burden of excess weight in BC at \$2.6 billion. Diseases caused by excess weight consume \$772 million in direct health care costs, or 2.8% of BC’s total health care expenditures (\$27.1 billion, in 2013). Indirect costs total \$1.8 billion.

Although there are more than twice as many overweight British Columbians as there are obese British Columbians, the economic burden of obesity still exceeds that of overweight (\$1.4 billion vs. \$1.1 billion, respectively). As shown in figure 4, the economic burden associated with one individual with obesity is more than three times that associated with one individual who is overweight.

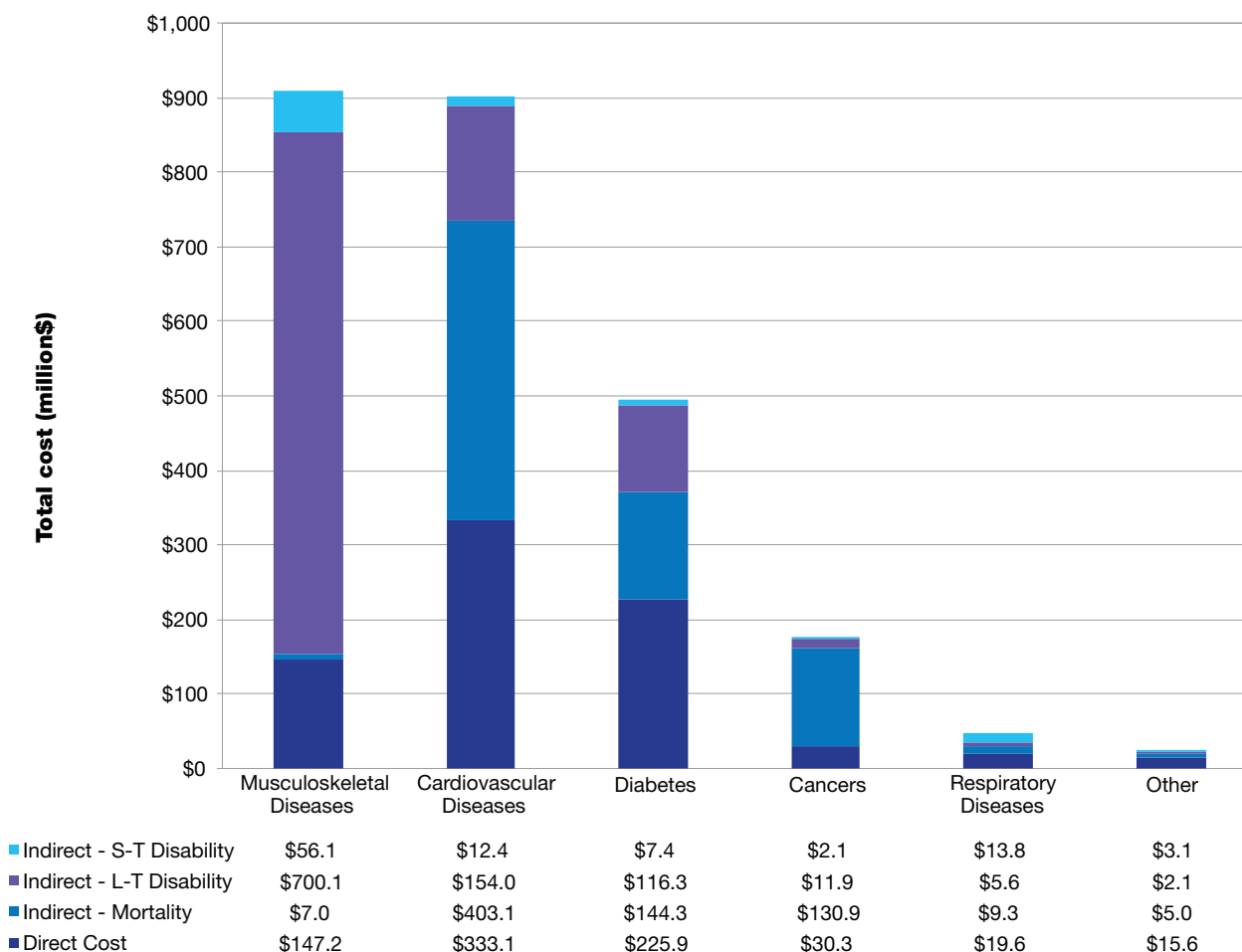
Figure 4. Estimated direct and indirect costs in British Columbia attributable to overweight and obesity, per individual with the risk factor.

British Columbia, 2013 (adjusted for multiple risk factors in one individual)



These direct costs are distributed among disease categories unevenly, with the majority of costs resulting from musculoskeletal diseases and cardiovascular diseases (see figure 5).

Figure 5. Estimated direct and indirect costs attributable to excess weight by disease category British Columbia, 2013, in million \$ (adjusted for multiple risk factors in one individual)



Musculoskeletal diseases (for example, arthritis and chronic back pain) consume the largest portion of the annual economic burden attributable to excess weight (\$910 million; see figure 5), while the economic burden of musculoskeletal diseases attributable to tobacco smoking and physical inactivity is less than one-tenth of this. It is therefore likely that excess weight is the primary modifiable risk factor contributing to musculoskeletal diseases, and interventions targeting excess weight may substantially reduce the economic burden associated with this class of diseases.

The annual economic burden of cardiovascular diseases attributable to excess weight (for example, heart failure and strokes) is \$903 million, which is only marginally lower than that of musculoskeletal diseases (see figure 5). The distribution of the economic burden, however, is very different. For musculoskeletal diseases, 77% of the economic burden from excess weight is attributable to long-term disability. Whereas for cardiovascular diseases, 45% of the economic burden is attributable to premature death, 37% to health care expenditures and just 17% to long-term disability.

We estimate that cases of diabetes that are attributable to excess weight cost \$494 million annually (see figure 5). The majority of these costs are due to obesity rather than overweight. The risk of developing diabetes is approximately three times higher for an individual with obesity than for an individual with overweight.²⁵

How much will excess weight cost in 2036?

If prevalence rates of excess weight were to remain unchanged between 2013 and 2036, we project that the economic burden attributable to this risk factor would still increase by 22% due to population growth. In 2036, direct costs would total \$1.0 billion and indirect costs \$2.4 billion.^{ix} However, the prevalence of excess weight has been steadily increasing over the past three decades,²⁶ and our projections do not consider this trend. If rates of excess weight continue increasing as they have, the economic burden of excess weight in 2036 will be substantially higher than the \$3.4 billion we estimate in this report.

What are the economic benefits of reducing excess weight?

A 1% annual relative reduction in the prevalence of excess weight would reduce the economic burden by a cumulative \$7.8 billion between 2013 and 2036. Thirty per cent of the costs avoided, or \$2.4 billion, would be in direct health care expenditures. By 2036, the prevalence of excess weight would decrease from 41.6% to 33.7%. As a result, the economic burden would be \$682 million lower in 2036 than it would be if prevalence rates remained the same as they were in 2013.

In order to achieve this reduction, every year approximately 22,100 British Columbians with excess weight would need to achieve a BMI less than 25 kg/m².

Over the course of 23 years, we could avoid an estimated \$3.3 billion in costs by reducing the number of individuals with overweight (\$9,299 avoided per individual no longer overweight). Alternatively, we could avoid an estimated \$4.5 billion in costs by the much smaller reduction in the number of individuals with obesity (\$29,485 avoided per individual no longer obese). Note that this average includes all individuals with obesity who moved into the normal weight category throughout years 1 to 23. If an individual with obesity moved into the normal weight category in year 1, then the cumulative reduction over the 23-year period would be \$58,942 per person.

