

Urban Transportation, a Question of Health

2006 Annual Report
on the Health of the Population



Urban Transportation, a Question of **Health**

2006 Annual Report
on the Health of the Population



Urban Transportation

Published by the

**Direction de santé publique
Agence de la santé et des services sociaux de Montréal**

1301, Sherbrooke Street East
Montréal, Québec H2L 1M3
Telephone : 514-528-2400
<http://www.santepub-mtl.qc.ca>

La version française de ce rapport est disponible sur demande

Credits

Scientific supervision and coordination

Louis Drouin
Patrick Morency
Norman King

Editor

Jean-Luc Moisan

Research and manuscript development

Norman King
Patrick Morency
François Thérien
Lucie Lapierre (INSPQ)
Céline Gosselin
Louis Drouin

Collaborators

André Bergeron
Marie-Soleil Cloutier
Gilles Lavoie

Revision

Louis Jacques
Tom Kosatsky
Michel Mongeon
Robert Perreault
(CRE Montréal)
Michel Rossignol
Audrey Smargiassi

Editorial consultant

Solange Lapierre

English translation

Traductions Terrance
Hughes inc.

Text revision (English)

Sylvie Gauthier
Norman King
François Thérien
Patrick Morency

Production and distribution

Jo Anne Simard

Distribution

Marie Pinard
Sylvie Audet
Johanne Boileau
Manon Girard
Manon Hudson
Blaise Lefebvre
Micheline Tremblay

Graphic design

Paul Cloutier

Computer graphics

Javier Valdés

Photography

Javier Valdés
Paul Cloutier
Jean Bruneau
Richard Bergeron
Archives de la STM
Getty Images
RSQA

Secretary

Jocelyne Ayotte

© Direction de santé publique
Agence de la santé et des services sociaux de Montréal (2006)

Legal deposit:
Bibliothèque et Archives nationales du Québec
Library and Archives Canada

ISBN: 2-89494-500-0 (printed version)
2-89494-501-9 (on-line version)

Price: \$35

This document is printed on completely recycled paper containing
100% post consumption fibers and was produced without elementary chlorine.

Completely recyclable - the responsible choice

The inks used for this production contain vegetable oils.



Recycled

Supporting responsible use
of forest resources

www.fsc.org Cert no. SGS-COC-1727
© 1996 Forest Stewardship Council





TABLE OF CONTENTS

Acronyms and Abbreviations	6
A Message from the Director	7
Chapter 1 – Shifting Transportation Trends	11
The situation in Montréal	13
Demography	13
Rising mobility	14
Chapter 2 – Transportation: Pollution and Health	19
Overview of air quality in Montréal	21
The impact of contaminants generated by the transportation sector	23
Pollution near heavy traffic routes	24
The noxious effects of ozone	25
The effects of particulate matter	26
Long-term impact	27
Children are more vulnerable than adults	27
The burden of air pollution on health	29
Greenhouse gases and climate change	32
Impact of heat waves	33
Interactions with biological aeroallergens	34
Noise pollution	35



Chapter 3 – Road Deaths and Injuries, a Heavy Burden	41
The consequences of accidents	42
A major cause of death among young people	43
Thousands of hospitalizations	44
Tens of thousands of road injuries	44
Pedestrians are very vulnerable road users	46
The economic burden of road accident traumas	48
Contributing factors	50
A basic factor: the vehicle's energy	50
Behavioural risk factors	50
For whom are vehicles being improved?	52
Traffic flow and automobile trips	52
Is the physical environment dangerous or protective?	53
The role of regulations	56
The role of the automotive industry	56
Improvement of health services	57
Avoidable tragedies	57
Chapter 4 – Active Transportation and Sedentariness	65
The impact of sedentariness	67
The economic burden	67
Half of Quebecers are obese or overweight	67
Physical activity	69
Leisure time physical activity	69
Active transportation: walking or cycling	70
Active transportation and obesity	72
Urban planning plays a decisive role	72
Other factors that favour active transportation	76
Distances to be travelled	76
Safety along the route	78
Walking to school	79
The long-term benefits of active transportation	80



Chapter 5 – Transportation & Social Exclusion: New Perspectives on a Long-Standing Problem	87
The predominance of the automobile	89
A definition of social exclusion	90
Transportation and exclusion: a well-documented hypothesis	90
Facets of the accessibility deficit	91
The consequences of an accessibility deficit	92
The situation in Montréal	92
Questions to be explored	94
Chapter 6 – Initiate a Genuinely Sustainable Shift	97
Reduce the pressure that automobiles exercise	98
Public transportation and active transportation should account for 50% of travel by 2020	99
Increased funding for public transportation	100
Dissuade residents from relying on automobiles	103
Fiscal measures to enhance the competitiveness of public transportation	103
Urban planning: intervene upstream	104
Promote cycling and walking in Montréal	106
Traffic calming	107
Education and social marketing	108
Promote the Allégo program	108
Reduce polluting emissions from motor vehicles	110
Chapter 7 – Leadership and Mobilization are Conditions for Success	115
Working towards a consensus in Montréal	117
Political leadership that is, first and foremost, centred in Montréal	118
A central role for the Mayor of Montréal and elected municipal representatives	119
A renewed partnership with the Quebec government	120
Concrete support from federal authorities	121
Afterword	123
Figures	127



ACRONYMS AND ABBREVIATIONS

AMT:	Agence métropolitaine de transport	MTQ:	Ministère des Transports du Québec
AQI:	air quality index	MZI:	metropolitan zone of influence
AT:	active transportation	NO₂:	nitrogen dioxide
BMI:	body-mass index	NO_x:	nitrogen oxides
CAM:	Carte Autobus-Métro (monthly pass)	O-D:	origin-destination
CARB:	California Air Resources Board	PM:	particulate matter
CMHC:	Canada Mortgage and Housing Corporation	RR:	risk ratio
CMM:	Communauté métropolitaine de Montréal	RTOR:	right turn on red
CPHI:	Canadian Population Health Initiative	SAAQ:	Société de l'assurance automobile du Québec
DALY:	disability-adjusted life-year	SEU:	Social Exclusion Unit (UK research organization)
DSP:	Direction de santé publique de Montréal	SOFIL:	Société de financement des infrastructures locales
GHG:	greenhouse gas	STM:	Société de transport de Montréal
GIS:	geographic information systems	SUV:	sport utility vehicle
GST:	goods and services tax	TOD:	Transit-oriented development
GTPPP:	Groupe de travail provincial sur la problématique du poids	VOC:	volatile organic compounds
HDL:	high-density lipoprotein or "good" cholesterol	WHO:	World Health Organization
INSPQ:	Institut national de santé publique du Québec		
LDL:	low-density lipoprotein or "bad" cholesterol		
MESS:	Ministère de l'Emploi et de la Solidarité sociale		
MSSS:	Ministère de la Santé et des Services sociaux		
MT:	mass transit		



