

IMPACTS OF TRANSPORTATION ON PUBLIC HEALTH

In the twentieth century, widespread access to the automobile drastically changed transportation practices. In Québec, the number of automobiles rose from 3.2 million vehicles in 1984 to 5.2 million in 2004, an increase of 60% in 20 years. In addition, since 1990 the trend toward vans and sport utility vehicles, commonly called SUVs has resulted in the number of these vehicles doubling (see Figure 1). The increasingly dominant place of the car has had an impact on public health. For this reason, the Montréal Public Health Department will soon publish a report entitled *Impacts of Transportation on Public Health*, written by Norman King, Patrick Morency and Lucie Lapierre. This summary provides an overview of the main health impacts on Montrealers and outlines several possible solutions to these problems.

From 1998 to 2003 in the Montréal area¹ (Montréal, Laval, South Shore and the suburban ring north and south of the Island), the number of automobiles increased by 10%, while the population grew by 3%. In five years, there were 180 000 more vehicles in the region, almost 65 000 of which were among households on the Island of Montréal and 115 000 off the island, thus reaching a total of 1.8 million.

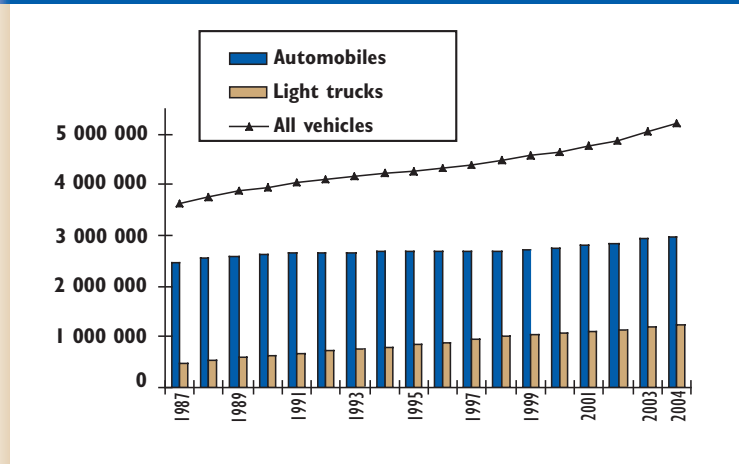
However, these figures cannot be applied uniformly over the entire region. The further one gets from the downtown area, the greater the percentage of individuals who own cars: 37.1% of households in downtown Montréal compared with 94% in the suburbs north and south of the Island.

In 2003, residents of the Montréal area made 7.8 million trips every day, including over 2 million during the morning rush hour (6:00 a.m. to 9 a.m.). The automobile was the method of transportation for the large majority of these trips, as illustrated in Figure 2.

The supremacy of the automobile, however, is not natural law fixed in stone. Indeed, in some North American cities, there has been a significant increase in public transit's share of overall transportation owing to improved urban planning and lower public transit fares.

¹ Data for the Montréal area are taken from the highlights of the survey *Origin-Destination 2003* published by the Agence métropolitaine du transport and the *Plan de Transport de Montréal, Portrait et Diagnostic*, 2005.

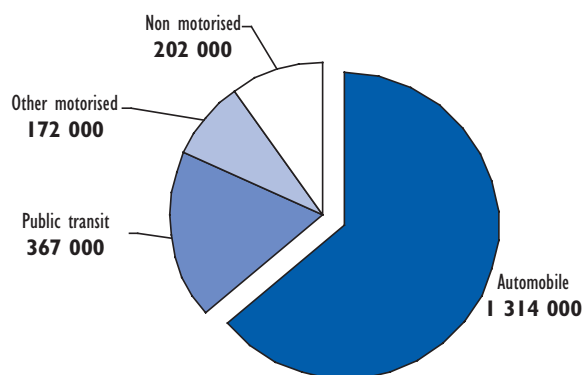
Figure 1
Growth in the number of automobiles in Québec
between 1987 and 2004



This figure depicts the number of vehicles authorised to circulate on Québec roads on December 31 of each year.

- **Automobiles:** road vehicles under 3000 kg whose main use is to transport passengers, and that do not have truck chassis.
- **Light trucks:** road vehicles under 3000 kg, including vans, pick-up trucks and four-wheel drives.
- **All vehicles:** automobiles, light trucks, taxis, buses, heavy trucks, etc.