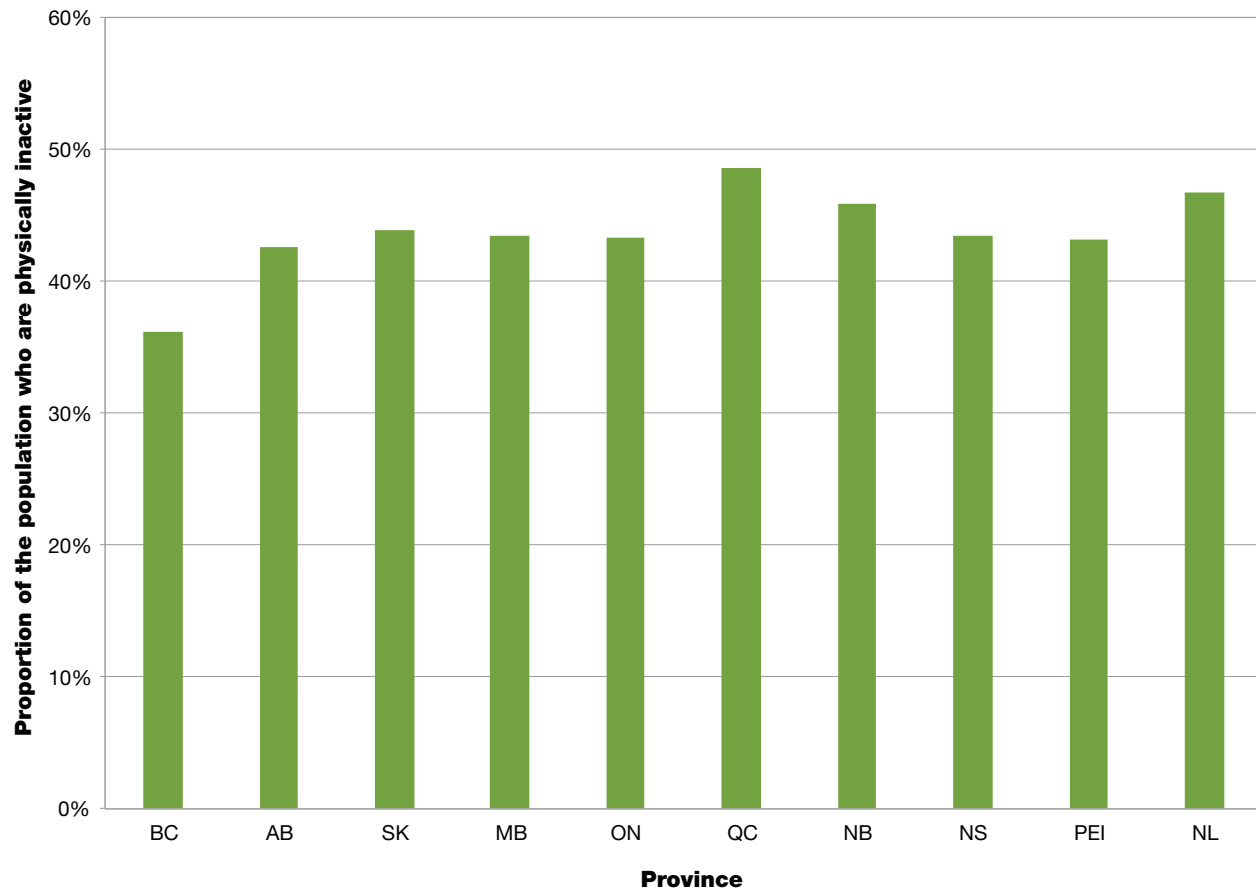
^{ix} All future costs in this report are presented in 2013 constant dollars.

Physical inactivity

What is the extent of physical inactivity in British Columbia?

Nearly two in five British Columbians (37.9%) report low levels of leisure-time physical activity*. Even still, British Columbians are considerably more active than individuals living in all other provinces, as our provincial inactivity rate is approximately four-fifths that of the Canadian average (see figure 6).

Figure 6. Prevalence of physical inactivity in Canada
By province, 2012

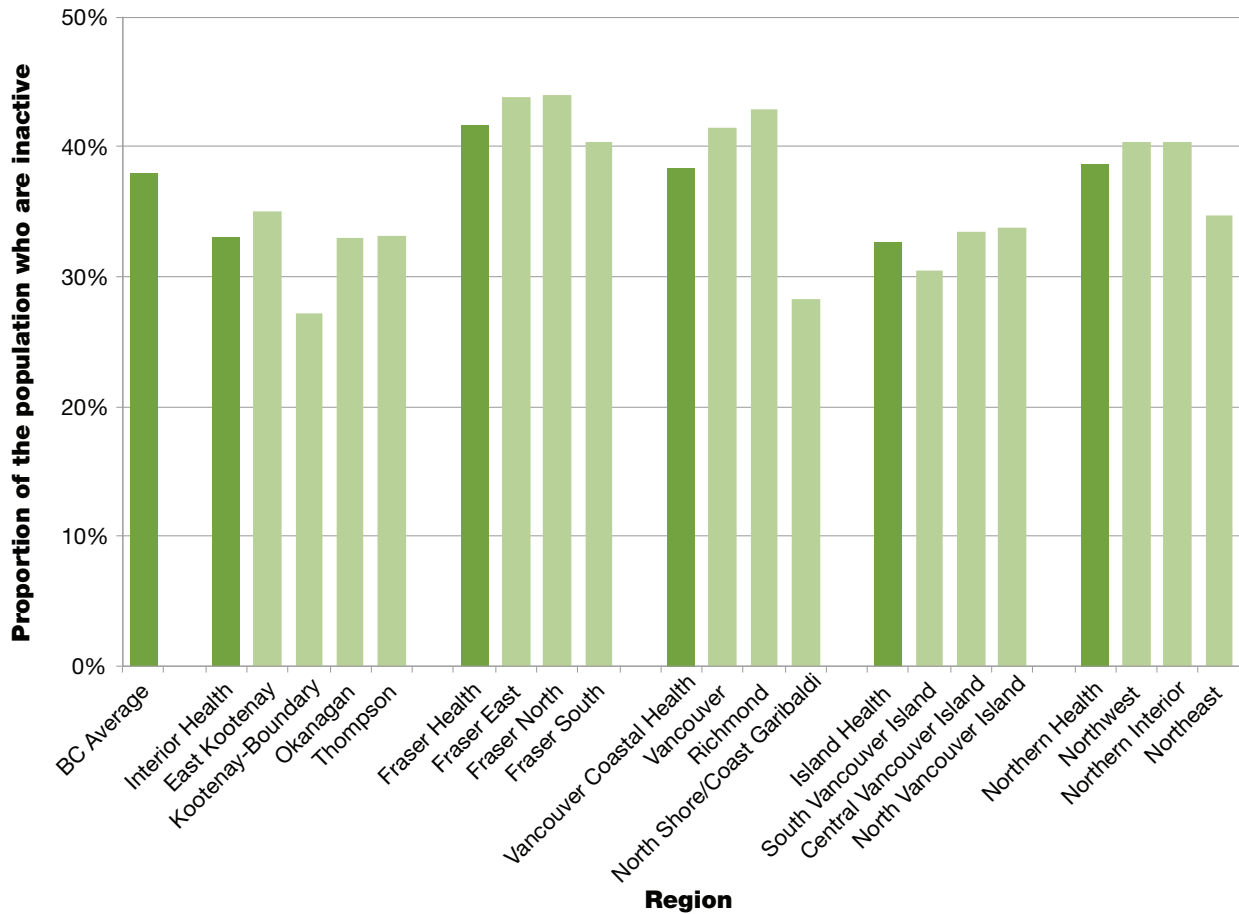


There is notable geographic variation in activity levels across BC. The highest rates of physical inactivity are found in the Fraser North HSDA, while the lowest are found in the Kootenay Boundary HSDA (see figure 7). The five highest rates of physical inactivity are all in HSDAs within Vancouver Coastal Health and Fraser

x Leisure-time physical activity accounts for only a portion of an individual's overall physical activity and does not include daily living, commuting or occupational physical activity.

Health. Conversely, all HSDAs within Interior Health and Island Health have lower rates of physical inactivity than the provincial average. Residents of the Northern Health region have activity levels similar to the provincial average.

Figure 7. Regional prevalence of physical inactivity in British Columbia
By health authority/HSDA, 2011-12



Males report significantly lower rates of physical inactivity than females (35.5% of males in BC, compared to 40.4% of females). This finding is true for all health authorities except for Northern Health.

