

## Introduction

A growing body of evidence is demonstrating a link between the design of our built environment and its effect on health. There are questions that remain unanswered and research that is required; however, there is enough evidence, as will be outlined in this paper, that links urban sprawl with public health. Simply put, sprawl requires vehicle use to survive; vehicles contribute both to air pollution and sedentary living; both of those have negative health consequences. Aside from vehicle use, there are other health consequences associated with sprawl that will be discussed briefly in this paper.

It is dishonest to tell people to increase physical activity to improve health, when their neighbourhoods are constructed without safe places for recreation. It is also dishonest to tell people to leave their vehicles at home, to choose walking, cycling or transit, when homes are separated from schools, work places and commercial areas by distances that make walking or cycling impossible, and the transit system is inadequate.

The disciplines of urban planning and public health arose together in the mid-1800's in response to the rapidly rising urban population caused by industrialization, and the sanitation and housing problems that resulted (Northridge and Sclar, 2003). Given increasing awareness about the impact of air pollution, and the long-term effects of the obesity epidemic, this paper is a call to action. It is time to put public health back into community planning, and to ensure that every land use decision is sustainable.

## Definitions

The **built environment** is part of the overall ecosystem of our earth. It encompasses all of the buildings, spaces and products that are created, or at least significantly modified by people. It includes our homes, schools and work places, parks, business areas and roads. It extends overhead in the form of electric transmission lines, underground in the form of waste disposal sites and subway trains and across the country in the form of highways.

It affects our health through the design and construction of buildings, urban planning (availability and design of recreational facilities etc.), and vehicle emissions. The key to creating healthy built environments is good planning that recognizes potential health impacts from the outset<sup>1</sup>.

**Sprawl** is uncontrolled, poorly planned, low-density and single-use community growth (Jackson and Kochtitzky).

Sprawl, according to the definition above, requires individual motor vehicles in order to flourish. As people inhabit low-density, single-use residential areas, they must commute to shop, to work, to attend school and, ironically, to access recreational facilities. The word sprawl brings to mind large cities – in our case the lower mainland. However, if one thinks of it in terms of low-density, single land use neighbourhoods where vehicle use is

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<sup>1</sup> Source: The National Environmental Health Strategy, 1999

essential, then sprawl is much more prevalent in BC than just greater Vancouver. The implications of vehicle reliance are the air pollution that they produce, their contribution to sedentary living, and the injury and death associated with their use.

### **The Current Problem: Air Pollution**

Motor vehicles are a leading source of air pollution and even though vehicles engines are becoming much cleaner, the increasing number of vehicles on the road, and the increasing distances we travel result in significant emissions (Frumkin, 2002). The number of licensed vehicles in British Columbia has increased by 13 percent from 1995 to 2003.<sup>2</sup> Jackson and Kochtitzky report that residents of cities that have grown more over the past decade have also experienced a greater increase in the average time spent in a vehicle than residents where growth has remained stable. In Atlanta, often studied because of its sprawl, this increase was 44 percent from 1992 to 1996. The Sierra Club points to a similar trend in Ontario: a greater proportion of commuters (45 percent more) travel more than 20 km between their residences and work in Ontario's fastest growing urban centers than those in its slowest.<sup>3</sup> Killingsworth and Lamming (2001) report that 25 percent of all trips are less than one mile and 75 percent of those are made by car. Americans make 89 percent of all trips by automobile, impacting both air quality and physical activity levels.

Motor vehicle use consumes fossil fuels, releasing carbon monoxide and dioxide (CO and CO<sub>2</sub>), oxides of sulphur (SO<sub>x</sub>), and oxides of nitrogen (NO<sub>x</sub>). Particulate matter (PM) is also released, forming and changing in the atmosphere as molecules combine and larger particles break down into smaller ones. Finally, volatile organic compounds (VOC's) are released, both from combustion and from evaporation during fuel handling. In addition to these, some pollutants form from precursors: ozone is created when NO<sub>x</sub> and hydrocarbons react in the presence of heat and sunlight (Frumkin, Frank and Jackson, 2004).