A MESSAGE FROM THE DIRECTOR

Each year since its first annual report in 1998, the Director of Public Health and his team of professionals have attempted to fulfil the mandate the government has conferred on them, i.e. to inform the public and their partners of the state of health of Montrealers. Year after year, these reports have pursued the same objective, which is to pinpoint the key issues regarding the health of the population and suggest solutions likely to solve the problems examined. Each report focuses on a topical theme based on surveys, studies or research conducted in Quebec and elsewhere in the world and centred on scientific data. In light of these data, our team targets priority health problems, the most vulnerable groups, key risk factors and the interventions deemed to be the most effective, geared to conditions in Montréal. We propose objectives to be attained and an array of measures to be adopted to solve the problems noted both from the standpoint of practitioners in the health care network and the intersectoral partners concerned.

This year, in the wake of the United Nations Climate Change Conference held in Montréal from November 28 to December 10, 2005, our team is focusing on the question of transportation in the Montréal area and its effects on health.

Transportation systems significantly influence city residents' daily lives. In

Montréal, as elsewhere, transportation infrastructure partly determines the number of daily trips, the modes of transportation chosen, and where people live and work. Even free time and the choice of leisure activities depend on the ability to get about. It is, therefore, not surprising that households and governments earmark a large proportion of their budgets for passenger transportation.

Our initial observations are drawn from an extensive survey that has been conducted regularly in the Montréal area for 35 years. The origin-destination survey reveals trends with respect to mobility, especially the modes of transportation on which residents rely depending on where they work and live. In this report, our professionals also analyse numerous studies that examine changes in the number of motor vehicles in Quebec and elsewhere, and the impact on air quality, climate change, road deaths and injuries and the health of residents of big cities, especially Montrealers.

The report reveals that transportation systems are essential and contribute to well-being. However, they can also curtail and restrict personal development, and engender exclusion (a question that touches on the social inequalities of health and that we are only beginning to assess) or serious health problems. For example, pollution from fossil fuel-burning motor vehicles is



linked to serious chronic illnesses; greenhouse gases are causing climatic change, which, in turn, is generating heat waves and exacerbating atmospheric pollution, with specific consequences in big cities; injuries stemming from road accidents are among the world's greatest epidemics, according to the expression used by WHO; motor vehicle transport has increased to the detriment of modes of transportation that are beneficial to health, such as walking and cycling, and of the level of physical activity in the population; urban planning is geared more to vehicles than to residents, and so on. In Quebec alone, the burden imposed by transportation on health represents direct and indirect costs estimated at billions of dollars a year.

Without counting environmental and health costs, governments spend enormous amounts each year to maintain, design and develop the road network. In Quebec, the funds directly allocated each year by governments to road infrastructure alone exceed \$3 billion. Few sectors obtain as much funding to adapt to new needs; such funding could be used to steer us to measures that would reduce the scope of the health problems linked to transportation. Solutions exist or have already been implemented at home and abroad, and their effectiveness has been demonstrated. A number of international, Canadian, Quebec and

Montréal agencies support the key strategies aimed at curbing automobile traffic, reducing air and noise pollution, and enhancing the living conditions of city residents of all ages. Moreover, several big cities the world over are showing the way in this respect and have achieved convincing results without straining government budgets. The City of Montréal has set as its objective to reduce dependence on automobiles by relying on broader use of mass transit and active transportation.

Once we have given an overview of urban transportation in Montréal, the general objective of our annual report is to heighten awareness among officials responsible for policy-making and city residents of the scope of the health problems stemming from a transportation model that gives priority to the automobile and of the urgency of emphasizing active transportation and mass transit. To this end, our report first proposes that we reach a regional consensus in the population, in collaboration with all socioeconomic stakeholders, and that we develop political leadership to move forward. The comprehensive action plan that we are suggesting to Montrealers could enable us to shift to a model that relies more extensively on alternative modes of transportation and, to do so, to enhance access to mass transit and active transportation such as walking and cycling, for the benefit



of all Montrealers. The Direction de santé publique de Montréal, in keeping with its mandate and its expertise in the realms of prevention, knowledge gathering and monitoring, undertakes

to endorse the shift to sustainable transportation, and offers its support to the bodies that assume political and administrative responsibility for planning the city of tomorrow.

Richard Lessard, M. D.

Director of Public Health

1

Trends

Urban Transportation

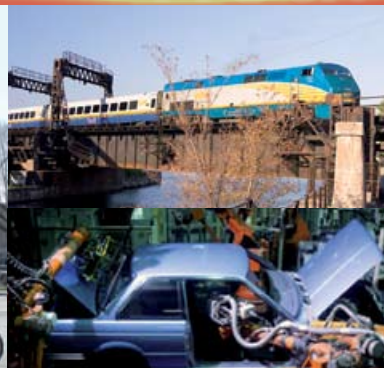
Health

Shifting **Transportation Trends**

Transport

Urban Transportation

Health



Urban Transportation

Trends



CHAPTER 1

Shifting **Transportation Trends**

Our modes of travel underwent a veritable revolution in the 20th century, attributable essentially to widespread use of automobiles. Indeed, the number of cars, distances travelled and paved roads increased markedly. Initially, only the wealthiest individuals could afford everyday travel by car. Over time, growth in the number of vehicles per capita and in the number of driver's licence holders affected all social classes.

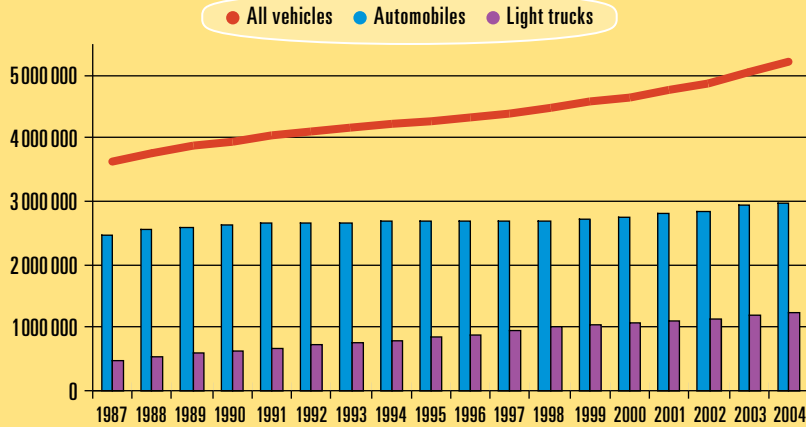
In Canada, the number of motor vehicles soared from nearly 15.5 million in 1989 to close to 19 million in 2002. Furthermore, the number of gasoline-powered light trucks doubled, from over 3 million to nearly 6.5 million. A similar trend was noted in Quebec (Figure 1).