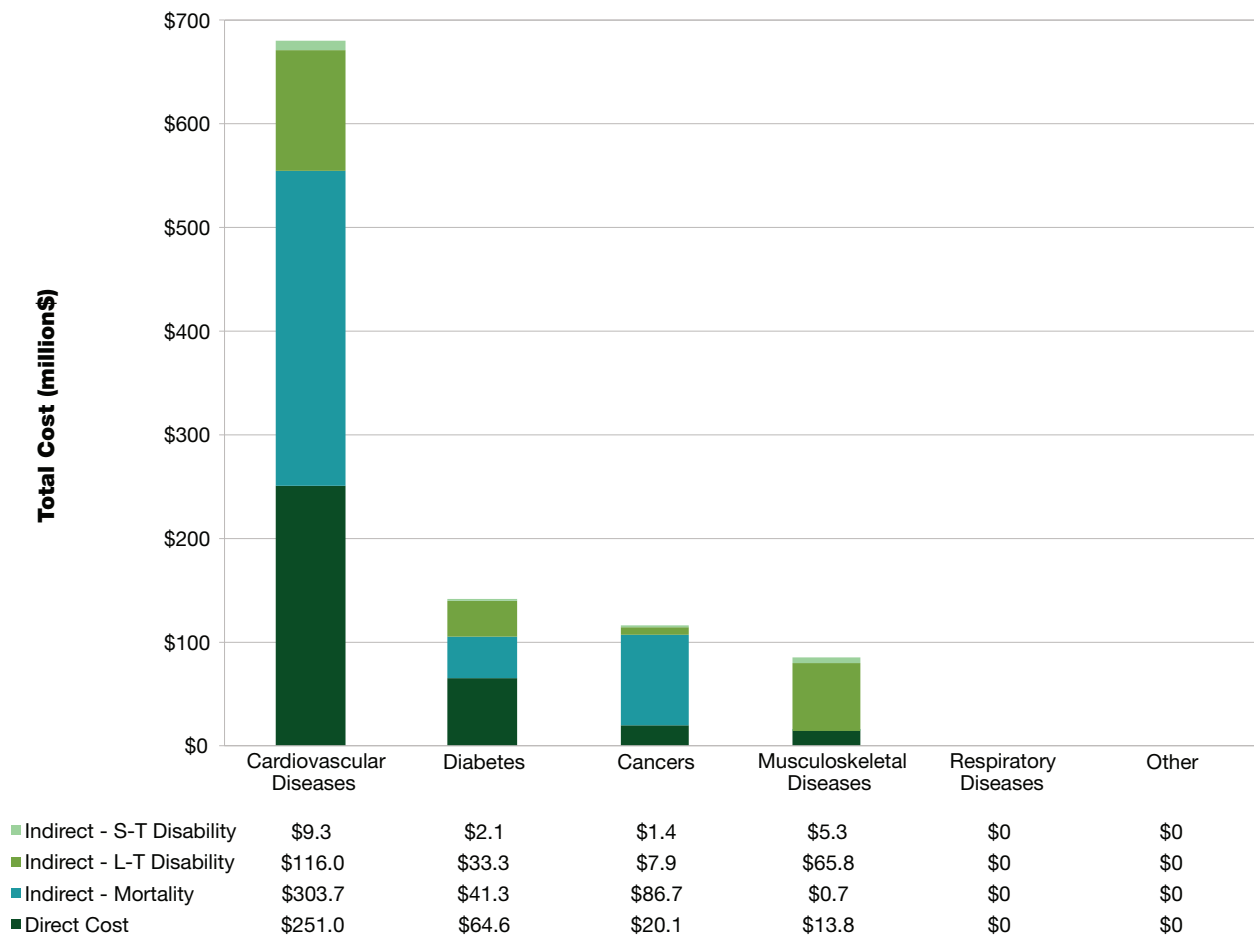
What is the economic burden of physical inactivity?

The annual economic burden of physical inactivity in BC is approximately \$1.0 billion. Disability and premature mortality cost \$673 million, while direct health care costs total \$350 million, or 1.3% of BC's total health expenditures in 2013.

When averaged across the whole population in BC who reported being inactive, the annual cost of inactivity is \$589 per person in combined direct and indirect costs. Of this, \$201 is due to direct health care expenditures, and \$388 is in indirect costs.

Although physical inactivity contributes to a number of different diseases, the majority of costs result from cardiovascular diseases. In fact, two-thirds of the economic burden attributable to physical inactivity is the result of cardiovascular diseases, while the remaining one-third is due to diabetes, cancers and musculoskeletal diseases combined (see figure 8).

Figure 8. Estimated direct and indirect costs attributable to physical inactivity by disease category British Columbia, 2013 in million\$ (adjusted for multiple risk factors in one individual)



How much will physical inactivity cost in 2036?

If prevalence rates for physical inactivity remain the same in 2036 as they were in 2011-12, we expect the economic burden due to physical inactivity to increase by approximately one-third. Combined direct and indirect costs would increase from \$1.0 billion to \$1.4 billion, because of projected population growth alone.

What are the economic benefits of increasing physical activity?

If we reduced the number of individuals who are inactive by 1% each year until 2036, overall prevalence rates of physical inactivity would decrease from 37.9% to 31.2%. This 1% reduction is a conservative goal, and would require approximately 20,100 British Columbians to moderately increase their leisure time activity levels each year. By 2036, 463,000 more individuals would be active than if rates remained the same as in 2013.

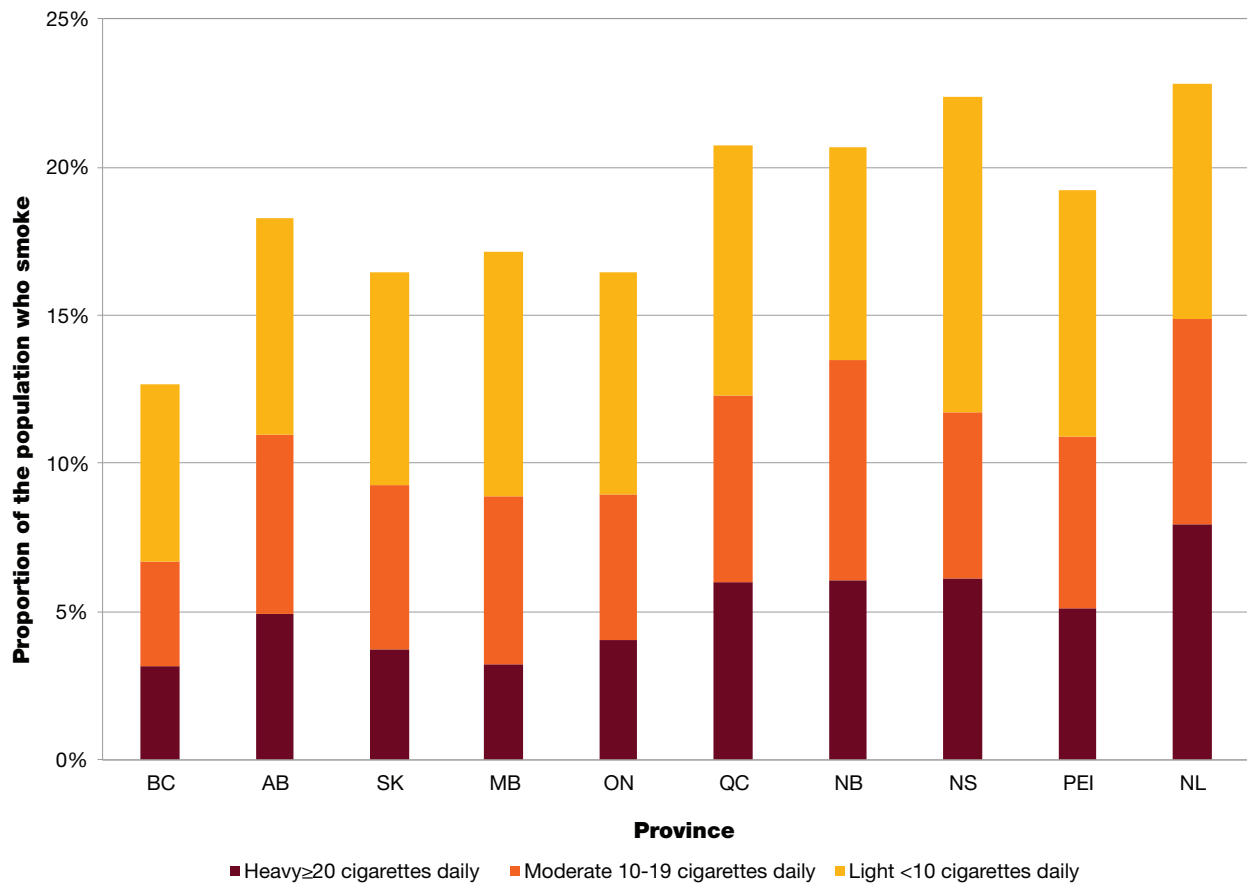
As a result of this increase in activity levels, the annual economic burden would be an estimated \$273 million lower in 2036 than it would be if prevalence rates remained the same as they were in 2013. Between 2013 and 2036, we would see a cumulative reduction in economic burden of \$3.1 billion. Thirty-four per cent, or \$1.1 billion of the avoided costs would be direct health care expenditures.