While automobiles are an important source of pollutants, they are not the only one; other sources include industrial emissions, other mobile sources and even natural sources. However, automobiles are an important source: Jackson and Kochtitzky report that the Congressional Research Service found that in 1997, on-road vehicles accounted for about 58 percent of carbon monoxide, 30 percent of NO<sub>x</sub>, 27 percent of VOC's and 9 percent of PM emissions in the United States.

Frumkin, Frank and Jackson (2004) quote several studies that draw the link between land use, vehicle pollution and human exposure. A number of European studies have found that locations in proximity (both indoors and outdoors) to busy roads have higher levels of PM, NO<sub>x</sub>, hydrocarbons and CO than locations that are further away. These studies also found that ozone and SO<sub>x</sub> levels vary on a large scale, so locations near busy roads are no worse than any others. They also quote a Seattle study that found that sprawling

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<sup>2</sup> [http://www.icbc.com/Library/research\\_papers/Traffic/index.html](http://www.icbc.com/Library/research_papers/Traffic/index.html)

<sup>3</sup> <http://www.sierraclub.ca/national/postings/sprawl-hurts-us-all.pdf>

conditions – low density, low land use mix and disconnected street networks – consistently predicted greater NO<sub>x</sub>, CO and VOC emissions.

It is worth noted some dilemmas that Frumkin, Frank and Jackson (2004) describe in considering the issue of urban design and vehicle pollution. Firstly, encouraging people to walk or cycle during periods of air pollution could reduce traffic density and vehicle emissions, but may actually prolong their expose to higher levels of pollutants as they exercise along roadways than if they took their car. Secondly, higher densities could increase traffic congestion and pollution in those areas, increasing the exposure of those who live there. The authors conclude that land use changes need to go together with cleaner vehicles and a shift to transportation alternatives so that these dilemmas are avoided.

Finally, the Provincial Health Officer (2003) notes that the issue of automotive pollution remains unsolved and is inextricably linked to dependence on the internal combustion engine as the vehicle of choice for personal transportation.

### **The Current Problem: Physical Inactivity**

In addition to increased vehicle dependence and resulting air pollution created by sprawl, the built environment is an important determinate of whether or not we exercise, presenting either an opportunity or a barrier to it. Research has indicated that a lack of structures or facilities such as sidewalks and parks, and concerns about safety are two of the main reasons given for not exercising. People are therefore more likely to use facilities that are easily accessible and well maintained (Jackson and Kochtitzky). The built environment is also important consideration for the elderly and disabled peoples. A lack of sidewalks or curbs may keep people with disabilities from getting any physical activity. For the elderly and disabled, a lack of access to the community makes it difficult to participate in physical activity, establish social support or get to and use the health care system (Jackson and Kochtitzky).

Several studies have confirmed that our levels of physical activity are inadequate. According to Statistics Canada, 44.2 percent of males and 53.8 percent of females 12 years and older were physically inactive<sup>4</sup>. The Provincial Health Officer (2002) references the BC Nutrition Survey that found 61 percent of study participants did no strenuous exercise and 36 percent did no moderate exercise. The PHO's report notes that according to the World Health Organization, the fundamental causes of the obesity epidemic are high-fat, energy-dense diets, and sedentary lifestyles. Modest increases in the level of physical activity, especially for those who are currently inactive or sedentary, could have important, positive health effects. One estimate predicts that obesity-related diseases could be reduced by one third if the most inactive segments of the population increased their activity levels (Frank, Anderson and Schmid, 2004).

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<sup>4</sup> <http://www.statcan.ca/english/Pgdb/health46.htm> accessed February 26, 2005.

Community design is certainly not the only cause of our sedentary lifestyles; however, an increasing body of evidence shows that the physical design of work and living places influences travel choice and how frequently people in those environments walk or cycle for utilitarian travel. Recreational physical activity is done for the purpose of exercise; utilitarian physical activity is gained for some other purpose, such as walking to a store or cycling to work. Utilitarian physical activity provides the opportunity for physical activity without exercising, an important consideration when lack of time was the most frequent reason given by participants in the BC Nutrition Survey for not doing more physical activity.<sup>5</sup>

Physical activity does not need to occur all at once. Recommended activity levels can be accumulated during the day in increments as short as 8 to 10 minutes (Frumkin, Frank and Jackson, 2004). This highlights the importance of utilitarian physical activity, especially for those who are unable to engage in recreation for whatever reason. Built environment designs that encourage people to walk or cycle for utilitarian travel on multiple occasions in a day can be an important contributor to helping achieve recommended levels of physical activity.