At the same time, a significant increase was noted in the number of kilometres of paved roads. During the 20th century, in the United States and developed countries, the distances travelled yearly by automobile rose constantly. According to a WHO report, the number of kilometres travelled more than doubled in Europe between 1970 and 1997. However, since the 1980s, such growth has tended to stabilize in the United States. The factors that explain the increase in number of trips and distances travelled certainly include changes in technology and the automotive industry but also, more recently, demographic factors such as the massive entry of women into the labour market, factors related to urban planning, such as urban sprawl, and other factors of an economic nature.



Figure 1

Growth in the number of motor vehicles in Quebec between 1987 and 2004



The situation in Montréal

To understand transportation trends in the Montréal area, the report on the origin-destination (O-D) survey¹ conducted every five years since 1970 is highly useful. The survey focuses on the nature of travel by all modes of transportation on working days. It enables us to understand how Montréalers travel from Monday to Friday, mainly to go to work or to school, but does not provide information on weekend travel habits, stemming mainly from recreational activities, shopping and social life. We will refer to the latest survey, conducted in 2003, by

the Agence métropolitaine de transport (AMT), which covered the territories of the Island of Montréal, Laval, Longueuil and the northern and southern suburbs, encompassing 88 municipalities with a total population of 3 613 000 residents, half of whom live on the Island of Montréal. Before we examine data on mobility, let us first look at a few demographic factors that strongly affect the intensity of travel.

Demography

Between 1998 and 2003, the population of the metropolitan area increased by 3.0%, an average annual growth of 0.6%,

1. The O-D survey is conducted by means of telephone interviews in a zone that expands each time. The sample used here encompasses 169 900 respondents living in 70 400 households, i.e. nearly 5% of the population covered by the survey. For the purpose of comparison between years, the O-D survey uses the most restricted territory, that of 1987, called the comparable territory.



which is slightly less than between 1987 and 1998 when it stood at 1.0% per year. Population growth on the Island of Montréal itself picked up slightly between 1998 and 2003, while such growth slowed in the suburbs (Figure 2).

Figure 2

Annual population growth on the Island of Montréal and the suburbs

	Population in 2003 (comparable territory)	Average annual growth 1998-2003	Average annual growth 1987-1998
Montréal	1 813 000	0.4 %	0.1 %
Laval	343 000	0.8 %	1.6 %
South Shore	348 000	0.0 %	0.8 %
Southern suburbs	388 000	1.0 %	3.2 %
Northern suburbs	408 000	1.2 %	4.3 %

The number of households rose by 1.1% a year between 1998 and 2003, at a more sustained pace than the population, for a total increase of 5.6% in five years, while the average size of households declined. The population in the region is ageing, which is another decisive factor: between 1987 and 2003, the proportion of the population under 29 years of age fell by 5%, while the proportion of residents over 50 years of age rose by 5%.

The workplace also directly affects travel. In 2003, the Island of Montréal still accounted for most jobs, i.e. 881 000, or 71% of the total, down from 81% in 1987.

Indeed, between 1998 and 2003, 26 000 new jobs were created on the Island of Montréal, equivalent to a 3% increase. However, job creation was much more pronounced in the suburbs, up 19%, equivalent to 53 000 new jobs.

In recent years, the number of motor vehicles has continued to increase faster than the population, to just over 1.8 million vehicles in 2003. This is equivalent to 10% growth between 1998 and 2003, i.e. 2.1% per year, slightly below that noted during the period 1987 to 1998 (2.4% per year).

The prominence of automobiles increases as we move away from the city centre. In 2003, the number of automobiles per household and per person, and the proportion of households with motor vehicles were higher in the suburbs than in central neighbourhoods (Figure 3). Indeed, on the Island of Montréal, roughly 250 000 households or over 550 000 residents do not own a vehicle.

Rising mobility

The 2003 O-D survey reveals that transportation habits are still changing. If we examine the morning rush hour, work (50%) and school (30%) account for most trips. The increase in morning travel continues. In 2003, residents made over 2 million trips, up 3.4% in relation to 1998, or 0.7% per year. Figure 4 indicates the percentage of individuals who chose various modes of transportation.



Figure 3

Number of automobiles per person and proportion of households with vehicles (2003)

Sector	Number of automobiles	Number of automobiles per person	Number of automobiles per household	Proportion of households with vehicles
Downtown	18 550	0.27	0.47	40.3 %
City centre	361 100	0.37	0.80	61.9 %
East end of Montréal	133 192	0.45	1.10	76.7 %
West end of Montréal	239 639	0.50	1.25	82.3 %
Laval	192 856	0.56	1.45	90.2 %
South Shore	200 293	0.54	1.34	87.0 %
Southern suburbs	334 638	0.62	1.64	94.0 %
Northern suburbs	323 156	0.60	1.63	94.0 %

Source: 2003 O-D survey

It is worth pointing out that the increase in the number of automobile trips slowed between 1998 and 2003 and that the average annual increase (0.9%) was lower than between 1987 and 1998 (3.1%). Moreover, the downturn in reliance on mass transit noted until the mid-1990s reversed itself: between 1998 and 2003, the use of public transportation increased on average by 1.6% per year, whereas it had fallen previously (-1.4% between 1987 and 1998). Mass transit now accounts for 22% of various modes of transportation (comparable territory). It stabilized between 1998 and 2003, the first time since 1970. It must, nonetheless, be emphasized that in absolute numbers, the increase

Figure 4

Modal share of transportation used during morning rush hour (2003)

Mode	Number of trips	Annual change since 1998
All	2 019 000 (100 %)	+ 0.7 %
Non-motorized *	202 000 (10 %)	- 0.3 %
Motorized	1 811 000 (89.7 %)	+ 0.8 %
Automobile	1 314 000 (65.1 %)	+ 0.9 %
Public transportation	367 000 (18.2 %)	+ 1.6 %
Other (taxis, motorcycle, etc.)	172 000 (8.5 %)	- 0.9 %

* Including trips made exclusively on foot, by bicycle and on rollerblades.