Tobacco smoking

What is the extent of tobacco smoking in British Columbia?

In total, 13.2% of British Columbians self-reported smoking tobacco: 6.4% of British Columbians smoke fewer than 10 cigarettes per day or consider themselves occasional smokers, 3.8% smoke between 10 and 20 cigarettes per day, and 3.0% smoke more than 20 cigarettes per day. While this suggests that a large number of British Columbians are still smoking cigarettes, BC currently has the lowest rate of smoking in all 10 Canadian provinces (see figure 9). BC has achieved considerable reductions in smoking prevalence in the past decade. In 2000-01, 17.5% of males aged 12 or older and 14.2% of females aged 12 or older smoked daily. By 2012, those numbers had dropped to 11.8% and 9.4% for males and females, respectively.

Figure 9. Prevalence of tobacco smoking in Canada
By province, 2012

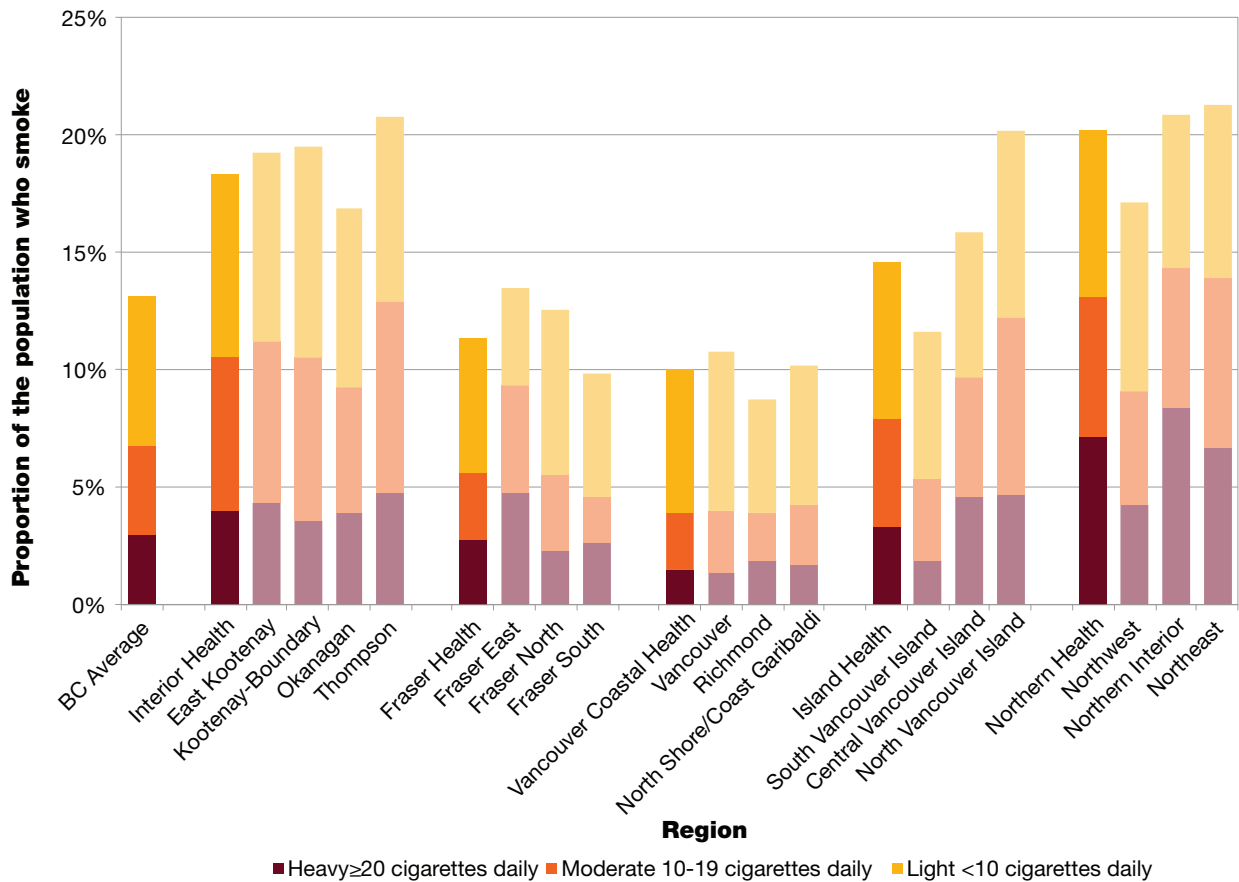


However noteworthy these achievements may be, the task of lessening the burden of smoking in BC is far from over. Cause for particular concern is the wide variation in smoking rates across the province, and the noticeable geographic trends that arise.

All HSDAs within Vancouver Coastal Health and all but one within Fraser Health have smoking rates below the provincial average (see figure 10). Conversely, all HSDAs within Interior Health and Northern Health, and all but one HSDA within Island Health have smoking rates that are above the provincial average. The Richmond HSDA has the lowest smoking rates (8.8%), while the Northeast HSDA has the highest (21.3%).

This would suggest that only some HSDAs are contributing to the low provincial smoking rates, and others still demand significant attention.

Figure 10. Regional prevalence of tobacco smoking in British Columbia
By smoking category and health authority/HSDA, 2011-12



In addition, there is a noticeable difference in smoking intensity between males and females. Approximately the same number of males and females are considered light and moderate smokers; however almost twice as many males as females are heavy smokers. The difference in overall smoking rates between males and females (14.1% and 12.2%, respectively) is almost entirely attributable to the high rates of heavy smoking among men.

What is the economic burden of tobacco smoking?

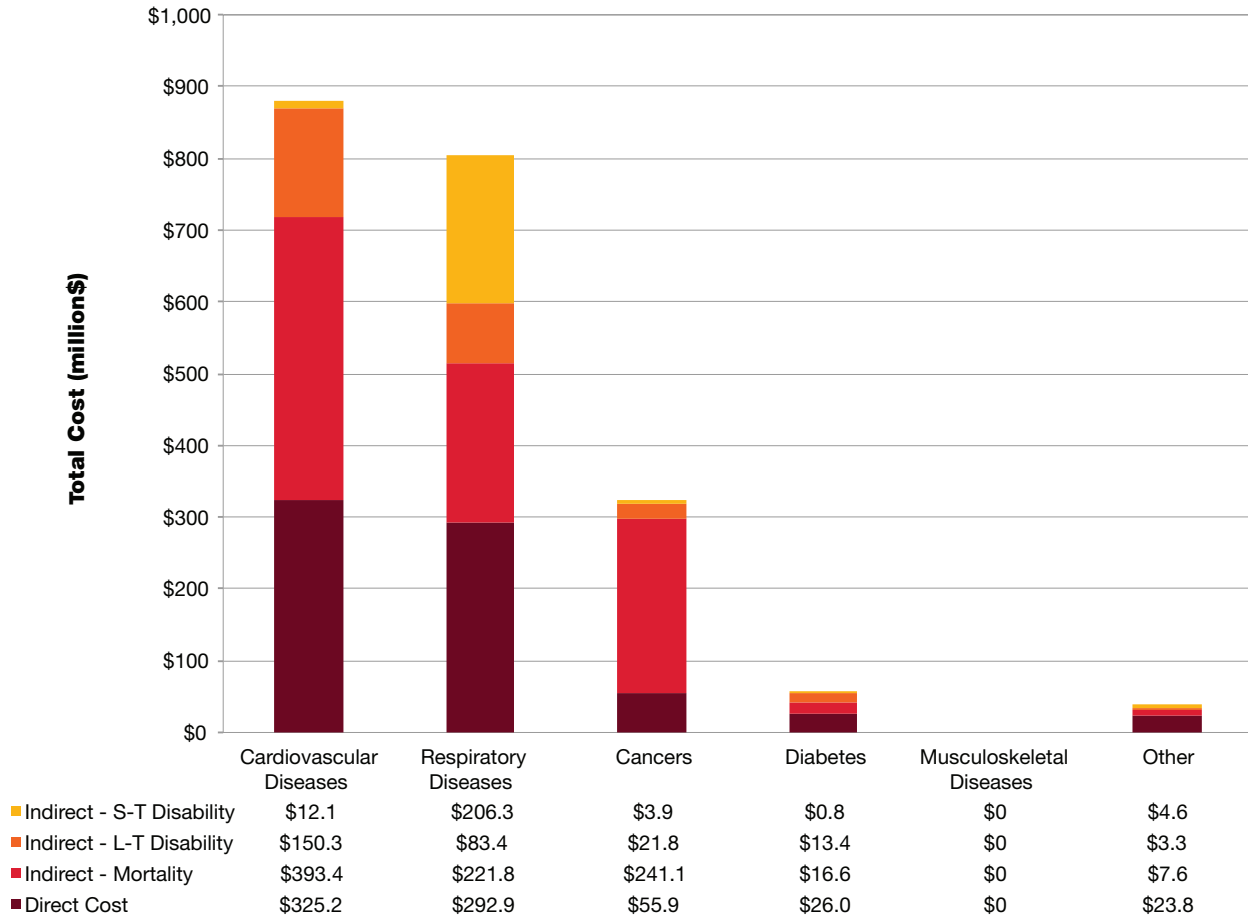
An annual \$724 million in direct health care costs is attributable to tobacco smoking. This is equivalent to 2.7% of BC's total health care expenditures in 2013. In addition, smoking incurs \$1.3 billion in indirect costs. The total annual cost of tobacco smoking is \$2.0 billion.

