Investigating the State of Walkability and Neighbourhood Health in Metro Vancouver: Implications for Policy-Makers



Capstone Professional Report

Stuart Hamre

April 2018



Faculty of Applied Science

Acknowledgements



With thanks to the J. Armand Bombardier foundation for their generous financial support of student research through the Sustainable Transportation Fellowship.

Merci à la fondation J. Armand Bombardier pour son généreux soutien financier à la recherche étudiante par la Bourse du transport durable.

With further thanks to Dr. Lawrence Frank, Academic Supervisor at the School of Community and Regional Planning, and Dr. Andy Hong and the team at the Health & Community Design Lab at the School of Population and Public Health, for their continued support over the course of this research project.

Stuart Hamre, BA (Hons)

This report represents an independent research project fulfilling the Capstone Professional Report requirement of the University of British Columbia School of Community and Regional Planning Master of Community and Regional Planning degree. The views expressed in this report are solely those of the author.

Executive Summary

Scientific evidence increasingly suggests that in addition to reducing environmental impacts such as greenhouse gas emissions, the health impacts of utilizing active and sustainable transportation methods such as walking, biking, and transit are substantial. In environments where people are given the opportunity to utilize active and sustainable modes of transportation, populations tend to have better physical health. Obesogenic environments characterized by an auto-centric design where people do not have these same active lifestyle opportunities are generally correlated with poorer physical health. For this reason, it is widely understood that by providing citizens with access to active and sustainable transportation options, municipalities can expect healthier and more active populations.

This report investigates the state of active and sustainable transportation infrastructure in Metro Vancouver municipalities by conjunctively reviewing the following: features of the physical built environment such as parks, sidewalks, and bicycle lanes in neighbourhoods, technical walkability data from the UBC Health & Community Design Lab's 2011 Walkability Surface dataset, and health data from the 2013 My Health My Community Survey administered to residents of the Lower Mainland. This analysis is used to understand the correlations that exist between the built environment and health outcomes amongst residents

of the Lower Mainland, setting the stage for discussions of built environment modifications and policy development approaches that may lead to improved health outcomes in the population over time, resulting in both reduced healthcare expenditures and environmental impacts.

Results of the multi-level assessment paint a picture of a region that has wide variability both in terms of built environments and physical and mental health. Generally, suburban built environments characterized by low walkability are home to populations with less sustainable travel characteristics and worse physical health outcomes. Generally, urban built environments characterized by high walkability are home to populations with sustainable travel characteristics who walk, cycle, and take transit for most purposes. Residents in these neighbourhoods tend to have better physical health. However, though they tend to have worse physical health outcomes, the mental health of suburban and rural residents is often reported to be better than that of their more urban colleagues.

A range of modifications to the built environment that can increase a neighbourhood's walkability may help increase the use of active and sustainable forms of travel, thereby increasing a population's overall physical health and contributing to reduced healthcare expenditures and reduced environmental impact in the long term. These include increasing mid-block connectivity in suburban environments, fixing fragmented pedestrian and cycling routes, and investing in new active and sustainable transportation infrastructure.

Planners and policymakers have a leading role in ensuring that modifications to the built environment are purposefully targeted towards increasing residents' propensity to walk, cycle, and take transit, thereby increasing their overall physical health. The mental health implications of these same lifestyle changes also warrant substantial consideration.

With the right infrastructure investments, residents of the Lower Mainland can lead healthier, more active lives, with reduced environmental impact and with implications for overall healthcare utilization and cost.

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Introduction

Health and the Built Environment

Canadian healthcare expenditures totaled an estimated \$242 billion in 2017, averaging \$6,604 per person and 11.5% of GDP.¹ Infrastructure spending in Canada is harder to pinpoint, given its multiple funding sources. Collectively, however, federal, provincial/territorial, regional, and municipal Canadian governments will spend hundreds of billions of dollars in the coming decades to maintain, repair, and replace existing infrastructure, while spending billions more on new infrastructure projects. These costs are massive—and rising. Since 2008, federal infrastructure spending has grown significantly, with Canada ranked 9th of 35 OECD countries in per capita infrastructure expenditures from 2010 to 2014.² What if there were a way to offset health expenditures by allocating infrastructure spending more effectively, thereby contributing not only to an upgraded built environment, but to reduced spending overall, at all levels of government?

The built environment—that is, the world of human-built infrastructure around us—has significant impacts on mobility patterns, tendencies to

exercise, and more, thus impacting our physical and mental health, as well as healthcare expenditures. For example, built environments characterized by vehicle-oriented infrastructure and a lack of transit and active transportation amenities by nature require residents to commute and complete errands by car. This has a direct impact on the amount of time residents must spend in vehicles as opposed to in or on more sustainable modes of transportation, such as bus or bicycle. More time spent in vehicles means more time spent sitting, additional stress, and exposure to harmful air pollutants; all of which are factors which impact physical health.

There is a growing body of evidence which supports the linkages being drawn between the built environment, health, and healthcare expenditures. In addition to reducing the environmental impacts such as greenhouse gas emissions, the health impacts of utilizing sustainable transportation methods such as walking, biking, and transit are substantial. This is particularly true of active transportation travel: walking, biking, skateboarding, and rollerblading. Obesogenic environments which create cardependency are correlated with unhealthy populations while

environments which provide the opportunity to travel sustainably and healthily are correlated with healthier populations. For this reason, it is widely understood that by providing citizens with access to sustainable transportation methods, municipalities can expect healthier and more active populations.

These linkages between the built environment and health are part of a growing field of research that bridges the fields of applied science (such as urban planning and engineering) and population health. As municipalities seek to lower their environmental burden and as national governments are faced with increasing healthcare expenditures, the value of smart infrastructure investmentstargeted towards critical active and sustainable transportation projects in particular—is more important than ever.

Planners and policymakers continuously make decisions around investments in the built environment. Due to the implications the built environment can have on population and public health, it is therefore important to evaluate the policy implications of the relationships between transportation and land-use planning decisions, and physical and mental health.

¹ Canadian Institute for Health Information, 2017. "National Health Expenditure Trends." Web. Accessed 06 Feb 2018. 2 The Fraser Institute, 2017. "Myths of Infrastructure Spending in Canada," p. 9. Web. Accessed 06 Feb 2018.

Typically, evidence used to inform major built environment investment decisions has not accounted for the potential monetary implications of these actions on national healthcare costs, focusing instead on initial up-front construction costs, as well as ongoing operating costs. Investments which modify the built environment can result in cost savings elsewhere that are typically unaccounted for in the financial planning of capital projects. Building a case for potential modifications to the built environment that will promote quality of life and reduce the economic burden of healthcare

problems can help policymakers make sound decisions based on evidence, in support of healthier communities.

Metro Vancouver leads the world in many aspects related to sustainability, particularly in its commitments to sustainable transportation. In the City of Vancouver, nearly half of trips are made by sustainable modes: walking, cycling, or transit.³ In fact, more people bike to work in the City of Vancouver than in

3 City of Vancouver, 2015. "Transportation Panel Survey," p. IV. Web. Accessed 06 Feb 2018. any other major North American City.⁴ While commuting to work by personal automobile continues to be the dominant transportation preference for Metro Vancouverites as a whole, sustainable transportation methods are popular overall, and are growing in overall desirability.

Trips on transit have also been growing steadily in recent years. According to Metro Vancouver's regional transit provider, TransLink, ridership grew between 3% and 10% between 2015 and

4 City of Vancouver, 2015. "Transportation Panel Survey," p. IV.



Causal Pathway Linking Environments, Health, and Cost

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2016 depending on region, with a system-wide average increase in ridership of 5%.⁵ As Metro Vancouver municipalities make investments in active and sustainable transportation infrastructure, their populations and the environment benefit from healthier lifestyles.