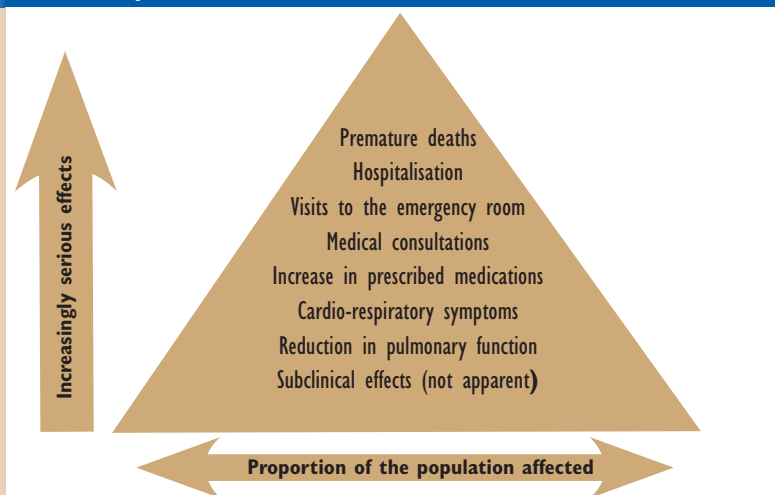
Figure 2
Distribution of morning rush hour trips every morning in the Montréal area (O-D 2003 survey)



The terms “collective transport” and “public transit” are used interchangeably and refer to transportation by train, metro or bus.

Non-motorized transportation includes bicycles, in-line skates, and walking. The latter category excludes travel that combines walking with other modes of transportation such as the bus or metro.

Figure 3
Pyramid of cardiac and respiratory effects associated with air pollution



VARIOUS IMPACTS ON PUBLIC HEALTH

POLLUTION

Pollution generated by transportation

Transportation, industry and heating are the three major sources of air pollution and greenhouse gases (GHG), the foremost of which is carbon dioxide (CO₂). In the metropolitan area, 85% of nitrogen oxide (NO_x) emissions, 43% of volatile organic compounds (VOC) emissions—including noxious products such as benzene and polycyclical aromatic hydrocarbons (PAH)—and 47% of GHG are attributed to transportation. Moreover, NO_x and VOC react with sunlight and heat to produce ozone, one of the components of summer smog. Finally, transportation also adds to fine particulate emissions less than 2.5 microns in diameter (PM_{2.5}), which penetrate deeply into the lungs and contribute to smog formation year round.

Smog contains a mixture of toxic substances that contaminate the air including one or several components that exceed recommended criteria. The main components of smog that have an impact on health are PM_{2.5} and ozone. These pollutants have immediate and longer-term impacts on health. As the gravity of the effects increase, the number of people affected decreases, as shown in Figure 3.

Seniors with cardiorespiratory diseases are among groups who are most vulnerable to these health effects. According to a study conducted in three European countries (France, Switzerland and Austria), air pollution is responsible for 6% of all deaths, half of which are linked to transport-related pollution. Health Canada, for its part, estimates that air pollution causes 1540 premature deaths a year in Montreal.

Children form another group at risk. Several recent studies have demonstrated the effects of air pollution on children's more vulnerable respiratory systems (development and exacerbation of asthma, reduced lung growth).

Living in the vicinity of busy roads

Several studies have shown that people who live along main thoroughfares are more exposed to certain pollutants linked to transportation: a Dutch study has revealed excess cardiorespiratory mortality, while a Montreal study has found an increased risk in hospitalisations for respiratory diseases among people aged 60 years and over.

Increase in greenhouse gases and climate change

Currently, there is consensus among scientists that global warming is real and largely attributable to human activity, which is releasing more and more greenhouse gases into the atmosphere. This warming trend will have a triple impact: more frequent, longer and more intense heat waves as well as other climatic changes, since rising temperatures are associated with the quantity and type of precipitation and the frequency of extreme meteorological events.

Heat waves can increase mortality among elderly people suffering from chronic ailments, notably cardiovascular, cerebrovascular, respiratory, neurological and renal diseases. Two other groups are particularly at risk, people living in urban 'heat islands' where there is little vegetation and where few homes are air conditioned, and people who live alone, are bedridden or are unable to take care of themselves. The heat wave that hit Europe during the summer of 2003 was proof of the devastating effects that can occur. Indeed, French public health authorities estimate that from 1 to 20 August 2003, there were about 15 000 more deaths than usual.

Climate change will also have an impact on plant growth and cycles, which will in turn raise the concentrations of allergens in the air and duration of the pollen season. For example, in the case of ragweed—an important cause of allergic rhinoconjunctivitis—the pollen season increased by 44% between 1994 and 2002.