By disease category, cardiovascular diseases (for example, heart failure and stroke) account for the greatest proportion of this economic burden due to smoking (42%), followed closely by respiratory diseases (for example, pneumonia or lung disease) which are responsible for 38% of the burden (see figure 11). Alone, smoking-attributable chronic lung disease consumes \$258 million of direct health care costs annually. Cancers account for 15% of the total economic burden attributable to smoking with the majority of these costs resulting from lung cancers.

It is well known that smoking substantially increases an individual's risk for conditions such as chronic lung disease and lung cancer. However, there are also many other diseases less commonly known for their association with smoking that contribute substantially to its cost. For example, compared to non-smokers, heavy smokers are almost four times more likely to have a stroke and over twice as likely to develop diabetes.²⁷ As a result, we estimate that by eliminating tobacco smoking we could avoid 22% of strokes that occur in British Columbian males and 18% that occur in females. Likewise, we could avoid 7% of male diabetes cases and 5% of female diabetes.

Figure 11. Estimated direct and indirect economic burden attributable to tobacco smoking by disease category

British Columbia, 2013, in million\$ (adjusted for multiple risk factors in one individual)



Although fewer than a quarter of all individuals who smoke consume 20 or more cigarettes per day, these individuals are responsible for 37% of the smoking-attributable economic burden. In fact, the average annual smoking-attributable costs incurred by a single individual who smokes heavily (\$5,397), is more than 2.5 times the costs incurred by a single individual who smokes lightly (\$2,146; Figure 12).

Figure 12. Estimated direct and indirect costs in British Columbia attributable to tobacco smoking, per individual with the risk factor.

British Columbia, 2013 (adjusted for multiple risk factors in one individual)



How much will tobacco smoking cost in 2036?

Using the present model, we have estimated the projected economic burden attributable to tobacco smoking in 2036, should smoking rates remain the same as they were in 2011-12. Assuming moderate population growth and no change in prevalence rates during this time, the total economic burden attributable to tobacco smoking would rise from \$2.0 billion to \$2.4 billion.

What are the economic benefits of reducing tobacco smoking?

If we reduced the proportion of British Columbians who smoke by only 1% each year, the resulting decrease in smoking-attributable costs would be considerable. This 1% annual relative reduction would translate to approximately 6,760 British Columbians quitting smoking per year. This goal is, in fact, very modest. Between 2003 and 2012, the proportion of smokers in BC decreased by much more than this, averaging 4.0% annually for males and 3.5% annually for females.

A 1% annual relative reduction would reduce rates of smoking from 13.2% in 2013, to 9.6% in 2036. As a result, the economic burden in 2036 would be \$401 million less than if smoking rates remained the same as they were in 2013. In total, we could avoid a cumulative \$4.0 billion in smoking-related costs between 2013 and 2036, simply by this reasonable reduction in smoking rates. Thirty-six per cent, or \$1.4 billion, of these costs avoided would be in direct health care expenditures.

When considering these costs, it is important to bear in mind that smoking cessation does not immediately remove one's risk of developing smoking-related disease. In fact, individuals who quit smoking may continue to suffer negative health effects years after their last cigarette. As such, the health and economic benefits of smoking reduction may not be fully realized until long after a reduction occurs. Accordingly, the economic benefit described above would continue to grow long after 2036.

The combined burden of excess weight, physical inactivity and tobacco smoking

As a whole, the economic burden of excess weight, physical inactivity, and tobacco smoking demonstrates the considerable impact that modifiable risk factors can have on costs associated with chronic diseases. We estimate that the combined annual economic burden of these risk factors in British Columbia total \$5.6 billion (see table 1). This economic burden represents 2.44% of British Columbia's gross domestic product in 2013 (\$229.7 billion).²⁸ Of this \$5.6 billion economic burden, \$3.8 billion is due to disability and premature mortality, and \$1.8 billion is due to direct health care costs. The health care costs resulting from excess weight, physical inactivity and tobacco smoking together equal 6.8% of the province's entire health care budget in 2013.

Table 1. Prevalence of risk factors and economic burden in British Columbia attributable to excess weight, physical inactivity, and smoking , both sexes.

British Columbia, 2013 (adjusted for multiple risk factors in one individual)

	% Population with RF	# of individuals with RF	Direct cost per individual with RF	Indirect cost per individual with RF	Total cost per individual with RF (\$'s)	Total direct cost of RF (million\$)	Total indirect cost of RF (million\$)	Total cost of RF (million\$)
Excess Weight								
Overweight	28.97%	1,327,364	\$226	\$586	\$811	\$299.8	\$777.2	\$1,077.0
Obesity	12.60%	577,253	\$818	\$1,745	\$2,563	\$472.0	\$1,007.3	\$1,479.3
Subtotal - Excess Weight	41.57%	1,904,617	\$405	\$937	\$1,342	\$771.8	\$1,784.5	\$2,556.3
Physically Inactive	37.93%	1,737,946	\$201	\$388	\$589	\$349.6	\$673.5	\$1,023.1
Smokers								
Light	6.37%	292,016	\$767	\$1,379	\$2,146	\$224.1	\$402.7	\$626.7
Moderate	3.78%	173,055	\$1,349	\$2,420	\$3,769	\$233.4	\$418.9	\$652.2
Heavy	3.00%	137,637	\$1,935	\$3,462	\$5,397	\$266.3	\$476.6	\$742.8
Subtotal - Smokers	13.15%	602,707	\$1,201	\$2,154	\$3,355	\$723.7	\$1,298.1	\$2,021.8
Total						\$1,845.1	\$3,756.1	\$5,601.2

RF = Risk factor

Table 2. Prevalence of risk factors and economic burden in British Columbia attributable to excess weight, physical inactivity, and smoking among males and females.
British Columbia, 2013 (adjusted for multiple risk factors in one individual)