5 TransLink, 2016. "Transit Service Performance Review, Appendix A." Web. Accessed 03 March 2018.

Literature Review

In order to understand and underscore the health impacts that built environments can have, a literature review was conducted, analysing built environment impacts on the following health outcomes:

- Chronic Disease (Coronary Heart Disease and Diabetes, being two of the leading, fastest growing, and most expensive chronic diseases in Canada)
- Mental Health

Built Environment and Chronic Disease

Between 2000 and 2010, the number of Canadian living with diabetes rose from 1.3 to 2.5 million, and cost the healthcare system \$14 billion in 2015.¹ Rates of type 2 diabetes, which can arise without being inherited as a person's obesity increases, such as due to inactivity, are growing quickly and show no signs of slowing.² Due to the lifestyle implications of type 2 diabetes, it is one disease with important ties to the built environment, if the built environment is impacting an individual's propensity to exercise.

In a survey of over 4,500 African Americans in Mississippi investigating the associations between social cohesion and the prevalence and incidence of type 2 diabetes, a 2017 study found that those living in neighbourhoods where better social cohesion was reported had a 22% lower incidence of type 2 diabetes (Gebreab et al, 2017). Meanwhile, the same study found that living in a neighbourhood with a high concentration of 'unfavourable' food stores was associated with a 34% higher incidence of type 2 diabetes, after adjusting for individual contextual risk factors (ibid.).

In a 7,800-person U.S. study of the association between the perception of neighbourhood problems and diabetes behaviours amongst those already diagnosed with the disease, results showed that residents in neighbourhoods where the most problems were perceived (e.g. crime, access to public transportation and supermarkets, and neighbourhood litter levels) smoked at higher rates and participated in physical activity less than those living in neighbourhoods with fewer problems (Gary et al, 2008).

In a 160,000 person study in Northern California estimating the associations between the loss or gain of a neighbourhood supermarket and the health impacts of those with type 2 diabetes, it was found that when a neighbourhood lost a supermarket, those with poor glycemic control (the ability to manage blood sugar levels which is critical to the health of those with type 2 diabetes) began having worse health outcomes (Zhang et al, 2017). This same study found moderately positive effects on health outcomes amongst those with poor glycemic control when a neighbourhood gained a supermarket (ibid.). These results speak to the importance of land use mix in a neighbourhood,

¹ Canadian Diabetes Association, 2015. "2015 Federal Pre-Budget Submission," p.3. Web. Accessed 22 Mar 2018.

² Mayo Clinic, 2018. "Type 2 Diabetes: Symptoms and Causes." Web. Accessed 21 Mar 2018.

where access to shops and services are within a reasonable distance particularly for those with existing health conditions.

Closer to home, a study of over 380,000 participants in Vancouver, BC examining the impact of transportation noise and pollution exposure in residential areas on the incidence of diabetes found that transportation noise was associated with an increased incidence of diabetes (Clark et al, 2017). Importantly, neighbourhood 'greenness,' or amount of green space available to residents, was a protective factor on the incidence of diabetes (ibid.).

Taken together, these results suggest that elements of the built environment, such as land use mix, access to transit, and green space, as well as social factors such as level of social cohesion, are associated with rates of type 2 diabetes. Many of these elements of the built environment are captured in the Walkability Index measure discussed later in this report, which suggests that higher walkability neighbourhoods may help mitigate rates of type 2 diabetes, a substantial contributor to overall healthcare expenditures in Canada.

Coronary Heart Disease (CHD) is a cardiovascular disease that costs public healthcare systems billions each year and can be highly dependent on lifestyle factors such as levels of physical activity.³ In the United Kingdom in 1999, CHD cost the public healthcare system £7.06 billion (\$12.9 billion CAD in 2018 dollars) and represented the largest proportion of diseaserelated healthcare expenditures in the country (Liu et al, 2002). Built environments that promote sedentary lifestyles may be a contributing factor in CHD rates, with immense implications for healthcare expenditures.

In a study of over 200,000 participants across 448 U.S. counties and 83 metropolitan areas which set out to determine the relationship between urban sprawl, health, and health-related behaviours, the level of sprawl of a person's neighbourhood had a small but significant impact on the number of minutes that person walked per day, with implications for their level of obesity, BMI, and hypertension (Ewing et al, 2003). These health factors can contribute to CHD in the long term, indicating that suburban style neighbourhoods may play a role in the path from sedentary behaviour to later-life CHD.

A study of 2,700 low-income women across the U.S. investigating whether features of the built environment such as land use are associated with obesity or CHD, CHD risk was 20% lower for those living in environments with a wide variety of land uses (e.g. residential, commercial, and institutional intermixed) than amongst those living in single-use environments, such as uniformly residential suburban neighbourhoods (Mobley et al, 2006). Being able to access fitness facilities led to a lower CHD risk by over 15%, as well as lower BMI (ibid.). These results suggest that in environments where residents

are able to access a wide variety of shops and services without the need to travel long distances likely by car—health results can improve substantially, though individual physical fitness plays an important factor.

In a later study of over 45,000 women across the U.S. examining the relationship between urban sprawl and CHD, it was found that women who lived in more compact (i.e. less sprawling) neighbourhoods at the beginning of the multi-year study period had a lower probability of experiencing a CHD event, or dying from CHD, over the course of the study (Griffin et al, 2013). Neighbourhood sprawl in this study was measured by factors that can be commonly arouped under the term 'walkability,' including residential density, land use mix, and street connectivity (ibid.).

In a Lithuanian study of 5,100 adults reviewing the incidence of cardiovascular disease (encompassing CHD) against participants' distance to and use of green space, it was found that living further away from green spaces was related to a higher risk of suffering cardiovascular disease after adjusting for other risk factors, amongst both men and women (Tamosiunas et al, 2014). The authors conclude that policies which promote a healthy lifestyle may help reduce incidences of cardiovascular disease (ibid.). This indicates that an individual's propensity to exercise, which can help reduce the risk of developing CHD, may depend on their access to green space—an important element of an urban or suburban

³ Mayo Clinic, 2018. "Coronary Heart Diseases: Overview." Web. Accessed 22 Mar 2018.

neighbourhood's overall built environment.

Taken together, studies on the incidence of CHD related to the built environment suggest that living in sprawling, suburban areas which may decrease a person's likelihood to exercise and increase the chances they live a sedentary lifestyle can have a direct correlation with their chances of developing CHD. Neighbourhood walkability, therefore, can be an important determining factor in analysing the risk of CHD, given that more walkable neighbourhoods may support a more active lifestyle.

Built Environment and Mental Health

Physical and mental health can be closely intertwined but can be impacted in substantially different ways by the built environment. As our understanding of mental health and appreciation for studying mental health grow, it is important to include impacts of mental health in this report. Mental health issues can have very real, very costly, and potentially physical implications.

In a 2005 study assessing the relationship between built environment characteristics of a neighbourhood and rates of depression over a 6-month and lifetime period, it was found that in neighbourhoods with 'good quality' built environments (with good interior and exterior building maintenance and street and sidewalk cleanliness) residents were between 29-

58% less likely to report having been depressed over the past 6 months, and 36-64% less likely to report lifetime depression than those living in 'poor quality' built environments (Galea et al, 2005). These results raise importation questions about the level of investment in neighbourhood maintenance and upkeep: where the built environment is in good condition, mental health is shown to be better than in areas suffering from disinvestment. From municipality to municipality, and between neighbourhoods within municipalities, the level of investment in the public realm can vary substantially, with very real implications for mental health.