Finally, gas and solvents volatilise more when temperatures are high, thus increasing the rate of volatile organic compounds in the air. Moreover,

the photochemical reaction between nitrogen oxides and VOC that results in ozone formation is also bolstered by higher temperatures.

SEDENTARINESS

The escalating use of cars acts as a deterrent to active transportation such as walking or cycling. We know that sedentariness increases the risk of developing a number of diseases. Among inactive individuals, the risk of cardiovascular disease and of becoming overweight or obese has almost doubled; they are also at greater risk for type II diabetes, high blood pressure, and colon or pancreatic cancer. We should point out that type II diabetes, which has been mostly observed among adults, now affects children. Finally, in terms of health care costs, the burden of sedentarity is enormous: in 1999, the cost was 2.1 billion dollars—2.5% of total health costs—not much less than costs linked to smoking, which equal 3.8% of the total.

The 2004 Canadian Community Health Survey revealed that 34% of Quebecers aged 18 and over are overweight, and 21.8% are considered obese. When totalled, these numbers indicate that more than half the population (56.3%) weighs too much.

Yet, in Québec, about 60% of individuals are not active enough in their spare time. Active transportation could help attain recommended levels of physical activity, but much still needs to be done. For example, in Québec, 55% of adults and 42% of young people between the ages of 12 and 17 walk less than an hour a week to get to work or school, or go shopping, etc.

Urban sprawl, physical activity and health

Scientific research supports the existence of a link between urban sprawl and decreasing physical activity, which has an impact on health. According to an American study published in 2004, the distance walked for utilitarian purposes increases in urban environments where residential density is high and land use is mixed (residential, commercial, office and institutional, including parks and recreational facilities). This study also presents two significant findings:

- the odds of obesity declines by 4.8% for each kilometre walked per day; and;
- the odds of obesity increases by 6% for each hour spent in a car per day.

Other factors linked to urban development also have an influence on mode of transportation, for example, distance per trip and feeling safe during the trip. These two factors are truly important for children since travel habits develop early in life. Currently, almost 60% of children in Québec get to school in motor vehicles.

Health benefits of active transportation

The benefits of active transportation have been documented in a number of countries. In Denmark, it has been noted that the mortality rate among adults who do not cycle to work is 40% higher than among individuals who use their bicycles. In Tianjin, China, people who employ active transportation have lower levels of total cholesterol, LDL (bad cholesterol) and triglycerides in the blood, but higher levels of HDL (good cholesterol) than people who travel by bus. Finally, studies conducted in Japan have shown that being close to areas conducive to walking promotes longevity and that walking regularly can help lower health costs.

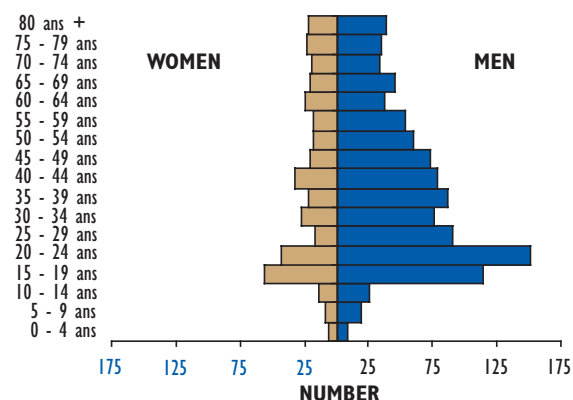
TRAUMA

Over the course of the twentieth century, road accidents became one of the leading causes of death and morbidity in the world, killing or seriously injuring over 20 million people a year. Although road deaths have been declining for the last thirty years in industrialised countries, collisions remain one of the primary causes of death, especially among young people: unlike deaths due to cardiovascular diseases or cancer, which mostly occur among older people, collisions kill younger people, as can be clearly seen in Figure 4. In the United States, road accidents are the first cause of death among 4- to 34-year-olds. In Quebec, they are the cause of about one out of every five deaths (21%) in this age group.

But to focus only on mortality rates overshadows the scope of the problem because the number of deaths represents only the tip of the iceberg. For example, in Montréal, there were 220 times more injuries than deaths. The severity of injuries, permanent physical sequelae and psychological impact on individuals and their quality of life are all factors that must be considered but are rarely included in road accident statistics. In Québec, the economic burden resulting from road trauma is enormous; road accidents in 2000 generated costs estimated at \$2.6 billion.

Figure 4

Number of road deaths in Quebec by victim's age, 2000 and 2001



Source: Quebec, deaths database, 2000 and 2001.