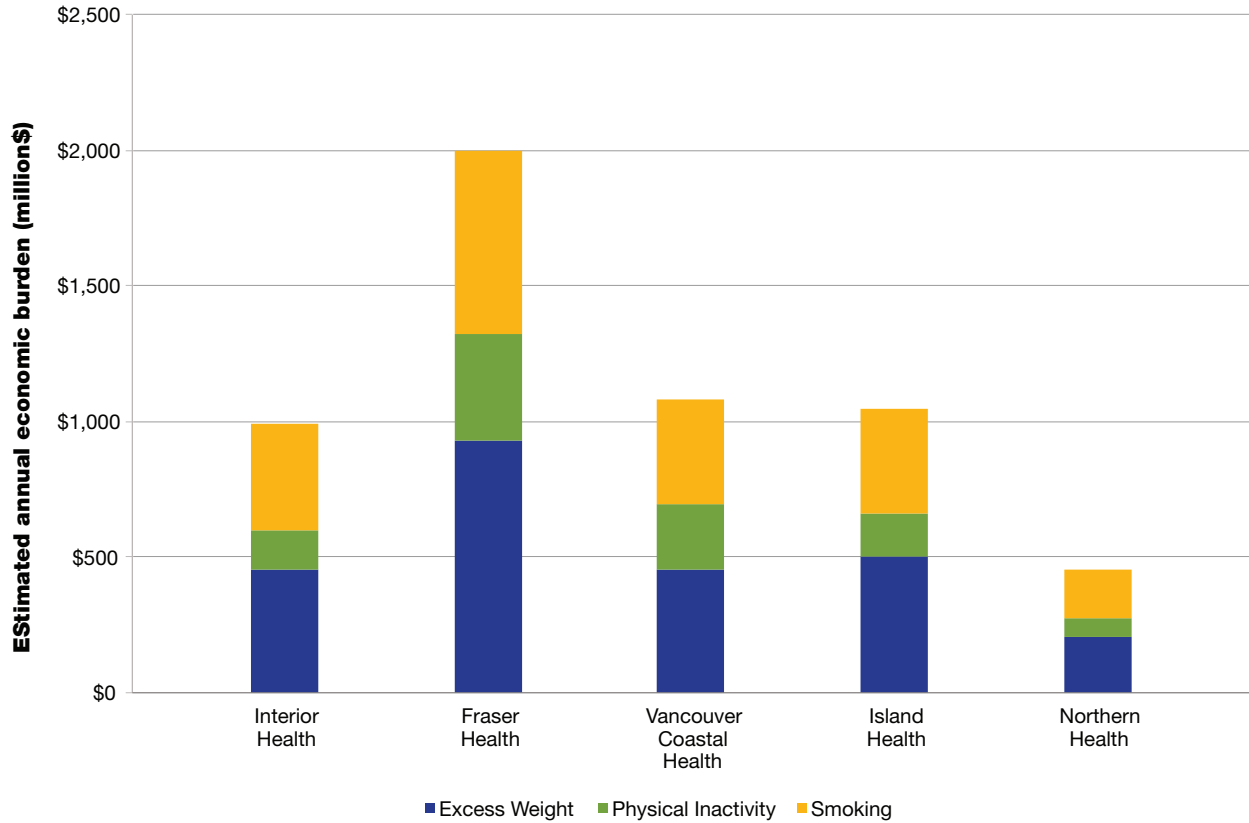
	% Population with RF	# of individuals with RF	Direct cost per individual with RF	Indirect cost per individual with RF	Total cost per individual with RF (\$'s)	Total direct cost of RF (million\$)	Total indirect cost of RF (million\$)	Total cost of RF (million\$)
Males								
Excess Weight								
Overweight	34.97%	796,125	\$190	\$519	\$709	\$151.0	\$413.5	\$564.5
Obese	14.22%	323,693	\$711	\$1,592	\$2,304	\$230.2	\$515.5	\$745.7
Subtotal - Male Excess Weight	49.18%	1,119,818	\$340	\$830	\$1,170	\$381.2	\$929.0	\$1,310.2
Physically Inactive	35.47%	807,684	\$223	\$392	\$615	\$179.8	\$316.8	\$496.6
Smokers								
Light	6.27%	142,741	\$905	\$1,655	\$2,560	\$129.2	\$236.2	\$365.4
Moderate	3.90%	88,701	\$1,554	\$2,830	\$4,384	\$137.9	\$251.0	\$388.9
Heavy	3.91%	89,029	\$2,011	\$3,635	\$5,647	\$179.1	\$323.7	\$502.7
Subtotal - Male Smokers	14.07%	320,471	\$1,392	\$2,530	\$3,922	\$446.1	\$810.9	\$1,257.0
Subtotal - Males						\$1,007.1	\$2,056.7	\$3,063.8
Females								
Excess Weight								
Overweight	23.05%	531,239	\$280	\$685	\$965	\$148.8	\$363.7	\$512.5
Obesity	11.00%	253,560	\$954	\$1,940	\$2,893	\$241.8	\$491.8	\$733.6
Subtotal - Female Excess Weight	34.05%	784,799	\$498	\$1,090	\$1,588	\$390.6	\$855.5	\$1,246.1
Physically Inactive	40.36%	930,262	\$183	\$383	\$566	\$169.8	\$356.7	\$526.5
Smokers								
Light	6.48%	149,275	\$636	\$1,115	\$1,750	\$94.9	\$166.4	\$261.3
Moderate	3.66%	84,354	\$1,132	\$1,990	\$3,122	\$95.5	\$167.9	\$263.4
Heavy	2.11%	48,607	\$1,794	\$3,146	\$4,940	\$87.2	\$152.9	\$240.1
Subtotal - Female Smokers	12.24%	282,236	\$984	\$1,726	\$2,710	\$277.6	\$487.2	\$764.8
Subtotal - Females						\$838.0	\$1,699.3	\$2,537.4

RF = Risk factor

The largest portions of these costs are incurred by Fraser Health, followed by Vancouver Coastal Health, Island Health, Interior Health and Northern Health (see figure 13).

Figure 13. Economic burden in British Columbia attributable to excess weight, physical inactivity, and smoking.

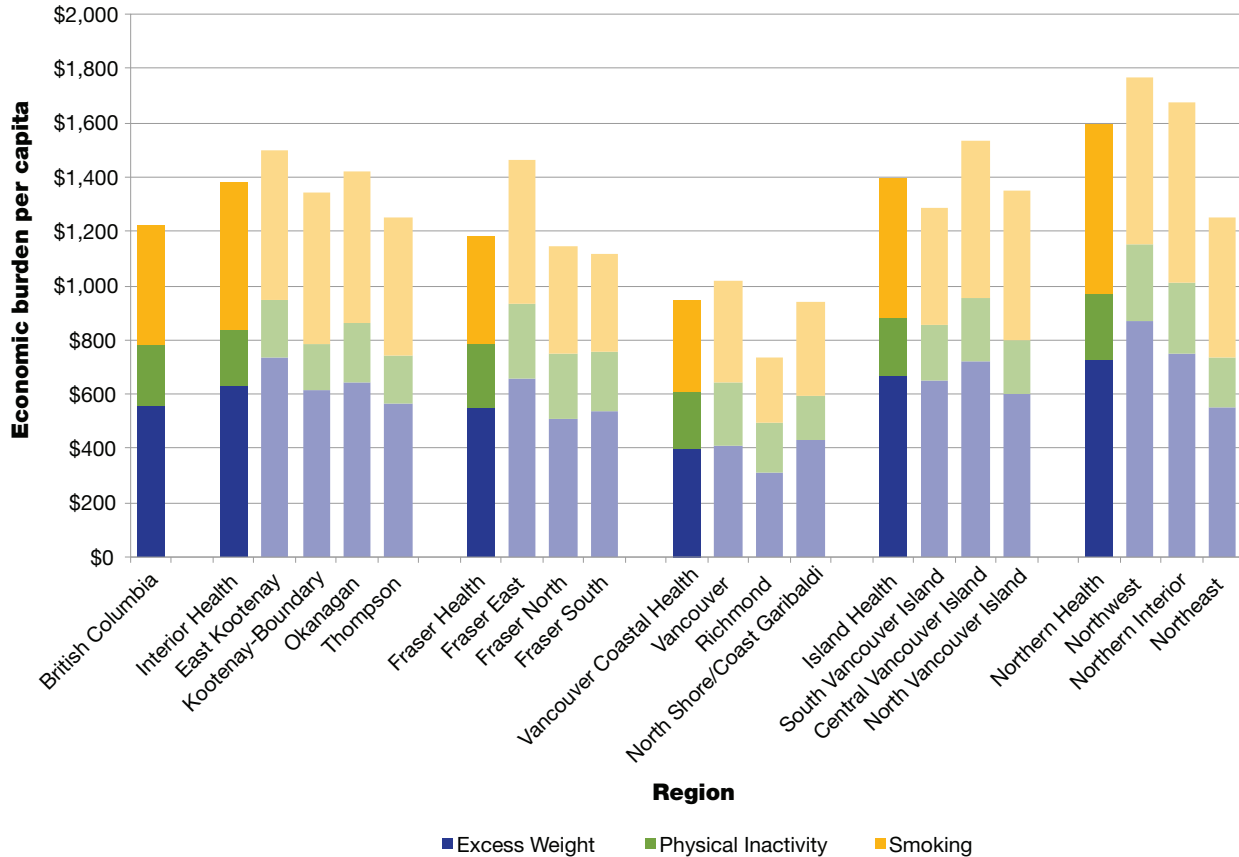
By health authority (2013)



Because of varying risk factor rates, the economic burden of the risk factors also varies greatly between regions (see figure 14). For example, the economic burden per capita of these risk factors in the Richmond HSDA (\$738) is less than half the per capita burden in the Northwest HSDA (\$1,766).