A recent study examining the association between neighbourhood walkability and quality of life in older adults in Hong Kong found that lower barriers to undertaking physical activity in urban environments were a significant determinant of mental health (Zhaoa et al, 2017). In addition, more varied land use, fewer hills, less neighbourhood crime, and better overall aesthetics in a neighbourhood were associated with better physical health, with implications for mental health (ibid.). In high density urban environments such as Hong Kong, there can be an increased prevalence of certain mental health problems, particularly schizophrenia in later years; however, access to green space in a neighbourhood may help reduce the likelihood of stress and mental health problems, whether as a result of encouraging more people to undertake more physical activity, or merely through the calming presence of green space

whose effects many authors have documented (Lederbogen et al, 2013).

In a study on the restorative effects of walking comparing differences between walking in urban versus rural settings in Scottish adults with good and poor mental health, it was found that going for a walk in a rural environment was positive for mental health amongst both groups of adults, with the best results seen amongst those with the worst baseline mental health (Roe et al. 2011). These results connect well to a more recent study exploring the between mental health and the built environment in Beijing, China, which found that among five measured characteristics of the built environment (floor area ratio, building coverage ratio, land use mix, neighbourhood size, and proximity to an urban park), it was only proximity to an urban park which had a significantly positive impact on the subjective wellbeing of those studied (Dong et al, 2017). Together, these studies suggest that the restorative effects of green space on mental health are very important in discussions of overall health, particularly in discussions of urban environments which may lack sufficient access to green space relative to more suburban or rural environments.

Social cohesion plays an important role in mental wellbeing, with walkable environments often providing superior places for people to interact in a positive manner. In a study measuring participants' sense of community, it was found that walkable environments which give residents the opportunity to meet and

engage can increase their sense of community and may improve mental health (Wood et al, 2010). Meanwhile, neighbourhoods characterized by auto-centric design features such as large parking lots and with heavy traffic discouraging walkability affect perceptions of neighbourhood safety and friendliness, which could contribute to poorer mental health (ibid.). Another study found similarly important results: in a study evaluating the association between neighbourhood walkability and depression in adults aged 65+, it was found that

Walkability

more walkable neighbourhoods which provided people with the opportunity to interact on the street were associated with fewer depressive symptoms in senior men (Berke et al, 2007).

Taken together, these studies suggest that in addition to the quality of the built environment through neighbourhood upkeep, certain characteristics of the built environment such as land use mix, intersection density, and access to green space can have substantial impacts on mental health. Interestingly, negative mental health outcomes may be mitigated by access to green space. In heavily urbanized built environments, access to green space is often reduced, even in the relatively verdant municipalities that make up the Lower Mainland. Even though neighbourhood walkability may increase in more urban environments, with positive impacts on physical health, studies show that mental health may suffer if efforts are not taken to encourage physical activity and access to green space in these urban areas.

The literature review supports the view that one particular feature of built environments neighbourhood walkability, or the measure of how friendly a neighbourhood is to walking—is one key to good physical health, and has significant mental health implications.

To understand a neighbourhood's built environment, one can therefore look to its measure of walkability. A neighbourhood's walkability can be correlated with its population's propensity to walk, cycle, use transit, or drive, as well as with overall health. As governments at all levels seek to understand the linkages between population health and the built environment, walkability statistics are one means of quickly and objectively comparing built environments based on a range of features. Future studies can seek to draw linkages between

walkability and distinct health impacts, which can be further analyzed to understand healthcare costs.

The 2011 Walkability Surface developed by UBC's Health & Community Design Lab for Metro Vancouver and the west Fraser Valley (Mission and Abbotsford) was created at the postal code level using one kilometre road network buffers and property land use data.¹ Each postal code's walkability index captures four measures of utilitarian walkability:

Minimum Metro Vancouver Neighbourhood Walkability Index residential density (the number of people living in a specified area), commercial floor-to-area ratio (the ratio of a building's floor area to the size of the property it occupies), land use mix, and intersection density. A higher walkability index indicates a more walkable neighbourhood, meaning a greater ability to accomplish dayto-day tasks on foot within walking distance of one's residence. The finalized walkability database allows for comparison between postal codes based on their level of walkability. 2011 Walkability Surface data are measured at the postal code level and aggregated to Metro Vancouver's Local Area Boundaries, which are commonly referred to as 'neighbourhoods.'

> Maximum Metro Vancouver Neighbourhood Walkability Index



6

12.065

¹ UBC Health & Community Design Lab, 2016. "2011 Walkability Surface Quick Overview," p. 1.

There is a high degree of variability in the walkability indices for Metro Vancouver neighbourhoods. Though the region is home to some of Canada's most walkable neighbourhoods, in particular, in the City of Vancouver, it also holds many



Suburban Environment



Above: the suburban environment in Coquitlam, BC, Metro Vancouver's 5th largest municipality.

low walkability neighbourhoods, meaning that health outcomes between neighbourhoods can be vastly different. The level of neighbourhood walkability aligns closely with regional land use and transit coverage maps, showing that in areas of higher residential

Comparing Neighbourhood Walkability

In both scenarios, the 'crow fly' distance is the same. However, the actual travel distance in the Suburban Environment (left) is far greater than in the Urban Environment (right) due to the nature of the road network layout. The further the distance between destinations, the greater the propensity to drive: generally, if destinations are further away than 5 minutes walk time (approximately 420 metres), people will opt to drive rather than walk.¹



Satellite imagery of two mid-sized Metro Vancouver municipalities shows the difference in neighbourhood walkability in practice. On the left, a suburban Coquitlam neighbourhood has many looping and gently curving roads that make walking for utilitarian purposes (such as to go to the store or a bus stop) more time-consuming and therefore less likely. On the right, an urban neighbourhood in North Vancouver where streets are laid out in a grid-like pattern makes walking more direct and therefore more feasible for everyday purposes. density, mixed use development, and with strong transit connectivity, walkability indices tend to be higher. In areas characterized by uniformly low-density residential zoning and with poor transit connectivity, walkability indices tend to be lower.



Urban Environment



Above: the urban environment in the City of North Vancouver, BC, Metro Vancouver's 12th largest municipality.

¹ Jarrett Walker, 2011. "Basics: Walking Distance to Transit." Web. Accessed 22 Mar 2018.

Metro Vancouver Neighbourhood Health: the My Health My Community Survey

populations. Others, typically

those more suburban in nature.

score less well. When overlaid on

the 2011 Walkability Surface data

described in the previous section,

the tendency for more walkable

healthier populations becomes

environments to be home to

clear.

My Health My Community is the result of a 2013 partnership between Vancouver Coastal Health, Fraser Health, and The University of British Columbia. Data were collected from over 33,000 survey respondents aged 18 and older living in the Metro Vancouver area and the Fraser Valley. The survey asked people "to provide information about their health, lifestyle choices, community involvement and neighbourhood characteristics," with results informing future health programming and services.¹ The survey data were compiled into the My Health My Community Atlas, allowing users to view population health data at the community level. The My Heath My Community Atlas also incorporates built environment features for ease of comparison.

Overall, survey results paint a varied picture of Metro Vancouver, much the same way as the 2011 Walkability Surface shows a high degree of neighbourhood walkability in the region. Many neighbourhoods, particularly those with walkable streets, a variety of land uses, and good access to transit, are home to some of Canada's healthiest



Above: sample results from the My Health My Community survey depicted via the My Health My Community Atlas.

SOURCE: My Health My Community, 2016

Technical information on the My Health My Community survey data collection methods is available from the My Health My Community online portal at www.myhealthmycommunity org/.

¹ My Health My Community, 2013. "Technical Notes: My Health My Community Atlas." Web. Accessed 03 March 2018.

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Project Background and Methodology

Purpose and General Methodology

The economic case for modifications to the built environment may be substantial. For example, diabetes, a disease which often results from sedentary behaviour in cases where it is not inherited, is estimated to cost the Canadian healthcare system between \$12.9 and \$13.8 billion by 2020.¹ Changes to the built environment which could reduce this cost burden would alleviate substantial health-associated costs on the single-payer healthcare system in Canada. Over time, these cost savings, if reinvested in further interventions in the built environment (or in other services such as mental health programs) could further alleviate healthcare expenditures, and lead to significant cost recoveries for the infrastructure components themselves.