Source: 2003 O-D survey

Suburbanites made most of the 54 000 new automobile trips while residents of the Island of Montréal accounted for the majority of the 26 000 new mass transit trips.

in automobile trips between 1998 and 2003 (+54 000) was higher than that in mass transit trips (+26 000).

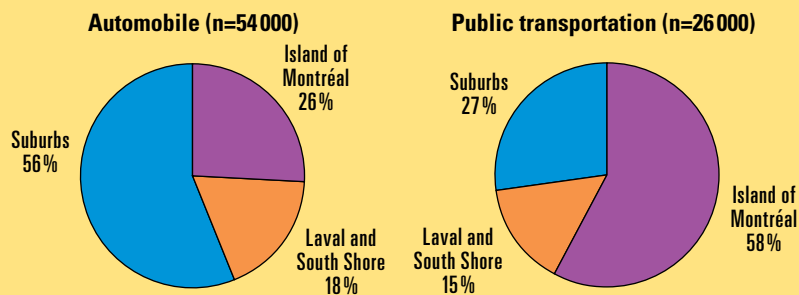
We also know that several factors affect the choice of mode of transportation. For example, points of departure and destination play a direct role. Among individuals travelling to the city centre during morning rush hour, mass transit accounted for 55% of trips in 2003, a proportion that has been fairly stable since 1987 (59%). Furthermore, the farther a household is located from the city centre, the less it relies on public transportation: while 34% of downtown residents use mass transit during morning rush hour, this proportion falls to 5% to 6% in the suburbs. Suburbanites made most of the 54 000 new automobile trips while residents of the Island of

Montréal accounted for the majority of the 26 000 new mass transit trips (Figure 5).

We must not conclude that the predominance of the automobile is inevitable. For example, in the United States, the number of vehicles per capita and the distance travelled by automobile each year has tended to level off and even decline since 2000. Certain demographic factors, which also appear in the Montréal area, such as the ageing of the population, appear to partly explain these trends. New municipal policies aimed at controlling urban sprawl are perhaps also a contributing factor. Indeed, as the experience of several North American cities reveals, better use of urban space and reductions in mass transit user fees lead to a marked increase in the modal share of public transportation.

Figure 5

Breakdown of additional trips during morning rush hour in 2003 in relation to 1998



Source: 2003 O-D survey



REFERENCES

Agence métropolitaine de transport. 2000. "Enquête Origine-Destination 1998, la mobilité des personnes dans la région de Montréal", 174 p.

Agence métropolitaine de transport. 2003. "Kyoto, une stratégie en transport des personnes pour la région métropolitaine de Montréal", 31 p.

Agence métropolitaine de transport. 2004. "Enquête Origine-Destination 2003, Faits saillants", 26 p.

Litman, T. 2003. "Integrating Public Health Objectives in Transportation Decision-Making", *American Journal of Health Promotion*, 18 (1), p. 103-108.

Pollution

2

Urban Transportation

Health

Transportation: **Pollution** and **Health**



Urban Transportation

Health



CHAPTER 2

Transportation: Pollution and Health

It is important to emphasize that industry, heating and transportation are the three major sources of air pollution and greenhouse gases (GHG). Transportation alone accounts for several types of air contaminants that are of concern to health protection agencies because of their impact on health, i.e. nitrogen oxides (NO_x), volatile organic compounds (VOC), and particulate matter (PM), which are the main ones.

Emissions of these pollutants and GHG from the transportation sector vary according to the contaminant considered and whether they occur in urban or rural areas. Overall, we have observed that transportation is a major source of pollution in most instances, but to a greater degree in urban areas (Figure 6).

Figure 6

Transportation's contribution to air pollution

	Quebec	Metropolitan area (1994)
NO _x *	85 % (2000)	85 %
VOC*	39 % (2000)	43 %
PM	17 % (2000)	30 %
GHG	37 % (2003)	47 %

** These contaminants are precursors of ozone.*

*Source: Développement durable, Environnement et Parcs Québec, 2006,
Regroupement montréalais pour la qualité de l'air, 1998*

Two of these contaminants, NO_x and VOC, are precursors of ozone in that they react in the presence of sunshine and heat to produce ozone through a photochemical reaction. A large proportion of these precursors is at-



tributable to the transportation sector, which thus contributes significantly to the formation of ozone. Among airborne pollutants, ozone merits close attention because of its impact on health. The transportation sector is also one of the principal sources of greenhouse gases, a cause of climate change. Later in this report, we will examine the health impacts of climate change and the effects of noise on health, two other problems engendered by the transportation sector.

Overview of air quality in Montréal

The first factor to consider is smog, which appears in the form of a haze that is in fact a mixture of noxious substances that contaminate the air. Its main components that affect health are ozone and fine particles smaller² than 2.5 µ, also called PM_{2.5}. Environment Canada issues a smog warning whenever it anticipates that one of these contaminants will exceed acceptable levels.

Since the late 1970s, several measures have been adopted to reduce polluting emissions. As a result of stricter control over industrial and vehicle emissions, the levels of several contaminants such as NO_x and VOC have fallen in the Montréal area although this has not prevented the concentration of ozone from increasing.

Little is known about changes in the concentration of PM_{2.5} in the region since these particles have only been measured in recent years. To at least partially overcome this shortcoming, we can refer to Canadian data that reveal a certain decrease between the 1980s and the mid-1990s in 11 urban centres, followed by a period of stabilization. In Quebec, however, a comparison between 2003 and the four preceding years reveals a 13% increase in the average annual concentration of PM_{2.5}.

Agencies such as WHO at the international level and the three levels of government in Canada have set standards and made recommendations pertaining to ozone and fine particles. The standards have been established in light of research focusing on the health impact of these pollutants. For example, the Canadian government has drawn up a Canada-wide standard that sets objectives to be attained by 2010. At present, the ministère du Développement durable, de l'Environnement et des Parcs du Québec and the City of Montréal air quality monitoring network rely on an air quality index (AQI) to ascertain the quality of outside air.

In the case of ozone, it is difficult to establish problematical concentrations in the air since duration of exposure must also be considered. For example, the ozone level used to calculate the

2. The micron (µ) is a unit of length equivalent to one millionth of a metre.



AQI in Quebec and to trigger a warning from the Environment Canada Info-Smog program is an average of $160 \mu\text{g}/\text{m}^3$ over a period of one hour, or 82 parts per billion (ppb). In addition, under the Canada-wide standard, the objective to be attained by 2010 is an average concentration below $127 \mu\text{g}/\text{m}^3$ over an eight-hour period (or 65 ppb). As Figure 7 indicates, during the summer, the ozone levels in Montréal exceed this standard at 7 of the 10 sampling stations where this pollutant is measured.