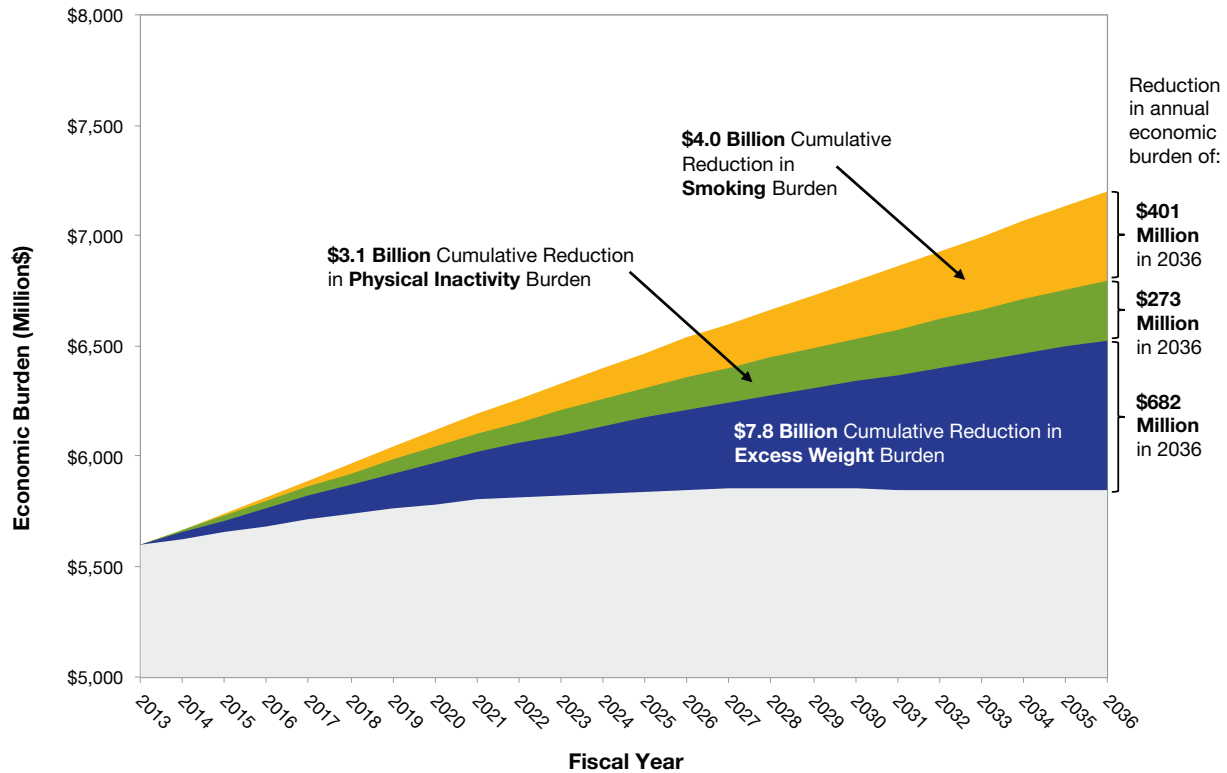
Figure 14. Economic burden per capita in British Columbia attributable to excess weight, physical inactivity, and smoking.

By health authority and health service delivery area, 2013 (adjusted for multiple risk factors in one individual)



This economic burden, much like the risk factors that it results from, is modifiable. Multipronged efforts to reduce the prevalence of these risk factors will lead to a proportional reduction in direct and indirect costs. Simply reducing the rates of excess weight, physical inactivity and tobacco smoking by 1% annually, as described previously, would result in considerable costs avoided. If rates are lowered, the 2036 annual economic burden of these three risk factors combined would be \$1.4 billion less than if rates remained the same as in 2013. In total, we could avoid a cumulative \$15.0 billion in costs between 2013 and 2036 if we reduce risk factor rates by this modest 1% (see figure 15).

Figure 15. Cost avoidance associated with a 1% annual relative reduction in risk factor prevalence British Columbia, 2013-2036 (1% annual relative reduction compared with no change)



Discussion

Lessons from five decades of smoking reduction

Experiences in Canada concerning tobacco smoking serve as an excellent reminder of both the progress that is possible through intensive efforts at reducing the prevalence of a risk factor, as well as the reduction in disease that accompanies it. The reduction in smoking during the last 50 years has had demonstrable effects on the incidence of lung cancer. In males, reduced smoking rates resulted in declining lung cancer rates approximately 20 years after smoking rates peaked (see figure 16). In females, however, the prevalence of daily smoking remained relatively stable until the mid-to-late 1980s. Between 1989 and 2012, Canada reduced its rates of smoking by almost two-thirds. As a result, lung cancer incidence among females has also stabilized and, based on the approximately 20-year lag time observed in the male population, is expected to begin declining in the near future (see figure 17).^{29,30,31,32,33}

Figure 16. Prevalence of daily smokers and age-standardized lung cancer incidence rates
Males, Canada, 1964 - 2012

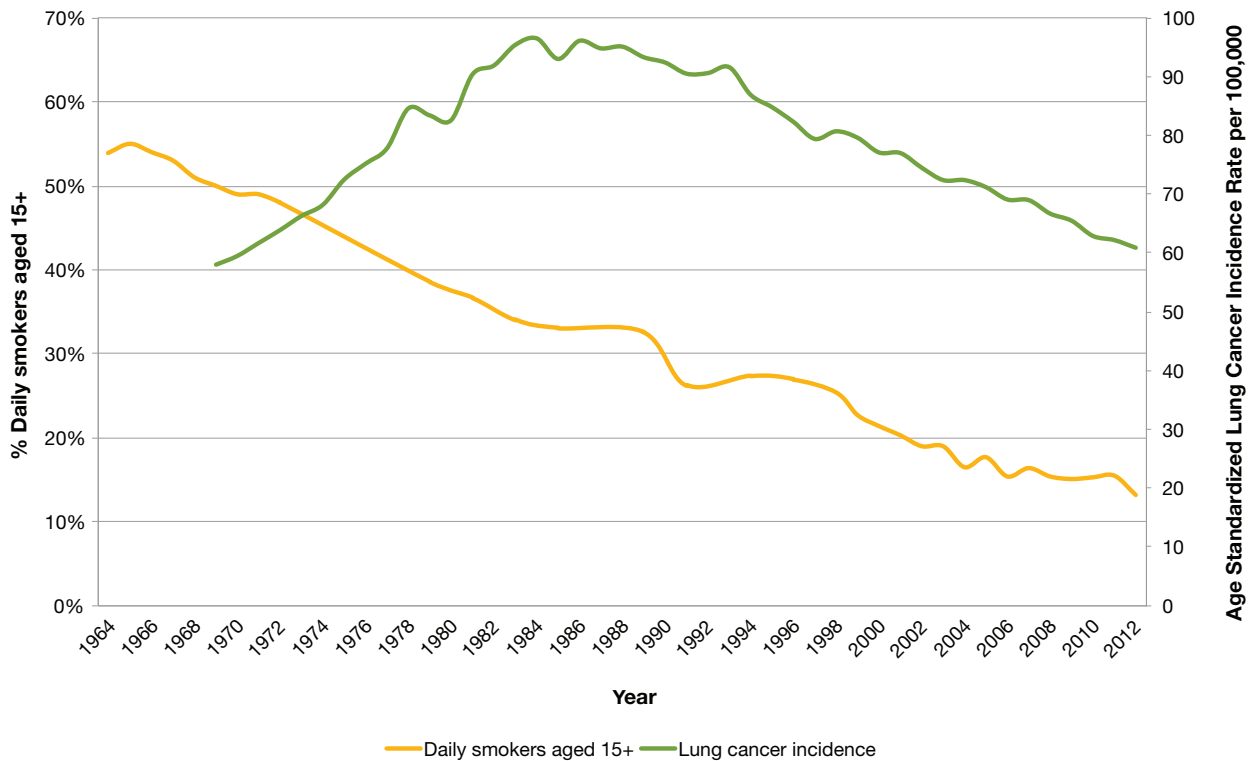
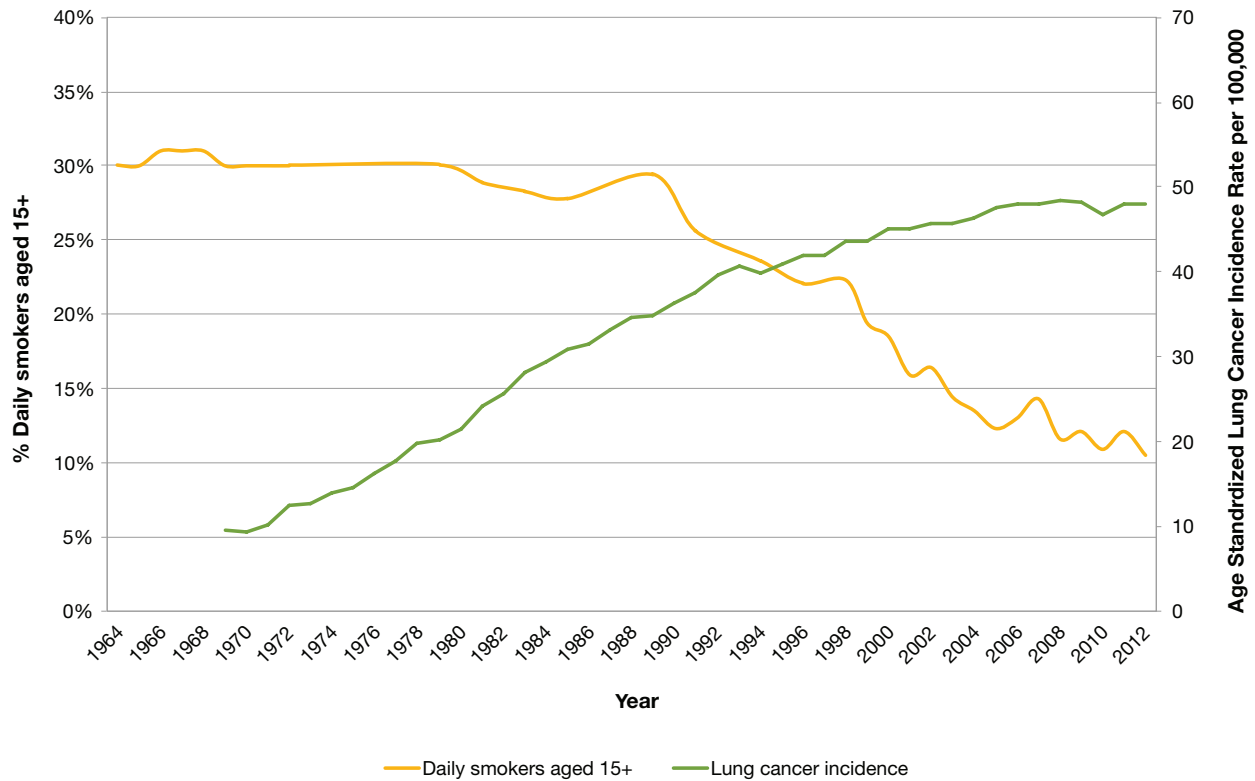