Next, knowing that the City of Vancouver consistently leads the country in many aspects of its built environment features, such as with good transit connectivity, active transportation networks, and parks and green space, it is important to understand how other neighbourhoods and regions within Metro Vancouver might work to achieve similarly positive built environment features, in support of healthy populations. At the same time, not all Vancouver neighbourhoods are equal, with neighbourhood income levels and individual lifestyle factors playing a large role in individual health, irrespective of neighbourhood walkability measures.

Understanding this context, this report investigates the state of the built environment in Metro Vancouver regions which present different built environment characteristics to the City of Vancouver, in order to investigate how residential travel characteristics and health outcomes relate to the walkability indices in areas studied.

Given the strong correlation between the built environment and health outcomes, the report then offers insights into potential modifications to the built environment through policy and planning initiatives that will promote quality of life and reduce the economic burden of disease in the Vancouver region.

My Health My Community (MHMC) data are reviewed alongside Walkability Surface data and a built environment assessment, forming 6 neighbourhood and regional profiles: 3 neighbourhoods in the City of Vancouver and 3 areas in the Metro Vancouver region. Next, these 6 profiles are compared, in order to assess the potential impacts the built environment may be having on population health in each profiled area, and to understand how differences are manifest across the region. The purpose of conducting an assessment of each area's built environment is to give practical and approachable support to the walkability and health measures, and to contribute to the development of policy directions with the help of illustrative, realworld examples.

Following the full investigation of each region/neighbourhood and the overlaying of health data to build a complete area profile, the final step of the project involves suggesting modifications to the built environment which, over

¹ Canadian Diabetes Association, 2009. "An Economic Tsunami: the Cost of Diabetes in Canada," p. 17. Web. Accessed 03 March 2018.

time, may help contribute to better health outcomes for local populations, thereby easing the burden these people may place on the healthcare system.

Neighbourhoods in the City of Vancouver were selected using on a data-driven process based on 2011 Walkability Surface data, which is provided at the postal code level, then aggregated to the neighbourhood level. Regional areas which are compared to City of Vancouver neighbourhoods were selected based on the built environment features they present, their present and future transit investments, and their regional location.

Notes on the nature of neighbourhood and region comparison:

It is important to note that due to the self-reported nature of My Health My Community survey results and no specific associations being made between individuals in neighbourhoods and their specific health outcomes, causal claims cannot be inferred. However, based on decades of sound research and clear correlations between neighbourhood walkability and health outcomes, policymakers can begin to understand the impacts that the built environment may be having on neighbourhood residents.

Further, the purpose of comparing built environments across the region is not to suggest that one area or neighbourhood is subjectively 'better' or 'worse' than another. The comparative analysis focuses on features of the built environment in order to provide an objective and data-driven contribution to health outcome research. The comparative analysis allows planners and policymakers to understand the implications of built environments, and in the future through additional economic analysis, the correlative impacts of these built environments on healthcare expenditures.

Finally, different individuals can have different experiences in different neighbourhoods, irrespective of that neighbourhood's walkability index. Individual and contextual risk factors such as occupation, smoking status, family history, attitudinal predisposition to unhealthy behaviours, and residential preference all influence health outcomes in any built environment. However, there are clear linkages between built environments and health outcomes that manifest themselves at a societal level with implications for national healthcare expenditures, making the clear understanding of what constitutes a high walkability versus low walkability environment critically important to the development of sound policy.

Built Environment Selection: Methodology

There are 20 neighbourhoods in the City of Vancouver captured by the My Health My Community Survey. Walkability data are provided at these same neighbourhood boundaries for the purposes of comparing data at the same scale. Neighbourhoods were ranked based on their walkability, and a high, middle, and low walkability neighbourhood in the city were selected in order to complete the analysis.

The following 3 neighbourhoods were selected:

- 1. Dunbar-Southlands selected as the lowest walkability neighbourhood in the city
- 2. Hastings-Sunrise selected as the nearest approximate median walkability neighbourhood in the city
- 3. Downtown selected as the highest walkability neighbourhood in the city

3 regional areas were selected based on the built environment features they present, their present and future transit investments, and their regional location. These 3 regional areas are:

- Langley selected due to its location at the eastern edge of the Metro Vancouver region, its suburban built environment, and for the proposed Surrey-Langley LRT line that may link Langley to the rest of the region in the future
- 2. North Shore selected due to its location at the northern edge of the Metro Vancouver

region, its challenging hillside topography that may complicate infrastructure projects, and the wide variety in built environment features between its municipalities (e.g. City of North Vancouver versus the District of West Vancouver)

3. New Westminster - selected due to its location near the centre of the Metro Vancouver region, its small size relative to other municipalities, and its strong transit connections to other Metro Vancouver municipalities

From lowest to highest aggregated walkability, regions and neighbourhoods are listed as follows:

- A Langley (Township, Fort) Min Walkability: -5.439 Max Walkability: -0.001 Average Walkability: -2.350 Median Walkability: -1.397 Number of neighbourhoods: 9
- North Shore (Bowen Island, North Vancouver City & District, West Vancouver & Lions Bay) Min Walkability: -3.938 Max Walkability: 1.083 Average Walkability: -0.531 Median Walkability: -0.626 Number of neighbourhoods: 8
- C New Westminster

Min Walkability: -0.993 Max Walkability: 6.405 Average Walkability: 2.079 Median Walkability: 1.411 Number of neighbourhoods: 6

- Vancouver (Dunbar-Southlands neighbourhood) Walkability Index: 0.002
- Vancouver (Hastings-Sunrise neighbourhood) Walkability Index: 1.256
- Vancouver (Downtown neighbourhood) Walkability Index: 12.065

Vancouver Average Walkability: 2.863 Vancouver Median Walkability: 1.276



Results: Neighbourhood Profiles



Walkability Index & Built Environment Characteristics

Langley has moderate variability in its neighbourhood walkability, but generally falls at the low end of the walkability spectrum for Metro Vancouver. As the municipality the furthest east in Metro Vancouver before the predominantly rural Fraser Valley, Langley does not yet offer the same level of transit connectivity as other municipalities do. Due to much of Langley's land base being Agricultural Land Reserve (ALR), restricted from non-farm uses, providing high frequency transit coverage is not economically feasible nor necessarily the best use of

-2.350

services. In non-ALR areas, Langley is highly suburban in nature, with large lots and a lack of pedestrian infrastructure contributing to a highly auto-centric urban form. There is very little, if any, nonresidential zoning in Langley outside of key urbanized pockets in town centres, making driving to shops and services a virtual necessity. Yet, Langley is home to many natural sites and green which provide recreational opportunities and may support positive mental health among its residents.



Langley's suburban character

Fort Langley Langley Centre Aldergrove

connections

Transit coverage in Langley is minimal, with most service offered between Langley Centre and western municipalities. Outside of small residential pockets, most land is ALR and not served by transit.



Langley Built Environment









MHMC Built Environment & Health Results

Langley falls below the Metro Vancouver average across the board in MHMC Built Environment survey responses, with fewer residents agreeing that there is a transit stop within 5 minutes of home, amenities within walking/ cycling distance, and well maintained sidewalks in their neighbourhood. As a result, travel behaviours lean heavily towards use of private vehicles. Less than 10% of Langley residents commute by public transit, approximately one third as many as the Metro Vancouver average. Meanwhile, more than 80% of Langley residents commute by car, an

increase of more than 25% over the Metro Vancouver average. The built environment has direct implications on these results: due to its suburban nature where distances to amenities are far and transit coverage is low, driving is a requirement of life in Langley.