From one year to the next, the striking variations noted are affected by weather conditions: when the summer is cool and rainy, smog warnings for ozone are less frequent than if the summer is hot and sunny. For example, no warning was issued during the summer of 2000, but there were 16 warnings during the summer of 2001.

Figure 7

Air quality in Montréal with regard to ozone

	Concentration and duration	
Canada-wide standard (2010 objective)	$127 \mu\text{g}/\text{m}^3$ (or 65 ppb) over 8 hours: average of fourth maxima for three consecutive years	In 2002-2004, the Canada-wide standard was exceeded at 7 out of 10 stations
AQI or Info-Smog	$160 \mu\text{g}/\text{m}^3$ (or 82 ppb) over 1 hour	Between 1995 and 2004, the AQI was exceeded up to 16 days per year during the summer

Source: RSQA, 2002-2004 annual reports

In the case of fine particles, too, standards and air quality indices governing $\text{PM}_{2.5}$ make it possible to compare the levels measured in Montréal. The recommended levels vary according to the duration of exposure in this instance as well. As Figure 8 indicates, the levels of fine particles exceed standards at all seven sampling stations where they are measured.

It must be emphasized that the air quality standards in question are targets to be attained to protect most of the population. However, vulnerability to the effects of airborne pollutants varies considerably from one individual to the next. Indeed, a WHO task force concluded in 2003 there is no threshold of exposure to PM and ozone below which there is no effect on the health of the population overall. In other words, there are always individuals at risk, even at very low levels of exposure (see the section “The burden of air pollution on health”).

Exposure to pollution engendered by the transportation sector is not uniform among all residents of a city like Montréal. A pilot study conducted by the Direction de santé publique (DSP) assesses temporal and spatial variations of several pollutants linked to transportation within a reduced perimeter (less than 2.5 km). Researchers selected four sites with variable traffic flows, ranging from a quiet residential street with urban background noise



Figure 8

Air quality in Montréal with regard to PM_{2.5}

	Concentration and duration	
Canada-wide standard (2010 objective)	30 µg/m ³ over 24 hours: annual average of the 98th percentile for three consecutive years	In 2002-2004, the Canada-wide standard was exceeded at all seven stations
AQI	35 µg/m ³ over 3 hours	Number of days on which the AQI was exceeded: 47 in 2002 (15 f/w; 32 s/s)* 62 in 2003 (47 f/w; 15 s/s) 69 in 2004 (42 f/w; 27 s/s)

* f/w: fall and winter, i.e. January to March and October to December inclusive.

s/s: spring and summer, i.e. April to September inclusive.

Source: RSQA, 2002-2004 annual reports

(nearly 1 000 vehicles per day) to the worst scenario, near the Autoroute métropolitaine, where over 150 000 vehicles travel every day. They measured PM_{2.5} and nitrogen dioxide (NO₂) and indirectly estimated the level of elementary carbon.³ The findings reveal that the levels of PM_{2.5} vary little depending on traffic flow, which demonstrates a fairly uniform distribution on the Island of Montréal, although the absorption coefficient of the filters and levels of NO₂ increases significantly with traffic. These findings are similar to those from studies conducted in Boston and New York.

Another team of researchers, which also measured the spatial variability of NO₂ concentrations in Montréal, showed that concentrations increase in light of several variables linked to traffic flow.

Exposure in vehicle passenger compartments

Another facet of the problem of air pollution engendered by road traffic is exposure in vehicle passenger compartments, above all in traffic jams. The concentration of pollutants, especially VOCs and carbon monoxide, can reach levels 10 times higher in the passenger compartment than in the ambient air. This factor depends, in particular, on the level of maintenance of the vehicle ahead. Indeed, old, poorly maintained and diesel-powered vehicles emit more pollutants in the direction of the vehicle behind. Another problem should be noted in passing, i.e. exposure to diesel fumes among children using school buses.

The impact of contaminants generated by the transportation sector

Researchers in Canada and elsewhere have published literature reviews examining the impact of air pollution on health that pinpoint the noxious effects recorded. Figure 9 illustrates

3. The level is determined by means of a measurement of the absorption of the filters. Elementary carbon is a major constituent of black smoke produced by combustion.



these effects and the link between the severity of the effects and the proportion of the population affected.

Pollution near heavy traffic routes

One way to attempt to understand the health impact of pollution stemming from the transportation sector is to study populations living along heavy traffic routes. For example, a group of Dutch researchers assessed the impact of pollution on mortality according to place of residence. Their findings reveal that, in the population overall, the relative risk⁴ of dying the day

Epidemiological studies, an essential tool

There are several ways to examine the health effects of the pollutants emitted by the transportation sector. Toxicological studies seek to establish the toxic properties of contaminants and epidemiological studies examine the impact of pollutants on the health of populations by means of an array of methodologies, such as time series studies and prospective surveys.

Time series studies monitor changes in morbidity or mortality in a given population over a time scale as a function of the level of pollutants. This type of study is often conducted because it offers three advantages: the population acts as its own control group, since the same population is studied at different times; the necessary databases already exist; and it is easy to make comparisons as pollution levels can vary markedly over time. The statistical power of these studies is very high since the large number of individuals monitored makes it possible to detect fairly limited risks, which is another useful criterion. However, there are also weaknesses in such studies, especially the absence of data concerning the levels of air pollution to which each individual is really exposed.

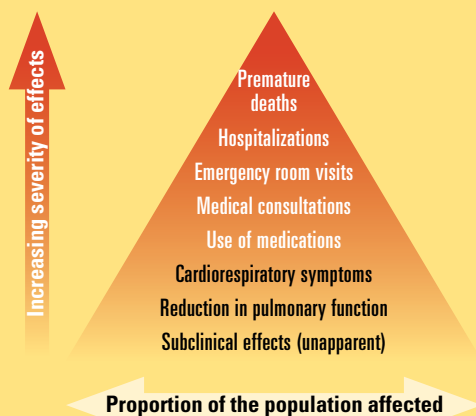
Some studies assess, above all, the impact of pollutants generated by the transportation sector. In particular, they compare the health of populations living along heavy traffic routes with that of populations living farther away. Or, they compare populations more extensively exposed to specific transportation-related pollutants, such as NO_x or black smoke⁵, with populations subject to less exposure.

As for the recommended thresholds, studies conducted since the 1990s have revealed that low but statistically significant risks of respiratory and cardiovascular problems are linked to levels of pollution that nonetheless comply with the established limits. In this respect, it should be emphasized that a risk, even a limited one, can have an appreciable impact if the population exposed is large.