Frank, Andresen and Schmid (2004) studied the relationship of obesity with community design, physical activity and time spent in cars. The study found that land use mix, car time and distances walked were significantly associated with obesity. The odds of obesity decreased 12.2 percent for each quartile increase in mixed land use and by 4.8 percent for each additional kilometer walked. The proportion of obese persons declined from 20.2 percent in the lowest to 15.5 percent in the highest land-use-mix quartile. The odds of obesity increased 6 percent for each hour spent in a car each day. The authors conclude that increased levels of mixed land use and corresponding moderate physical activity are associated with decreased odds of being obese. Land use mix was the most important aspect of the built environment related to obesity.

One final note about physical activity: Jackson and Kochtitzky report that in 1977, children age 5 to 15 years walked or biked for 15.8 percent of all of their trips; by 1995, children made 9.9 percent of their trips by walking or cycling, a 37 percent decline. A study of children found that 61.5% of 9 to 13 year-olds do not participate in any organized physical activity during their non-school hours and that 22.6% do not engage in any free-time physical activity.<sup>6</sup> This is especially troubling, given the increases the rates of overweight and obesity among children discussed later in this paper.

### **The Current Problem: Some Additional Considerations**

In addition to air pollution and its contribution to sedentary living, there are several other problems created by sprawl and poor community planning:

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<sup>5</sup> BC Nutrition Survey cited in the Provincial Health Officer's 2002 annual report.

<sup>6</sup> Physical Activity Levels Among Children Aged 9 - 13 Years -- United States, 2002 found at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5233a1.htm>

- Development replaces natural environments with built areas; the creation of roads, buildings and parking lots creates runoff. Frumkin, Frank and Jackson (2004) reference a study that found that an 18 percent increase in impervious areas resulted in an 80 percent increase in the average annual rainwater runoff. The flush of vehicle contaminants from parking areas into surface waters during the initial period of heavy rains contributes significantly to non-point source loading of chemical pollutants entering streams (Jackson and Kochtitzky).
- The urban heat island is an effect caused by two factors (Frumkin, 2002). Roads and buildings absorb heat and then reradiate it as thermal infrared radiation, reaching temperatures significantly higher than the air. Secondly, urban areas may be relatively void of vegetation, especially trees that can provide shade and cool the air by evapotranspiration. Heat islands can raise the air temperature in a city by up to 5 degrees C (Jackson and Kochtitzky).
- Conflicts where new development is created that borders farmland; a variation of this, urban development pushing into forested areas, brought devastating results in BC in 2003.
- Frumkin, Frank and Jackson (2004) acknowledge that suburban living may have some positive mental health benefits, there may also be significant consequences to the extent that social ties are frayed by the long and difficult vehicle commutes of sprawling cities.

### **The Burden of Disease: Overweight and Obesity**

The evidence presented in the previous section shows that as a society, we are becoming increasingly vehicle dependent due, at least in part, to the fact that we are building communities where distances that make vehicle travel essential separate our destinations. Increased vehicle use contributes both to inactivity and air pollution, two consequences with negative health impacts. Community design that necessitates vehicle use is certainly a contributor to the problem and to understand how this impacts our health, it is important to consider the burden of disease that results from it.

Body Mass Index (BMI) is calculated by dividing weight in kilograms by height in metres squared. While imperfect, it is standardized and the simplest method of estimating overweight and obesity, and making judgments about health risk. An adult with a BMI of 25-29.9 is considered overweight, while 30 and higher is considered obese.