Langley fares reasonably well in terms of its residents' health status relative to the Metro Vancouver average despite its low walkability, though its obesity rates are 7% higher than the Metro Vancouver average, and some of the highest in the region. Obesity rates are substantially higher than in any of the City of Vancouver neighbourhoods profiled in this report. Rates of arthritis and heart disease are also higher than average. Residents fare better in terms of mental health, with lower reports of having a doctordiagnosed mood or anxiety disorder, and better self reported mental health overall. Thanks to its rural nature and its significant number of green spaces, Langley residents may be benefiting from the positive effects that these natural characteristics can have on mental health and stress levels



Walkability Index & Built Environment Characteristics

The North Shore has high variability in its neighbourhood walkability, given the vastly different built environments across its municipalities and regional centres. The Districts of North and West Vancouver have small town centres that generally have a good land use mix and provide residents in the immediate areas with walkable access to shops and services. Transit coverage in these areas is generally good, especially regionally. Elsewhere in these districts, the development form is heavily suburban, with the topography of the North Shore mountains requiring roads to be

Average Walkability

-0.531

built in a switchback pattern that significantly increases walking and driving distances. In these areas, land use is overwhelmingly devoted to single-family residences. The hilly nature of much of the North Shore also poses mobility challenges for certain cohorts, such as the elderly. This, combined with poor sidewalk coverage in many areas, further increases residents' propensity to drive as opposed to walk. At the same time, the North Shore provides excellent access to nature, and its south-facing views are some of the best in the region.



Mixed housing forms in North Vancouver



The North Shore provides good transit coverage in more dense areas such as Lonsdale and Ambleside, with links to other regional centres. Coverage in suburban areas is light.



North Shore Built Environment

North Shore Travel Behaviour



North Shore Health Status



MHMC Built Environment & Health Results

The North Shore fares roughly average in MHMC Built Environment survey responses. There is likely a variability in the responses given the large differences between the built environments in many of the North Shore neighbourhoods. Slightly more residents than the Metro Vancouver average agreed that there is a transit stop within 5 minutes of their home, the same agreed that there are amenities within walking/cycling distance, and slightly less than average agreed that they have well-maintained sidewalks in their neighbourhood. Though

commute times in the North Shore are slightly lower than average, a higher proportion of residents commute by car than average, though at just over 60%, a much smaller percentage than in Langley. In low walkability areas of the North Shore, the number of car commuters is likely higher given the winding hillside roads, while in centres such as Lonsdale in North Vancouver, with the SeaBus providing fast and convenient service to downtown Vancouver, and bus connections to elsewhere in the region, the number of public transit commuters is likely substantially higher. The North

Shore has a number of town centres and areas with a good mix of land uses and higher residential density, allowing for a choice of housing options which can provide walkable access to many shops and services, as well as transit connections to elsewhere in the region.

The North Shore has health outcomes that are generally on par with the Metro Vancouver average, though rates of arthritis are slightly higher. However, more residents than average report being in excellent or very good mental and general health.



Walkability Index & Built Environment Characteristics

New Westminster's built environment is, on the whole, very walkable. A good land use mix which puts residents in close proximity to shops and services is a large contributing factor, in addition to many mid- and highrise residential developments. This higher neighbourhood density makes good transit coverage and service levels possible by providing a critical mass of riders, though SkyTrain service on fixed routes provides timely service only to certain areas; travellers to other areas must rely on bus networks or their own transportation. New Westminster also makes efforts

Average Walkability

2.079

to provide a good pedestrian experience, particularly for its substantial senior population, for whom mobility may be more of a challenge. Curb bump-outs at intersections that slow traffic and shorten street crossings contribute greatly to a safer, more inviting streetscape and help encourage walking. Though some New Westminster neighbourhoods retain their suburban character, much of the small municipality is marked by increasingly dense residential redevelopment which over time will contribute to its everincreasing walkability.



Mid/high density, mixed use development



New Westminster provides excellent transit coverage thanks to the SkyTrain network, made possible in part due to its geographic location and higher density developments relative to other municipalities. Accessing the City of Vancouver is fast and convenient from most areas in the city.



New Westminster Built Environment







MHMC Built Environment & Health Results

New Westminster does better than average in MHMC Built Environment survey responses, particularly in its ability to provide amenities to residents within walking/cycling distance. This is aided by a good land use mix that puts residents next to shops and services, thereby reducing the need to drive. Though transit coverage is strong in New Westminster, the ability for residents to walk or cycle—as opposed to take transit or drive-to shops and services is crucially important in providing utilitarian walking/ cycling opportunities, which is key

to maintaining an active lifestyle. Travel behaviours correlate with residential perceptions of the built environment: more New Westminster residents commute by public transit relative to the Metro Vancouver average (nearly 35%), as well as by walking/cycling, though the proportion of residents with commutes longer than 30 minutes is slightly higher than average.

The health status of New Westminster residents raises some questions. Overall, health outcomes are slightly worse than the Metro Vancouver average. Though residents fare better in some respects, such as obesity and heart disease rates relative to more suburban built environments such as Langley, rates of doctordiagnosed mood or anxiety disorders are higher than average. Results in this respect speak to findings that residents in more walkable urban environments tend to have worse mental health. Despite this slight spike in doctordiagnosed mood or anxiety disorders, residents rate their mental health as excellent or very good at a slightly higher rate than the Metro Vancouver average.



Walkability Index & Built Environment Characteristics

Though as a whole, the City of Vancouver has the highest overall walkability in the Metro Vancouver region, not all its neighbourhoods are created equally: Dunbar-Southlands is one such neighbourhood, representing the lowest walkability neighbourhood in the city. In comparison to the region, however, Dunbar-Southlands fares better than many in terms of walkability and built environment characteristics. Much of the reason behind its low walkability is its primarily suburban residential land use characteristics, which makes driving far more convenient for residents, though

Walkability Index



transit coverage by bus is provided along key arterial streets. Few shops and services exist within walking distance of most homes, meaning many residents may be forced to drive to access basic necessities. Dunbar-Southlands abuts Pacific Spirit Regional Park, one of the largest parks in the Lower Mainland, providing residents with fantastic recreational opportunities and contributing to a pleasant neighbourhood atmosphere despite the generally low walkability, as well as having potential mental health implications.



Residential characteristics of the area



Dunbar-Southlands provides local bus connections to surrounding neighbourhoods in the City of Vancouver, but is not connected via SkyTrain. Connections at the north and south ends of the area to UBC via bus and bicycle networks are strong.

Vancouver - Dunbar-Southlands Built Environment



Vancouver - Dunbar-Southlands Travel Behaviour



Vancouver - Dunbar-Southlands Health Status



MHMC Built Environment & Health Results

Dunbar-Southlands residents have above average perceptions of their built environment relative to the Metro Vancouver average in MHMC survey results, but are less likely that the City of Vancouver average to agree that there is a transit stop within 5 minutes of home or amenities within walking/ cycling distance. This speaks to the suburban characteristics of the neighbourhood and low prevalence of any land use other than single-family residential. As a result, travel behaviours are much different than the Vancouver average, but on par with the region: Nearly 55% of

Dunbar-Southlands residents commute by car, compared to just 33% of City of Vancouver residents, on average. This highlights the disparity between this neighbourhood and others within the same municipality, with the built environment significantly impacting travel behaviours. Some minor cycling infrastructure exists on Dunbar Street through the heart of the neighbourhood, providing a north-south linkage from 41st to 16th Avenue, but not connecting well to other municipal cycling networks.

The health status of Dunbar-Southlands residents paints the neighbourhood in a positive light in this respect. Residents are only marginally more likely than average to have been doctor-diagnosed with a mood or anxiety disorder, and in all other health respects, far better than both the City of Vancouver and Metro Vancouver average. This speaks to the importance of a full understanding of neighbourhood walkability, and that walkability alone is not a sufficient measure of resident's health outcomes Individual and contextual factors can also have significant impacts.