The number of people injured is increasing

Although the number of people injured in road accidents in the early 1990s was on a downward trend, more recently, figures have been on the rise. From 1998 to 2003, the annual number of people injured in road accidents rose 20% in Québec (to reach 56 516 in 2003), even though the population increased by only 3%.

Severity of injuries among pedestrians

The energy of a moving vehicle, which depends on its size and speed, poses a particular risk to pedestrians. Indeed, unlike the occupants of a motor vehicle, pedestrians are totally unprotected. Consequently, if there is a collision, the probability that a pedestrian will be seriously injured or killed is higher. In the period 1999-2001, pedestrians represented 15% of all road injuries but a much higher proportion of hospitalisations (28%) and deaths (40%). Finally, on average, pedestrians are hospitalised longer for their injuries than passengers in a vehicle.

More collisions and injuries in central neighbourhoods

On the Island of Montreal, a concentration of collisions with injuries in central neighbourhoods has been observed, with half of these accidents occurring in six boroughs: Ville-Marie; Villeray–St-Michel–Parc Extension; Mercier–Hochelaga–Maisonnette; Ahuntsic–Cartierville; Rosemont–Petite-Patrie; and Côte-des-Neiges–Notre-Dame-de-Grâce. Figure 5 illustrates the distribution of pedestrians injured, by borough.

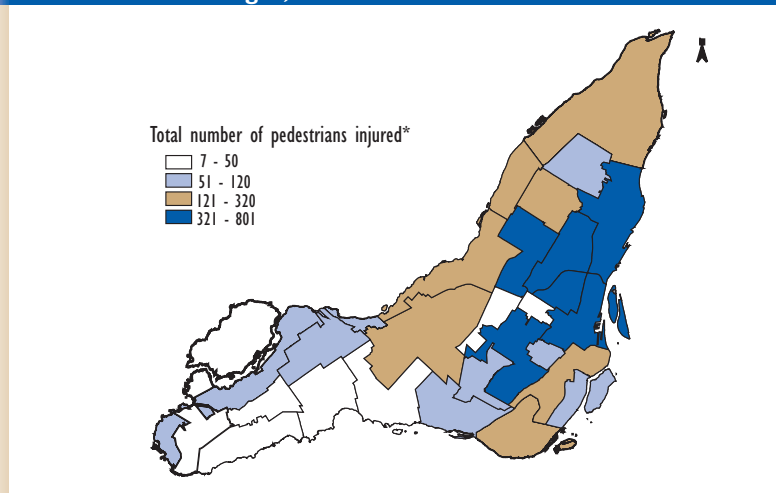
In each borough, however, sites where accidents with casualties occur are spread over a wide geographical area, with each collision site involving only a few injured individuals. For example, in the Ville-Marie borough, pedestrian injuries occurred at over 250 intersections over a period of 5 years (1999-2003).

In Montréal, pedestrians and the poor are most affected

Similarly to most health problems, the distribution of road injuries goes hand in hand with poverty. According to a Montréal study published in 1990, the rate of injuries caused by collisions is four times higher among children living in the poorest neighbourhoods; this rate is six times higher for young pedestrians. On the one hand, poor people travel more on foot and are more likely to use public transportation and, on the other, more of them live in neighbourhoods where the volume of cars is higher and vehicles circulate faster.

Figure 5

Distribution of pedestrians injured* in Montreal boroughs, 1999-2003



* Victims of road accidents that required the intervention of an ambulance.

Source: Urgences-santé. Map produced by: Marie-Soleil Cloutier

Factors involved in collisions

There are usually three broad categories of factors involved in collisions with injuries: individual factors, vehicles, and the environment.

The best known individual factors are undoubtedly excess speed, drunk driving, seat belt utilisation and compliance with the Highway Safety Code. It is important to note that these behaviours do not fall only under the category of personal choice. For example, speed is linked to the perception of the risk of an

accident, the power of the vehicle, the amount of police surveillance, road signs and signals, and how roads are laid out, to name a few.

Moreover, all vehicles are not equally safe—in spite of mandatory safety features—as can be seen in the variation of death rates by vehicle model and crash test results. Contrary to general opinion, bigger, heavier vehicles are not always the safest. At the end of the 1990s, death rates were higher among drivers of the most popular SUV sold in Canada (weighing about 1700 kg) than among drivers of the most popular car (about 1060 kg). In addition, when compared with mid-sized or large sedans, SUVs and light trucks caused two to four times more deaths in the drivers of the other cars involved. Finally, in accidents involving pedestrians, even at a low or medium speed, the probability of serious injury or death is much higher when an SUV is implicated.