Figure 17. Prevalence of daily smokers and age-standardized lung cancer incidence rates
Females, Canada, 1964 - 2012



The progress that we have made in reducing smoking rates should reinforce that similar successes are possible for other modifiable risk factors. Furthermore, the steps that we took to achieve this progress can serve as a roadmap for tackling other risk factors in the future, including excess weight and physical inactivity.

We have learned from smoking that real results require a comprehensive, multipronged approach.³⁴ We cannot solely attribute the reduction in smoking rates to one or two interventions; rather, various economic and policy changes as well as community-based and clinical interventions acted synergistically to lower smoking rates to where they are now. In the early years of tobacco prevention, there was a tendency to attribute behavioural change to personal choices. Similar attitudes and beliefs are often applied to current obesity prevention approaches. However, as the experience with smoking made clear, supportive environments are necessary to trigger and then reinforce individual change. An environment that makes it easy to make positive lifestyle decisions is best created through far-reaching policy and program changes, complemented by effective community and individual interventions.³⁵

We have also learned that in order to see a meaningful reduction in risk factor prevalence, a long-term approach is required. It has been nearly 75 years since medical literature began reporting an association between tobacco smoking and chronic disease. While the net reduction today is remarkable, smoking rates were relatively slow to respond to interventions, and much work still remains. There was no ‘quick-fix’ that

solved the problem of tobacco smoking, and it is unlikely that there will be for other modifiable risk factors either. Instead, interventions require a prolonged approach that span beyond the immediate political cycle.

The most important lesson from tobacco smoking, however, is that widespread changes in the behaviours of a population are not only feasible, but have resulted in real and tangible effects on population health.

The rising rates of obesity are considered by some as the 'new tobacco', based on both its rapidly increasing prevalence worldwide, and the tide of associated health consequences that come alongside it. At this time, tobacco smoking and excess weight are at a crossroads. As we have described in this report, the economic burden attributable to excess weight has recently surpassed that of tobacco smoking in British Columbia. In addition to this, there are now more obese British Columbians than there are daily smokers.

The burden of these risk factors on society is immeasurable, especially in terms of reduced health status and quality of life. It is, however, possible to gauge the consequences of these risk factors by their strain on the health care system and losses due to disability and death that result in economic costs. In turn, we can use the economic consequences of these risk factors to inform the prioritization of policy changes and interventions aimed at curbing the incidence of disease.

Conclusion

The impact of modifiable risk factors on chronic disease in British Columbia is substantial, in terms of both economic and social costs. For many diseases, the proportion that is attributable to excess weight, physical inactivity and tobacco smoking is striking. For example, in BC, we estimate that we could eliminate 71% of chronic lung disease, 68% of type 2 diabetes, 63% of lung cancers, 54% of heart disease, 43% of strokes, 32% of colorectal cancers and 24% of chronic back pain burden by removing these three risk factors from the population.

We can apply this same concept to the economics of disease, which allows us to calculate the proportion of direct and indirect costs that arise from these risk factors. As a result, we can estimate that the economic burden of diseases directly caused by these risk factors totaled \$5.6 billion in 2013.

The task of totally eliminating one or all of these risk factors from the population is largely unrealistic. However, our findings indicate the degree of influence these risk factors have on the health of British Columbians and the associated costs to our health care system and economy at large. Furthermore, our report demonstrates the major potential impact of a modest reduction in the rates of these risk factors. If we reduced the prevalence of each risk factor by a relative 1% each year until 2036, there would be a cumulative \$15.0 billion reduction in economic burden in BC. This estimate includes \$4.9 billion in direct health care costs that BC could avoid.

Not all of the risk factors contribute equally to the current and future economic burden. To prioritize prevention efforts, each risk factor should be considered independently. Primarily, we intend for the cost estimates in this report to provide insight into which areas for prevention or intervention can be priorities for action. Understanding the current costs of these risk factors for a given region, as well as how we expect these costs to change in coming years can help inform both immediate and long-term planning.

The considerable historical reduction in smoking prevalence in BC means that the economic burden currently attributable to smoking is now lower than that of excess weight. Our study estimates that modestly reducing the prevalence of excess weight could result in a cumulative cost avoidance of \$7.8 billion by 2036, as compared to \$4.0 billion for smoking.

The economic evidence we present also suggests that there are various regions within British Columbia that demand specific attention. In particular, the geographic variation between health authorities and HSDAs may act as a guideline for where region-specific prevention efforts may be most valuable. In general, rates of excess weight are lowest in Vancouver Coastal Health. Rates of tobacco smoking are lowest in Fraser Health and Vancouver Coast Health; however, the opposite is true for physical inactivity. Rates of all three risk factors are typically above average in all HSDAs within Northern Health. As a result of varying risk factor rates, the economic burden of the risk factors also varies greatly between regions. This study has calculated that the economic burden per capita of these risk factors is more than two times higher in the Northwest HSDA (\$1,766) than it is in the Richmond HSDA (\$738).

For the purpose of this report, we focused on the costs associated with individual-level risk factors, but also acknowledge that excess weight, physical inactivity and tobacco smoking are strongly influenced by a variety of social, environmental, and economic factors. These determinants are likely to drive some of the

geographic variation that was observed by this study, and recognizing the role of these underlying factors are fundamentally important to promoting health equity. Not everyone has an equal opportunity to make healthy choices, and any population-level interventions should address chronic disease risk factors while acknowledging the social determinants of health and structural factors that shape the distribution of risk factors in our population.

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