Walkability Index & Built Environment Characteristics

Hastings-Sunrise occupies the northeastern boundary of the City of Vancouver. It is more walkable than most neighbourhoods across the region. Though much of the neighbourhood is characterized by single-family residential land use, lot sizes tend to be small, and a significant amount of mixed-use development exists along East Hastings Street, a popular shopping area for locals, as well as some pockets along East 1st Avenue. The grid-like street pattern also contributes to more efficient walkability. The large Pacific National Exhibition grounds occupies a large portion

Walkability Index

1.256

of the neighbourhood and is a well-frequented attraction in summer months. Express transit service along East Hastings Street provides direct linkages to downtown Vancouver and Simon Fraser University. Local bus service serves other major corridors, and SkyTrain is available immediately south of the neighbourhood, with access to downtown Vancouver and other municipalities to the south and east. Quiet residential streets generally make for safe and efficient cycling in the neighbourhood, but separated cycling lanes do not exist.



Mixed use development on Hastings Street



Hastings-Sunrise has good bus connectivity within the neighbourhood and to other neighbourhoods and regions, with express buses available to downtown and SFU. South of the neighbourhood, SkyTrain is available.

Vancouver - Hastings-Sunrise Built Environment



Vancouver - Hastings-Sunrise Travel Behaviour



Vancouver - Hastings-Sunrise Health Status



MHMC Built Environment & Health Results

Hastings-Sunrise falls near the median value in terms of neighbourhood walkability in the City of Vancouver. In its MHMC Built Environment survey results, the neighbourhood generally fares well relative to Metro Vancouver averages, but does worse than average compared to the City of Vancouver. More residents than in Metro Vancouver agree that they are within 5 minutes of a transit stop and that there are amenities within walking/ cycling distance, but less than average agree that sidewalks in their neighbourhood are wellmaintained. Travel behaviours are

more environmentally sustainable than in less walkable Vancouver neighbourhoods, and better than regional averages. For example, less than 50% of Hastings-Sunrise residents commute by car, which is good in comparison to regional averages, but falls more than 10% short of City of Vancouver averages.

The health status of Hastings-Sunrise residents relative to City of Vancouver and Metro Vancouver averages is variable. The number of residents who report a doctordiagnosed mood or anxiety disorder is on par with City of Vancouver averages—slightly above that of the region as a whole —and rates of arthritis, high blood pressure, and diabetes are similar to the region. Obesity rates paint a positive picture, with Hastings-Sunrise having lower rates of obesity than both the City of Vancouver and Metro Vancouver. Residents fare worse in mental and general health categories, with fewer reporting excellent or very good mental and general health than both the city and region, though not in overwhelmingly substantial numbers



Walkability Index

Walkability Index & Built Environment Characteristics

The City of Vancouver's high average walkability is in many ways due to the success of the Downtown neighbourhood in providing the highest walkability in the region. Downtown Vancouver also offers some of the highest walkability relative to many other cities around the globe. Downtown benefits from being the business centre of the region: multiple SkyTrain lines intersect in the downtown core, providing access to a number of municipalities and important assets, such as Vancouver International Airport (YVR). Bus coverage to the North Shore, other Vancouver

neighbourhoods, and eastern regions is also strong. In addition to transit coverage, land use mix and density are high in Downtown and adjacent neighbourhoods, with residential and office towers intermixed with shops and services providing access to all necessities within a short walk or cycle. Cycling networks in Downtown are the strongest in the city, with a number of separated bicycle lanes providing access within the neighbourhood and to other areas of the city. Due to its small geographic scale and high population density, investments in Downtown have significant impact.



A high walkability urban centre



Downtown Vancouver is the highest walkability neighbourhood in the Metro Vancouver region, with the highest density and widest mix of transit options. Access to other neighbourhoods and the region is excellent from the downtown core.

12.065

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Vancouver - Downtown Built Environment Vancouver - Downtown Travel Behaviour



Vancouver - Downtown Health Status



MHMC Built Environment & Health Results

Results of the MHMC survey highlight the value to travel behaviour and some aspects of health of high walkability built environments. Built environment survey responses indicate that nearly 100% of Downtown residents are within 5 minutes of a transit stop—the best in the region, and a similar percentage agree that there are amenities within walking/cycling distance. In many ways, this can be attributed to Downtown's status as the business centre of the region, with a high number of daytime visitors necessitating good regional and sub-regional connectivity. Nearly

90% of residents agree that their sidewalks are well-maintained. Positive travel behaviours are a direct result of these built environment characteristics. Commute times are shorter than average, and more residents commute by walking/cycling than by car, one of the few neighbourhoods in Vancouver where this is the case. Downtown residents commute by car at less than half the rate of the Metro Vancouver average—under 23%.

The health status of Downtown residents is largely positive, but highlights the important research to be done into the impact to mental health of high walkability urban environments. Rates of arthritis, high blood pressure, diabetes, and obesity are approximately half that compared to Metro Vancouver averages, and lower across the board relative to the Vancouver average. 60% of residents rate their general health as excellent or very good, higher than in the city or region. A roughly equal proportion of residents rate their mental health as excellent or very good relative to regional averages, which is slightly more than the City of Vancouver average.

Results: Discussion

Results of the Walkability Index and Built Environment assessment in relation to My Health My Community survey results paint a picture of a region that has wide variability both in terms of built environments and physical and mental health.

Street Connectivity and Land Use

Generally, areas closer to the City of Vancouver, and more specifically, Downtown Vancouver, have higher walkability than other areas, though small urban areas and municipalities such as New Westminster have highly walkable urban environments and continue to make investments in infrastructure in support of good built environments. Where walkability levels are low, this is typically a result of low land use mix and a suburban development pattern where streets do not conform to a grid pattern, making walking for utilitarian purposes (i.e. to run errands, to access transit, or to commute) less convenient and less likely.

Though street layout does not necessarily lead to lower walkability, land use mix (in this case, the percentage of commercial and retail land use) in Metro Vancouver is far lower along streets that do not conform to a grid pattern. Instead, winding streets are typical of suburban environments with singular land use. In addition, block lengths tend to be shorter in areas with higher land use mix and a grid street layout, aiding walkability by reducing the need to double back on one's travel path and making travel on foot or by bicycle more efficient. Recreational walking for pleasure in these areas may not be affected; however, utilitarian walking may be a significant contributor to overall health, and results show that neighbourhoods that support these small opportunities for residents to exercise are generally home to healthier population with more positive travel characteristics.

Many neighbourhoods in the City of Vancouver have a relatively low land use mix, with buildings resembling some of their more suburban counterparts in municipal regions such as Langley and the North Shore. The key difference between suburban Vancouver and suburban Metro Vancouver is in many cases the layout of blocks. Even where suburban development patterns are highly prevalent in the City of Vancouver, blocks are generally small, contributing to an ease of walkability for utilitarian purposes, though it is land use mix and residential density that likely has the largest effect on walking and cycling rates.

Transit and Cycling Networks

There is a wide disparity in transit and cycling network connectivity across the region, as evidenced by the differences between the most and least walkable environments compared in the previous section of this report. Whereas many neighbourhoods in Vancouver and surrounding municipalities such as Burnaby and New Westminster offer SkyTrain coverage, plus express bus service linking key regional assets such as Vancouver's two main universities (the University of British Columbia and Simon Fraser University), municipalities further from the core do not offer nearly the same levels of transit coverage. This means that in these environments, such as Langlev and the North Shore. transit and active transportation usage tends to be very low relative to higher walkability environments such as New Westminster and the City of Vancouver.