5. Emissions stemming from combustion and that mainly comprise elementary carbon.

Figure 9

Cardiac and respiratory effects linked to air pollution



4. Relative risk (RR): the probability of exposed individuals developing a disease in relation to non-exposed individuals. A value over 1 represents an increase in risk, e.g. RR=1.10 corresponds to a 10% increase.



Old, poorly maintained and diesel-powered vehicles emit more pollutants in the direction of the vehicle behind.

after an increase of $100 \mu\text{g}/\text{m}^3$ in the concentration of black smoke reached 1.38. However, this risk increases to 1.89, a striking discrepancy, in the case of residents living along heavy traffic routes, i.e. thoroughfares on which over 10 000 vehicles a day travel.

Between 1986 and 1994 in Holland, researchers followed nearly 5 000 city-dwellers aged 55 to 69 years living near heavy traffic routes, i.e. less than 50 m from a major urban thoroughfare or less than 100 m from an expressway. They observed that the relative risk of death by cardiopulmonary disease was 1.95 (or nearly twice as high) among these city-dwellers in relation to those living farther away⁶.

After having examined the spatial variation of pollutants linked to the transportation sector, researchers at the Direction de santé publique then assessed the risk of hospitalization for respiratory problems among Montrealers 60 years of age or over living along heavy traffic routes: the study reveals that the risk is higher than among residents of quieter streets. Moreover, the researchers took into account variables such as socioeconomic status. While this variable affects the risk of hospitalization, the fact remains that the level of polluting emissions from vehicles seems sufficient to have an impact on the respiratory health of the elderly.

The noxious effects of ozone

At heavy concentrations, ozone (O_3) is a powerful irritant of the eyes, nose and upper respiratory tract. Furthermore, its oxidizing power allows it to react with a great variety of cellular elements in the body, thus provoking inflammation of lung tissue, reduction of defence mechanisms against infection, and deterioration of pulmonary function.

In addition to these acute effects, chronic exposure to lower levels of ozone can affect the morbidity and mortality of a population. In the late 1990s, researchers investigating emergency service visits in Montréal analysed the impact of air pollution bearing in mind variables such as the day of the week, weather conditions and the presence of other pollutants. They concluded that an increase in the maximum concentration of ozone, between June and September, corresponds to a 22% increase in the number of emergency room visits the following day for respiratory problems among individuals 65 years of age or over.

Similarly, researchers examined hospitalizations for respiratory diseases in 16 Canadian cities. They took into account the presence of other pollutants and meteorological variables and observed that an increase in the



6. This study takes into account confounding variables, i.e. variables that can have an impact on the value studied and which must be taken into account in a statistical analysis.



concentration of ozone was linked to a 4.3% increase in hospitalizations for respiratory illnesses between April and December.

One factor emerges from these two studies: the concentrations of ozone in question fall below the thresholds set by several health agencies. In other words, it appears that the impact on health is apparent even at concentrations below recommended levels.

The effects of particulate matter

Particulate matter (PM) is actually a mixture of solid particles and droplets of varying composition and size suspended in the air. They are classified according to their diameter: PM_{10} are less than $10\ \mu$ in diameter while $PM_{2.5}$ are less than $2.5\ \mu$ in diameter. The biggest particles, between 2.5 and $10\ \mu$ in diameter, come above all from natural sources such as the earth's crust, pollen and mould spores, and mechanical processes such as construction work. $PM_{2.5}$ —or fine particles—are generated primarily by combustion, e.g. heating, industrial processes and transportation. The distance that particles travel depends on their size, i.e. dozens of kilometres in the case of the biggest ones, and thousands of kilometres in the case of the smallest ones.

Primary pollutants, which are particles emitted directly into the atmosphere, in vehicle exhaust for example, can

undergo different chemical reactions upon contact with gases in the atmosphere (NO_x , SO_2 and ammonia), VOC and other particles, and thus form secondary pollutants.

The toxicity of particles depends on their size and composition. Particles between 2.5 and $10\ \mu$ in diameter settle, above all, in the upper respiratory tract. Fine particles penetrate farther, to the pulmonary alveoli. Researchers have recently begun to examine the effect of ultrafine particles ($PM_{0.1}$), whose smaller diameter⁷ allows them to directly enter the blood system, which then carries them throughout the body. As for their composition, particles are most frequently made up of nitrates, sulphates, VOC, elementary carbon, biological agents and metals (e.g. iron, copper, nickel and zinc).

Many studies have focused in recent years on the impact of particles on health. Their impact on pulmonary and cardiovascular health are most often reported. Particulate matter has short-term effects, e.g. an increase in morbidity and mortality during pollution peaks, and long-term effects, e.g. excessive frequency of cardiopulmonary disease among residents of cities with heavy pollution.

As for $PM_{2.5}$, two studies conducted in Montréal link temporal changes in the mortality rate with the level of

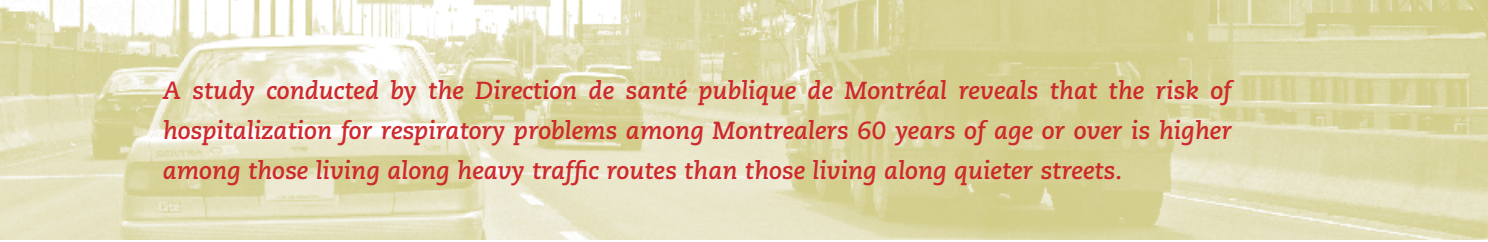


August 14, 2002, 10:45 a.m.
 $PM_{2.5}$: $37\ \mu g/m^3$



August 27, 2002, 10:03 a.m.
 $PM_{2.5}$: $3\ \mu g/m^3$

7. $PM_{0.1}$: 0.1 micron or less in diameter.