- According to Statistics Canada's Health Indicators, 38.6% of British Columbia adult (18 years and older) males and 23% of females are overweight and a further 13% of males and 10.2% of females are obese
- The 1996 United States Surgeon General's report *Physical Activity and Health* concluded that a sedentary lifestyle is a primary factor in more than 200,000 deaths each year; equivalent to about 25 percent of all chronic disease deaths

and 10 percent of all deaths. In addition, it is second only to smoking as a lifestyle risk factor for disease and premature death.

The problems caused by obesity are numerous. Obesity can increase the risk of type 2 diabetes (adult-onset) by up to 34 fold; diabetes is a major risk factor for kidney failure and heart disease. The Surgeon General's report outlines the increased health risks for those who are overweight and obese:

- An estimated 300,000 deaths per year may be attributable to obesity; the risk of death rises with increasing weight.
- Individuals who are obese have a 50-100 percent increased risk of premature death from all causes, compared to individuals with a healthy weight.
- The incidence of heart disease is increased in persons who are overweight or obese, high blood pressure is twice as common in obese adults and over 80 percent of people with diabetes are overweight or obese
- Obesity is also associated with breathing problems, some cancers, arthritis, reproductive problems, depression and decreased quality of life.

The costs to the health care system and to society from the complications of overweight and obesity are enormous. Each year, about 19,000 people are newly diagnosed with diabetes, the vast majority of that being type 2 which is largely associated with obesity and a lack of exercise. In 2000/2001, diabetic care cost the province \$663 million, representing 14.4% of the hospital, doctor and PharmaCare budget, and about 4.3% (175,000) of the population. These costs are projected to double by 2010 if significant action isn't taken. (Provincial Health Officer, 2003).

Even more disturbing than the incidence of overweight and obesity among adults, is its increasing incidence in children. Tremblay and Willms (2000) found that the prevalence of overweight among boys increased from 15 percent in 1981 to 29 percent in 1996, and from 15 to 24 percent among girls over this same time period. The prevalence of obese children more than doubled over that period, to 14 percent for boys and 12 percent for girls. The researchers noted that the prevalence of overweight and obesity was likely underestimated in the study, due to underreporting of body mass. According to the Surgeon General, risk factors for heart disease such as high cholesterol and high blood pressure occur with increased frequency in overweight children and adolescents. Type 2 diabetes, previously considered an adult disease, has increased dramatically in children and adolescents; it is closely linked to overweight and obesity. Tremblay and Willms (2000) note that excessive body mass during childhood and adolescence is associated with increased risk of becoming overweight in adulthood, and with higher morbidity and mortality rates in adulthood.

There are many plausible theories as to why the incidence of overweight and obesity is rising so significantly, related to significant declines in physical activity, changes in lifestyles and communities, and high-fat, calorie-rich diets. This paper does not intend to oversimplify a complex problem with many potential contributors; the obesity epidemic certainly cannot be blamed solely on poor community design that discourages physical

activity. Frumkin (2003) noted that sprawl does not fully account for our increasingly sedentary lives, nor does physical inactivity tell the entire story of our increasing weight. However, by contributing to physical inactivity and therefore to overweight and associated health problems, sprawl has negative health consequences.

## **The Burden of Disease: Air Pollution**

Many studies have considered the morbidity and mortality associated with outdoor air pollution. It is well recognized that ozone irritates airways and increasing ozone levels are associated with respiratory symptoms and declining lung function; those with asthma and other respiratory diseases are particularly vulnerable (Frumkin 2002). Particulate matter causes mortality: studies have found that when PM levels rise, mortality rises for about a day following. In addition to short-term effects, studies have shown that longer-term PM exposure outweighs the deaths that occur within just days of exposure. Finally, NO<sub>x</sub> and SO<sub>x</sub> exposure can result in similar respiratory irritation to what is caused by ozone (Frumkin, Frank and Jackson 2004).