Transit coverage and service levels require a critical population density that cannot be achieved in areas with low land use mix and low residential density, contributing

greatly to the disparity in transit coverage across the region. In Langley and northern reaches of the North Shore, where residential land use occupies the vast majority of the built environment and is low density, an insufficient number of residents in close enough proximity makes providing transit more difficult. For transit networks to expand, zoning for increased residential density is often a requirement. These changes often also result in a new mix of land uses, with increased residential density necessitating new shops and services that previously would not have been economically feasible with a low density of residents.

Geography is also a factor: on the North Shore, the hillside topography of all municipalities means that road networks are winding, with multiple switchbacks. Higher density development in these areas may not be possible due to geotechnical reasons, resulting in the lack of critical density required for transit service. Cycling and walking in these areas can also be challenging as it may require significantly more effort. In addition, shops and services are likely to be further from these areas, making utilitarian walking (e.g. walking to the bus stop to go to work or the store) even less likely.

Cycling network coverage in the City of Vancouver's higher walkability neighbourhoods varies but is generally good, though connectivity between neighbourhoods often suffers. The City of Vancouver, like many other municipalities, suffers from a cycling network that is incomplete and does not necessarily serve users who cannot access these networks due to gaps in coverage. In areas such as Langley and the North Shore, the built environment investigation reveals that many cycling networks are devoted to recreational purposes (e.g. natural pathways and trails) that would not serve utilitarian riders. Distances to business areas are often too great to make cycling for utilitarian purposes feasible, even if cycling infrastructure were to be built.

Physical and Mental Health

Physical and mental health are more varied across the region and are not necessarily directly correlated with higher walkability urban environments. Though measures of physical health such as rates of arthritis, high blood pressure, diabetes, and

obesity—generally decrease in higher walkability neighbourhoods across the region, individual and contextual risk factors such as occupation, smoking status, family history, attitudinal predisposition to unhealthy behaviours, and residential preference all

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influence physical and mental health outcomes to a significant degree. In particular, income levels can have a substantial impact on physical health. Though residents in low walkability neighbourhoods tend to have poorer physical health, when these neighbourhoods are characterized by high income levels, residents tend to fare better in terms of physical health. This underscores the importance of equitable access to healthcare.

Physical activity can be challenging to measure. There is a difference between undertaking physical activity in the form of purposeful exercise (e.g. going for a jog in the outdoors) and undertaking physical activity for utilitarian purposes. Built environments that encourage both these forms of exercise are important. Often, built environments do one or the other guite well, particularly in the Lower Mainland. For example, in Langley and the North Shore, a higher proportion of residents than average report having access to many natural sites, which can make undertaking purposeful exercise more pleasant and more likely, thereby aiding in certain aspects of physical and mental health. At the same time, these built environments may not be conducive to utilitarian exercise, because the built environment requires residents to travel solely by car, as evidenced by the much higher rates of car travel and much lower rates of transit use, cycling, and walking in these areas. Utilitarian exercise is an important component of overall health and in achieving good physical and mental wellbeing, therefore, environments should allow for

utilitarian walking to be feasible, as well as providing natural areas where residents can enjoy purposeful exercise.

Results of the built environment investigation reveal that mental health does not necessarily improve in a linear fashion as neighbourhood walkability increases. Often, it is lower walkability neighbourhoods such as those in Langley and the North Shore, which happen to have better access to green space and natural amenities, where residents report better mental health. The literature review supports these results, indicating that often, heavily urbanized built environments which are highly walkable do not provide sufficient access to green space, which can be important for maintaining good mental health and stress levels.

Modifications to the Built Environment Rationale

Results of the investigative exercise illustrate the disparities between built environments across the Lower Mainland. Many of these differences can be rectified through modifications to the built environment which can begin to improve neighbourhood walkability, thereby providing an environment which may result in improved health outcomes for local populations over time. By and large, most neighbourhoods in Metro Vancouver can be improved with some level of modification to the built environment to increase walkability.

Not all built environments can be modified to achieve the highest levels of walkability-nor should they. As evidenced by comparisons between the six built environments discussed previously, not all health metrics improve as neighbourhood walkability increases. In some cases, higher walkability neighbourhoods may be associated with reduced green space in the form of public parks and access to natural amenities, with implications for mental health and a population's propensity to exercise. Therefore, the healthiest built environments for some

groups may not necessarily be the ones that are the most walkable, merely those that have a good mix of walkable characteristics while providing access to green space and recreational opportunities. Overall, trends do indicate that higher neighbourhood walkability is associated with improved health outcomes, as well as improved travel behaviours (i.e. less likelihood to commute or complete errands by car), thereby aiding in environmental sustainability efforts.

Minor modifications to the built environment made gradually over time can have substantial impacts on population health, are cost effective, and can be more politically palatable in change-resistant communities. Larger modifications to the built environment can have significant impacts on people's travel behaviour and population health, but funding for these projects may be more challenging to secure. Some suggested modifications to the built environment are discussed in the following section, with modifications ranging in scale from least to most intensive and expensive.

Suggested Modifications

Add mid-block connections to increase walkability by shortening travel distances.

In highly residential areas of low land use mix with large, winding blocks, such as Langley and the North Shore, distances between destinations may pose a significant barrier (whether real or perceived) to walking or cycling, leading to residents travelling by vehicle for almost all purposes. Though the 'crow-fly' distance between destinations may seem short, the actual distance on the ground may be many times longer due to street layout. By adding mid-block connections in these areas, walkability can increase by shortening the distance between destinations to a reasonable distance so as to allow for walking. This is a minor modification to the built environment in many cases that may go a long way in increasing residents' propensity to walk for smaller tasks, such as to the corner store or to a neighbour's house.

Make targeted investments to increase the connectivity of existing pedestrian and cycling infrastructure.

Often, it is incomplete networks that cause the greatest pain for cyclists and pedestrians, and pose the highest potential safety risks. Many cycling lanes end at intersections, skip blocks, or are not maintained. Most problematic is the fact that it is often in highest traffic areas where cycling networks





Above: missing sidewalk infrastructure in a Vancouver neighbourhood contributes to a fragmented walking network that can discourage physical activity, particularly for those with mobility challenges.

abruptly end altogether, only to pick up again a short distance away. These sections may be where risky roadsharing behaviour takes place, putting all road users at risk. Where cycling networks are fragmented, upgrades should be made to complete the networks in order to improve safety and to make cycling more feasible, particularly for new riders who may be unfamiliar with typical cycling routes. Efforts should also be put into making intersections safer for cyclists.

For pedestrians, many built environments are made challenging because of missing sidewalks, particularly in areas such as the North Shore, where older development projects may not have been required to include sidewalks, and none have been constructed since. In these areas, new developments may

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include sidewalks along their frontages, however the network is often incomplete. This poses a particular challenge for those with mobility problems such as seniors or anyone using a mobility device such as a wheelchair, as even a small section of missing sidewalk can make an otherwise simple utilitarian journey difficult or impossible. By targeting sidewalk upgrades to areas lacking these missing pieces, municipalities can make walking feasible, enjoyable, and equitable.

Encourage an appropriate land use mix.

Many areas struggle to provide adequate transit service, not due to lack of will, but due to lack of sufficient demand. Though residents may desire to travel by transit, an insufficient number of users and large gaps between residential areas can make providing transit entirely economically infeasible. The main



Complete, Non-Fragmented Cycling Network



problem in these cases revolves around land use: where land is designated for low-density residential uses only, meaning for single-family homes such as in most parts of Langley, the North Shore, and suburban City of Vancouver neighbourhoods, not enough residents exist to allow for adequate transit service. In these instances, land use must allow for higher density residential development in order to encourage sustainable



transportation use, thereby promoting an important element of a healthy and less resourceintensive lifestyle.