A study conducted by the Direction de santé publique de Montréal reveals that the risk of hospitalization for respiratory problems among Montrealers 60 years of age or over is higher among those living along heavy traffic routes than those living along quieter streets.

exposure to these particles:⁸ excessive mortality rates are noted the day after an increase in $PM_{2.5}$ concentration in the outside air. For example, the increase in mortality due to respiratory diseases among people 65 years of age or over reaches 6.4% the day after a $12.5\text{-}\mu\text{g}/\text{m}^3$ rise in $PM_{2.5}$.

Two major studies of PM_{10} conducted in the United States and in Europe also reveal noxious effects. The American study examined the link between mortality and the concentration of such particles in the air in 20 big cities with a combined population of 50 million. The findings show a 0.21% increase in overall mortality and a 0.31% increase in cardiorespiratory mortality the day after each $10\text{-}\mu\text{g}/\text{m}^3$ increase in PM_{10} . The European study focused on 29 cities with a combined population of 43 million. In this instance, for each $10\text{-}\mu\text{g}/\text{m}^3$ increase in PM_{10} observed on the previous day or on the same day, a 0.6% increase in the overall mortality rate and a 0.69% increase in the mortality rate from cardiovascular disease were reported.

These two examples clearly show to what extent it is relevant for public health officials to be concerned about these contaminants. Indeed, even if the level of risk seems low, the population affected can be vast bearing in mind the thousands of people concerned. Furthermore, hundreds of

other smaller studies support these two studies, and a comprehensive analysis of their findings reveals 0.8% and 0.7% increases in hospital admissions for heart failure and ischemic heart disease, respectively, with each $10\text{-}\mu\text{g}/\text{m}^3$ increase in PM_{10} .

Long-term impact

In addition to time series studies, cohort studies compare morbidity or mortality in groups according to their exposure to one or more contaminants. For example, we can compare the populations of cities exposed to different levels of air pollution to assess its long-term impact on health. Thus, over the past 10 or so years, American studies have shown that the residents of more heavily polluted cities are at greater risk in the long run of dying of cardiopulmonary disease and lung cancer than the residents of less polluted cities. One American study dating from 2002 shows that each $10\text{-}\mu\text{g}/\text{m}^3$ increase in the average concentration of fine particles corresponds to an increase in the risk of death by cardiopulmonary disease (+6%) or lung cancer (+8%).

Children are more vulnerable than adults

To begin with, we must point out that children are especially vulnerable to the effects of air pollution when

8. Bearing in mind confounding variables such as meteorological parameters, other pollutants, and so on.



compared with adults. Three reasons come into play: their respiratory and immune systems are still developing; they inhale more air (and thus more contaminants) per kilogram of body weight than adults because of the structure of their lungs and their rate of respiration; and they spend more time outdoors than adults do, in particular to play, and are thus more exposed.

Indeed, several recent studies reveal the effects of the greater vulnerability of children's respiratory systems to air pollution. For example, American researchers have compared two groups of asthmatic children, one of which must take medications to control asthma and is thus deemed to suffer from more severe asthma than the second group, which does not have to take medication. They observe that, when the ozone level is higher, the likelihood of symptoms is greater in the first group. As several other studies draw similar conclusions, these observations might be explained by the heightened sensitivity to allergens that stems from exposure to ozone.

Several studies have focused on children attending a school located near main traffic arteries or living in such a sector. They reveal an increase in respiratory and asthmatic symptoms related to the density of traffic or to the concentration of contaminants generated by transportation (e.g. NO_x and fine particles).

The development of asthma among children with no previous medical history of the disease is another effect to be considered. Indeed, a study suggests that exposure to high levels of ozone can also play a role in the development of asthma. For example, in California, researchers followed 3 535 children without a medical history of asthma over a five-year period. They concluded that, in communities with the highest concentrations of ozone, children who engage in at least three sports were 3.3 times more at risk of developing asthma than children who did not practise sports. This statistically significant result suggests interaction between physical activity, which increases the respiratory rate, and ozone. Furthermore, the amount of time spent outdoors was also linked to the development of asthma. However, we should point out that the study's statistical power did not allow the researchers to definitely eliminate the effect of other pollutants. For the purpose of comparison, let us note that the average concentrations of ozone over an eight-hour period measured in these communities were over twice the levels measured in Montréal.

Another factor appears to come into play, and that is pulmonary growth in children. Researchers assembled a cohort of 1 759 10-year-old children living in 12 communities in southern California and followed them until the age of 18. They conducted annual



Studies devoted to children attending a school located near main traffic arteries or living in such a sector reveal an increase in respiratory or asthmatic symptoms related to the density of traffic or to the concentration of contaminants generated by transportation.

respiratory function tests from 1993 to 2001 and based on daily or bi-weekly environmental data, they calculated the annual averages of PM_{10} , $PM_{2.5}$, ozone and nitrogen oxides. They also took into account variables such as a history of asthma, whether the mother smoked during pregnancy, and the presence of contaminants in indoor air. The findings reveal a deficit in pulmonary growth linked to nitrogen oxides, particles (PM_{10} and $PM_{2.5}$), elementary carbon, and acid vapour. For example, in the communities with the highest particle levels, the forced expiratory volume⁹ is 80% lower than the anticipated value for their age and height for 10% of the children; this proportion is only 1% in the least polluted communities. In light of these findings, researchers say they are concerned about the long-term impact of air pollution and cite in support of their concern studies that demonstrate a link between a drop in pulmonary function and morbidity and mortality problems later in life.

In addition to these impacts on the lungs, other effects should be examined. Indeed, scientific reviews dating from 2004 cite studies that link air pollution to spontaneous abortion, premature births and low-weight babies. At present, we cannot confirm that

there is a causal link between these phenomena, but some researchers believe that we must devote further study to them. As for the development of cancer (leukaemia) among more heavily exposed children, not enough studies have been conducted to draw conclusions.

The burden of air pollution on health

Scientists responsible for helping organizations elaborate sound public policy governing transportation believe that they must first assess the burden imposed by diseases linked to air pollution.

To date, many assessments have been made but they remain a source of uncertainty for several reasons. First, these assessments can vary according to the type of effect measured, for example, depending on whether short- or long-term effects are considered. Another uncertainty arises because the result depends on three factors: the level at which the impact of the growing level of pollution is assessed, the relationship between exposure and effect,¹⁰ and whether or not there is a threshold below which no effect is noted, as we saw earlier. Another problem arises because the environmental data available usually focus on



9. The forced expiratory volume in one second (FEV1) is the maximum volume of air that can be expired in one second.

10. In other words, the dose-response, i.e. the relationship between the amount of a chemical product absorbed and the proportion of individuals in a group displaying an effect of a given nature and intensity.



a city or sector and not on individuals. It must also be emphasized that, while pollution exacerbates certain diseases, other factors can also come into play in the evolution of such diseases. Since the diseases are common and affect many people, it is difficult to pinpoint the fraction attributable to pollution alone. To extrapolate the findings of studies dealing with various cities to other cities can also be a source of error since all populations do not necessarily react in the same manner to the same contaminants.