The Provincial Health Officer's 2003 annual report estimates the health impact of air pollution in British Columbia. Extrapolating from Ontario studies using BC's population, the health burden of air pollution may be 644 premature deaths, 3,323 hospital admissions, and 4,408 emergency room admissions. This is likely an overestimation of the impact in BC, both because the Ontario studies may over-estimate the health impacts and because British Columbia residents are not exposed to air pollution to the extent that Ontario residents are. Using other studies, the Provincial Health Officer (2003) estimated that 25 to 250 annual deaths may be attributable to air pollution. In addition, 71 deaths could have been delayed in 2003 if PM<sub>2.5</sub> levels did not exceed 6µg/m<sup>3</sup> and 110 deaths could have been delayed if PM<sub>2.5</sub> levels were reduced 1µg/m<sup>3</sup> across the Province.

In addition to mortality, the Provincial Health Officer (2003) used the 2000 Ontario Medical Association report to estimate the impact of poor air quality on morbidity in BC. Ratios from the Ontario study were applied to BC to provide a mid-point estimate of 712 hospital admissions and 944 emergency room visits.

Jackson and Kochtitzky discuss research that examined the impact of transportation on human health at the Third Ministerial Conference on Environment and Health in London in 1999. In Northern Europe, vehicles contribute almost all carbon monoxide, 75 percent of NO<sub>x</sub> about 40 percent of PM<sub>10</sub>. Approximately 36,000 to 129,000 adult deaths per year are attributable to long-term exposure to air pollution from traffic in European cities. In addition, research was presented that found that air pollution caused 6 percent of total mortality (more than 40,000 deaths) in Austria, France and Switzerland. Half of the deaths caused by air pollution were attributable to traffic.

Frumkin, Frank and Jackson (2004) also quote numerous studies that establish the link between poor air quality and morbidity and mortality. Especially relevant to this discussion is the traffic reductions during the Atlanta Olympics in 1996 and the resulting

affect on health. Morning peak traffic flows decreased 22 percent and one-hour peak ozone levels decreased by 28 percent. During that time period, measures of acute asthma decreased between 11 percent and 44 percent.

The Provincial Health Officer (2003) notes that BC has low levels of health risks from air pollution and a relatively small population. Those factors along with differing study methodologies result in varying estimates of mortality and wide ranges between the low and high estimates. Morbidity and mortality estimates aside, it is clear that air pollution negatively affects health and that vehicles are a significant contributor to airborne pollutants.

### **The Burden of Injury and Mortality: Pedestrians and Cyclists**

There is one additional health impact worth considering. In December of 1995, Cynthia Wiggins, 17, took the bus to her job at a mall in suburban Cheektowaga, New York, outside of Buffalo. The bus did not stop right at the mall, forcing her to walk across a seven-lane highway to complete her trip. On this day, she made it across six of the lanes when she was struck and killed by a dump truck. The tragedy received wide media attention, seen as typifying inadequate transit links, pedestrian-hostile roads, and their disproportionate impact on minorities (Frumkin, 2002).

Data from the Insurance Corporation of BC show that in 2002 (the most recent year that is available), almost 10 percent of all traffic fatalities were pedestrians<sup>7</sup>. It should be noted that pedestrian fatalities averaged almost 15 percent of all fatalities the previous four years. It remains to be seen whether the improvement in 2002 is temporary or the start of a downward trend.

Of the 45 pedestrian fatalities in British Columbia in 2002, 57.8 percent of them did not occur at an intersection and of that number, 30.8 percent occurred where there was no cross walk and no signal. The reasons for this are unclear from the data, and further research would be required to determine what role, if any, community design played in these fatalities. A study in Atlanta found that as the city sprawled, the pedestrian fatality rate increased while the national rate declined slightly. The most dangerous stretches of roads for pedestrians were those characteristic of sprawl: traffic in multiple lanes at high speeds, no sidewalks, long distances between cross walks, and streets lined with commercial or apartment buildings (Frumkin, Frank and Jackson, 2004). The authors go on to observe that there is merit in encouraging people to walk and bike rather than travel by vehicle to increase physical activity and reduce air pollution. However, if roads are dangerous for pedestrians and sidewalks and trails are limited or nonexistent, the net risk may be higher than the benefit.