An appropriate land use mix is also important by allowing residents the opportunity to access shops and services by sustainable means in a short period of time. Being able to walk or cycle to a store is important for physical health. Though undertaking strenuous exercise each week is considered important for overall health, simply walking or cycling for utilitarian purposes throughout the day can contribute to overall physical and mental wellness. This is not possible without an appropriate land use mix. Where residents are not offered the opportunity to undertake utilitarian physical activity, even for short distances, they may need to resort to driving for all purposes, thereby decreasing their overall physical activity and resulting in a less environmentally sustainable lifestyle. The literature review also indicates that walkable

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neighbourhoods may increase a sense of community, which can have important implications for mental health. An appropriate land use mix, where commercial and retail areas are intermixed thoughtfully amongst residential areas, can make these things possible.

Small to medium-sized mixed-use land use rezonings in primarily residential areas where there is sufficient residential density to support shops and services is one way of making a more active lifestyle possible. Increasing residential density may also be an important first step in bringing shops and services to an area that will allow residents to travel on foot or by cycling. In many new transit-oriented redevelopment projects across the region, one can see how land use changes are supporting denser, more walkable, and more transit-friendly lifestyles.

Invest in new pedestrian and cycling infrastructure.

In environments with very low walkability, making targeted investments to increase the connectivity of existing pedestrian and cycling infrastructure may not be possible, because such infrastructure does not exist to begin with. In these environments, the introduction of pedestrian and cycling infrastructure is an important first step in increasing walkability, getting residents more physically fit, and improving overall health. It can also contribute to a more sustainable lifestyle.



Above: when neighbourhoods lack sidewalks or even roadside pathways entirely, there are both real and perceived barriers to physical activity. In these areas, even simple infrastructure investments that can get people physically active can contribute to broader health goals.

In areas where no pedestrian and cycling infrastructure exists, residents can be discouraged from undertaking even light physical activity. When something as simple as going for a walk requires driving somewhere (e.g. to a regional park or a gym or community centre), physical wellness can be difficult to achieve. Some environments in Langley and the North Shore, as well as similar built environments in the region, are places where even basic exercise can be made challenging due to lack of infrastructure. Though full sidewalks and cycling networks in these areas may not be feasible, well-maintained unpaved roadside pathways can be helpful in allowing for physical activity.

Invest in new transit infrastructure.

One of the most expensive investments that local and regional governments often face is for new transit infrastructure, particular for light- and medium-duty rail such as streetcars and Rail Rapid Transit (RRT). The Metro Vancouver SkyTrain network is an example of RRT. These investments often require considerable provincial and federal funding, but are critical to getting people more physically active and in ensuring more overall environmental sustainability.

Though transit investments may not at first seem like a means to get people more physically active, they may increase rates of utilitarian walking, i.e. walking for non-recreational purposes. Whereas before transit investments, a person might drive directly from their house to their destination, a transit line (whether bus or rail) a short distance from a person's residence can mean that they will walk to this transit stop, which may mean they undertake enough physical activity to make a difference in their health. In addition, this may reduce a person's need to drive for certain types of trip, contributing to lower carbon emissions.

Many regions in the Lower Mainland are taking steps towards large-scale transit investment. The regional public transportation agency for Metro Vancouver, TransLink, is in the midst of planning a number of rapid transportation projects that will transform the Lower Mainland and help contribute to neighbourhood health and environmental sustainability.¹

¹ TransLink, 2013. "Regional Transportation Strategy Strategic Framework," p. 13. Web. Accessed 05 March 2018.

Implications for Policymakers

The issue facing the Lower Mainland is a disparity in the walkability of built environments that may result in varying health outcomes between neighbourhoods. Though there are a variety of factors at play, evidence from communities and neighbourhoods investigated in this report suggests that there are direct correlations between the built environment and the health outcomes of people living in these built environments. Because planners and policymakers continuously make decisions around investments in the built environment, their role in this matter cannot be understated.

The role of planners and policymakers is such: to address varying health outcomes across the region, policy at all levels of government should address inequalities in the built environment that exist between municipalities and neighbourhoods in order to ensure good health outcomes for all residents, and to inform targeted infrastructure and healthcare spending.

Higher neighbourhood walkability generally means physically healthier populations, with the potential for reduced healthcare expenditures over time. Good design that seeks to improve the walkability of built environments with the goal of healthier



populations in mind must be supported by policy or else these designs may not be as successful as intended.

For example, targeted design interventions such as infrastructural modifications to a cycling network cannot succeed without riders. For riders to make use of this infrastructure investment, it must be well-connected to existing networks, offer a straightforward and sensible route, and be well-signed and enforced. In this situation, strong policy is required to ensure cohesion between cycling networks across neighbourhoods via integrated area plans that speak to a breadth of built environments that naturally make up the Lower Mainland and indeed most municipal environments across the country.

With this in mind, planners and policymakers should work to improve the walkability of built environments in their jurisdictions by:

- Addressing gaps in infrastructure between neighbourhoods, sub-regions, and regions that result in disparate walkability and may be impacting physical and mental health;
- Ensuring policies related to the built environment offer cohesion between neighbourhoods, sub-regions, and regions so as to provide good transit and active transportation connectivity that is equitable across communities to the highest reasonable degree; and,
- Relying on evidence related to health outcomes that stem from the built environment in order to develop thoughtful plans and make good decisions that will have the most equitable and economically positive impacts.

Conclusions

The walkability of the built environment has important implications for the physical and mental health of residents living across the Lower Mainland. Because of these health implications, the cost burden that residents place on the Canadian public healthcare system can have direct linkages to the built environment in which they reside. Knowing this, it is important to many elements of human health for people to live in environments in which they can undertake recreation on a daily basis, where their needs for access to sustainable transportation systems can be met, and where safe and attractive natural sites can be found within a reasonable distance.

Not all neighbourhoods across the Lower Mainland offer the same built environment characteristics. As a result of this fact, and as a result of individual and contextual risk factors that can impact an individual's physical and mental health outcomes, there are widely varying perceptions of the built environment, travel behaviours, and health outcomes across Metro Vancouver neighbourhoods. Some of these variations can be traced back to the differences across built environments, such as access to safe and well-maintained sidewalks and bicycle lanes, the presence of natural scenery and greenspace, and access to transit. In neighbourhoods that excel in these categories of built environment infrastructure. physical health tends to be better relative to lower walkability

neighbourhoods. Conversely, there may be certain adverse mental health impacts associated with these higher walkability neighbourhoods, which may be at least partially mitigated by access to parks and natural settings. In neighbourhoods with poor built environments which force residents to drive to access basic services and amenities, as well as for their daily commute, physical health tends to be lower relative to higher walkability neighbourhoods. There are also implications for lifestyle sustainability associated with the degree to which a person's neighbourhood is walkable or not walkable, given the impacts this factor can have on travel behaviour.

As important as the built environment can be in determining

a person's overall physical and mental health, results of this report also underscore the degree to which factors such as income may impact physical and mental health outcomes, regardless of built environment. Across the Lower Mainland, higher income communities tend to have better health outcomes than those with lower incomes. There may be a number of factors at play here, with access to adequate medical care potentially playing a substantial role. Therefore, in further explorations of the health and economic impacts of built environments, it will be important to consider these contextualizing factors.

Given the health and lifestyle sustainability implications that the built environment can have, it is important that everyone in the Lower Mainland, and indeed across the country, have equal opportunity to live in a community in which they could benefit from a high walkability lifestyle should they so choose. Equitability amongst built environmentsthat is, ensuring all residents can access transit, recreational opportunities, and services within walking distance—can help reduce disparities in travel behaviours and health outcomes that are visible between Metro Vancouver communities. Planners and policymakers have the task of using evidence of these inequalities in their decisionmaking processes in the workplace to support community equity, for the benefit of overall healthcare and infrastructure expenditures. Moving forward, studies of the health and economic benefits associated with various built

environments can and should be used to inform policy decisions across the country.

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