There are many important environmental factors related to the safety of everyone who uses the road: public policies, mode of transportation chosen, the number of car trips and speed at which cars travel, as well as the quality of urban planning.

PREVENTION STRATEGIES²

There is now clear consensus among stakeholders in the health and socio-economic sectors for the need to reduce the impact of transportation activities on the environment and on public health. This objective draws upon two complementary approaches:

- reduce the number of automobile trips and encourage alternative means of transportation, notably public transit and active transportation;
- reduce the health impacts of vehicles on the road.

Here is an overview of ways to reduce the health impacts of transportation.

Support public transit by allocating adequate funding

Adequate funding is essential to maintain public transit and develop new infrastructures. According to the Origin-Destination 2003 survey, 80% of morning rush hour commutes in the region are due to work or studies. If public transit could meet these needs, it would contribute significantly to the goal of reducing the number of automobile trips.

Encourage public transit and active transportation through urban planning

Urban planning that promotes alternatives to automobile transportation rests on two basic interrelated principles: intelligent growth (sector density; mixed-used neighbourhoods; integration of green spaces, etc.) and development based on public transit and active transportation. At the centre of this type of urban planning is a public transit station (train, metro), around which residential and commercial elements revolve, forming the heart of the development.

Introduce other measures fostering public transit and active transportation

Encouraging the use of other modes of transportation than the car also requires coherent parking policies. There are a number of such measures, including reducing the number of parking spaces and introducing parking fees in central neighbourhoods, and putting in parking lots next to train and metro stations as an incentive to public transit. As for travelling between home and work, employer programmes that have positive consequences include encouraging car pools or the use of public transit, facilitating non-motorised travel by installing bicycle stands, lockers and showers, etc.

Develop a safe and user-friendly transportation network for everyone

The transportation network must also be safe for all road users. An excellent way of suc-

² In addition to the global prevention strategies presented here, other strategies specific to the goods transportation sector should be developed. However, this issue is beyond the scope of this publication.

ceeding is to adopt traffic calming measures, which slow down and reduce the number of motorised vehicles.

A safe network also implies better infrastructure for pedestrians and cyclists, such as adequate signs and lighting, and year-round maintenance. Young people could be encouraged to develop the habit of using active transportation if safer routes to and from school were built. We also know that pedestrian malls, safe textured crosswalks, overhanging sidewalks, and 30-km/hour zones all foster walking. As for bicycles, various measures should be considered, including improvements to the bicycle path network and the installation of public equipment for cyclists.

Finally, measures that promote respect for the Highway Safety Code should be adopted. These measures, which are in addition to police surveillance and sanctions (fines), include adequate urban planning, and education for motor vehicle drivers, cyclists and pedestrians.

Make vehicles safer and reduce pollution and greenhouse gas emissions

A series of measures can be applied to the vehicles themselves to make them safer and reduce pollutants and greenhouse gas emissions. First, vehicle production and purchase should be geared to models that consume less energy, are less polluting and safer. To reach this goal, several public measures are required:

- reinforce emission regulations, for cars as well as for light trucks (SUV);
- establish an inspection and maintenance programme for all automobiles;
- offer significant financial incentives for buyers of low-emission vehicles;
- launch educational campaigns to change car-buying habits and to attempt to diminish the impact of marketing strategies of car manufacturers.

CONCLUSION

No one can deny that transportation plays a major role in contemporary society. But we must also admit that motor vehicles have a major impact on the environment and health. This is why it is crucial that we consider these effects in transportation planning. In a broader perspective, on a worldwide scale, the promotion of public transit and active transportation has the advantage of helping reduce our dependence on fossil fuels, which also has an economic and political impact.

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Synthesis report

The **Synthesis report** series focuses on highlights of major studies, research, and intervention and promotion projects conducted in various areas of public health.

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ERRATUM

Contrary to what is stated in the Introduction to the synthesis report entitled 'Impacts of Transportation on Public Health', the document summarized in the report has not been published in the form described and therefore cannot be ordered from our documentation centre. Indeed, given the importance of the problem for the health of Montrealers and the ongoing public debate surrounding specific topics such as the modernisation of Notre-Dame street and the extension of Autoroute 25 via a bridge over Rivière Des Prairies versus the development of public transportation services offered, Dr. Richard Lessard, Director of Public Health, has decided to retain this topic for his 8th Annual Report on the Health of the Population. The Report will be available around the end of March 2006. The 2006 Annual Report will be published shortly before a regional conference is held on this topic. Consequently, the publication will be coming out later rather than sooner!

Jean-Luc Moisan
Responsable de l'Information

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