### **Interventions and Evidence**

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<sup>7</sup> [http://www.icbc.com/Library/research\\_papers/Traffic/index.html](http://www.icbc.com/Library/research_papers/Traffic/index.html)



This paper has presented some of a growing body of evidence connecting urban sprawl to negative health outcomes. Urban sprawl requires vehicle use in order to thrive. Vehicle use contributes to air pollution, physical inactivity, and presents an injury risk to pedestrians. Air pollution, overweight and obesity, and getting hit by a car are all bad for health. It follows that community planning that avoids sprawl, with its decreased reliance on vehicle use, will have positive health impacts. Given all of the problems created by vehicle use, Frumkin (2002) notes that primary prevention would consist of decreasing exposure.

Population growth is an inescapable reality and our cities will inevitably become larger over time. Frumkin, Frank and Jackson (2004) observe that no growth is not an option, and the challenge is in ensuring that growth occurs in ways that are healthy, socially just, and environmentally sustainable. No single planning effort or public health strategy will set communities on a path to achieving these goals; it will require a long-term strategy where planners and health professionals both have a role to play to ensure that this occurs.

Smart Growth is a collection of urban development strategies to reduce sprawl that are fiscally, environmentally and socially responsible. Smart growth is development that enhances our quality of life, protects our environment, and uses tax revenues wisely.<sup>8</sup>

#### Smart Growth Principles<sup>9</sup>

1. Mix land uses.
2. Take advantage of compact building design.
3. Create a range of housing opportunities and choices.
4. Create walkable neighbourhoods.
5. Foster distinctive, attractive communities with a strong sense of place.
6. Preserve open space, farmland, natural beauty, and critical environmental areas.
7. Strengthen and direct development toward existing communities.
8. Provide a range of transportation choices.
9. Make development decisions predictable, fair and cost effective.
10. Encourage community and stakeholder collaboration in development decisions.

Source: Anonymous *Getting to Smart Growth: 100 Policies for Implementation*. Washington: Smart Growth Network and International City/County Management Association, 2002.

Community planning is the domain of local governments. The Ministry of Transportation may also be involved in the process, with staff acting as the approving officer for subdivisions in many rural areas. The involvement of Health Authorities also varies across the Province: generally, Public Health reviews and responds to development referrals where onsite sewage disposal will occur and perhaps ensuring that potable water is provided. There has reluctance among public health staff to consider land use decisions more broadly than these 'traditional' roles. With the implementation of the new Sewerage

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<sup>8</sup> From Smart Growth BC, [www.smartgrowth.bc.ca/index.cfm](http://www.smartgrowth.bc.ca/index.cfm)

<sup>9</sup> From the Smart Growth Network, [www.smartgrowth.org](http://www.smartgrowth.org)

System Regulations, at least one Health Authority is considering opting out of any further participation in the land use planning process.

The time to have meaningful input into any decision is at the beginning, when the goals and objectives are on the table and the scope is being defined. The challenge both for planners and for health professionals is to collaborate to address equity, health and land use planning challenges; to ensure that public health impacts of development decisions are given consideration in the subsequent decision. It is as health professionals and planners work together, that the principles of smart growth can be incorporated into the land use decisions that are made. Accordingly, there are just two recommendations from this paper, that:

- Public Health be engaged from the beginning of all land use discussions; and
- That the public health impacts of development and the smart growth principles be incorporated into land use decisions.

These recommendations if acted on will represent a paradigm shift for public health professionals, and education will be required so that they can understand and articulate the relationship between public health and community planning. This will also represent one more consideration on top of a host of existing considerations that planners must take into account during land use decision-making processes. In this regard, government may wish to mandate that public health be included in meaningful discussion from the outset.

The urban planning and public health disciplines arose together to address the health problems created by the rapid rise in urban populations in the late 19<sup>th</sup> century. It is imperative to reinvigorate the historic link to ensure that our built environment provides every opportunity for a healthy public.

## References

British Columbia. Provincial Health Officer. (2003). Report on the Health of British Columbians. Provincial Health Officer's Annual Report 2002. The Health and well-being of people in British Columbia. Victoria, BC: MOH Planning.

Frumkin, H., Frank, L., & Jackson, R. (2004). Urban Sprawl and Public Health Designing, Planning and Building For Healthy Communities. Washington: Island Press.