France, Switzerland and Austria were the subject of a study aimed at assessing the burden of morbidity and mortality linked to air pollution. In 1996, the reference year in the assessment, the three countries had nearly 73.5 million inhabitants. Researchers chose PM_{10} as a basic indicator. Based on previous epidemiological studies, they developed a mathematical relationship that describes the long-term impact of pollution on health depending on the level of exposure to these particles. Next, based on environmental data, they established the average annual exposure of the population. They then evaluated the impact of air pollution on mortality and on several indicators of morbidity. Their conclusions are indicated below.

- Air pollution is responsible for 6% of overall mortality in the three countries, i.e. 40 000 deaths per year.
- Half of these deaths are attributable to transportation-related pollution, which represents double the number of deaths stemming from road traumas.
- In terms of morbidity, transportation-related pollution appears to cause each year:
 - › 25 000 new cases of chronic bronchitis among adults;
 - › over 290 000 bronchitis episodes among children;
 - › over 500 000 asthma attacks;
 - › over 16 million person-days of restricted activity.

There is a second approach to calculate the burden of air pollution on health, which consists in estimating the number of deaths avoided if the level of contaminants drops. Europe has established a public health monitoring system¹¹ that assesses the impact of PM_{10} in 19 cities with a combined population of over 32 million inhabitants.¹² According to this second study, a $5\text{-}\mu\text{g}/\text{m}^3$ reduction in the concentration of these particles could have prevented from 3 300 to 7 700 premature deaths per year. Of this number, between 500 and



11. *Air Pollution and Health: a European Information System (APHEIS)* is a program financed jointly by the European Commission and municipal institutions, coordinated by the Institut de veille sanitaire (InVS) in France and the Agencia de Salut Publica (ASP) in Barcelona.

12. *The study relies on the same parameters as the one conducted in France, Switzerland and Austria.*

According to a study conducted in three European countries, air pollution accounts for 6% of overall mortality, i.e. 40 000 deaths per year.

1 000 deaths are linked to peaks in short-term exposure but the majority is associated with lower everyday levels. For this reason, researchers believe that a reduction in air pollution spread over the entire year would be more beneficial than a reduction in pollution peaks.

Closer to home, Toronto Public Health has assessed the burden of air pollution on the health of the 2.5 million

residents for which it is responsible. Researchers have evaluated the short-term effects¹³ of gases (ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide) and the long-term effects of PM₁₀. Overall, they estimate that air pollution is linked to over 1 700 premature deaths, of which 518 are associated with gases and 1 268 with PM₁₀. However, another impact must also be taken into account: number

Figure 10

Main health impacts of the two key pollutants found in smog

Pollutant	Vulnerable groups	Short-term effects	Long-term effects
Ozone	• Young children • Individuals suffering from chronic respiratory diseases and the elderly	• Temporary reduction in pulmonary function • Increase in the severity and frequency of asthma attacks • Increase in hospitalizations and emergency room visits for respiratory diseases • Increase in respiratory mortality	• Possible increase in the development of asthma • Reduction in pulmonary growth in children
Fine particles (PM _{2.5})	• Young children • The elderly • Individuals suffering from chronic heart and respiratory diseases or type II diabetes	• Increase in respiratory tract infections • Increase in the severity and frequency of asthma attacks • Increase in hospitalizations and emergency room visits for cardiovascular and respiratory diseases • Increase in cardiovascular and respiratory mortality	• Reduction in pulmonary growth in children • Increase in mortality from cardiorespiratory diseases • Increase in mortality from lung cancer

Note: The short-term effects can be observed among vulnerable individuals in the hours or days following the onset of a smog episode or during a lengthy period of smog. The long-term effects are observed after months or years of exposure.

13. Once again, epidemiological data are applied to health and environmental data.



of hospitalizations. Indeed, over 6 000 hospitalizations per year for respiratory and cardiovascular diseases appear to be due to these pollutants.

In eight big Canadian cities, including Montréal, researchers have recently estimated excess mortality linked to air pollution. They have taken into account short-term effects during pollution peaks and long-term effects among residents exposed to lower levels of pollutants. According to the researchers, 5 900 premature deaths per year are attributable to air pollution, including just over 1 500 deaths in Montréal, 400 of which are linked to pollution peaks and 1 140 to chronic exposure.

Figure 10 summarizes the effects of ozone and fine particles, the two main pollutants found in smog. It should be noted that the two pollutants react with each other and with allergens in ambient air (pollen and spores that trigger allergies in sensitized individuals). Furthermore, the effects of all of these contaminants in outside air increase in during heat waves.

Greenhouse gases and climate change

Currently, the scientific community agrees that global warming is a genuine phenomenon that is largely attributable to human activities, especially the growing presence of greenhouse gases (GHG) in the atmosphere. Indeed,

current climatic data show that the past decade has been the hottest since mid-19th century, that is, since temperature records have been kept. The effect of this warming trend will be to increase the frequency, duration and intensity of heat waves.

We must also add other notable climatic changes, since the rise in temperatures is linked to the amount and type of precipitation and the frequency of extreme weather conditions. In fact, scientists believe that warming can increase the frequency and intensity of hurricanes, storms, droughts and floods. These phenomena of course imply many health risks, in particular injuries, psychological distress and even death.

To react to these climatic phenomena, many countries agreed to adopt in 1997 the Kyoto Protocol, which came into force on February 16, 2005. The Kyoto Protocol calls for a 5% reduction in GHG emissions by 2012 in relation to 1990 levels. Each participating country sets its own objectives. In Canada, where the objective is 6%, a great deal must be done to reach this level since current emissions are 25% higher than they were in 1990. In other words, GHG emissions in Canada must fall by over 30% over the next six years.

The United Nations Climate Change Conference held from November 28 to December 10, 2005 in Montréal made it possible to again bring the Kyoto

According to certain studies, 1 540 premature deaths are caused by air pollution in Montréal (400 linked to short term peaks and 1 140 linked to chronic exposition).

Protocol to the forefront through the adoption of over 40 decisions to better structure ways of complying with commitments under the protocol. Discussions on the post-Kyoto Protocol period, i.e. commitments for the period 2013-2017, began in May 2006.

As we noted earlier, the transportation sector plays a leading role with respect to GHG emissions in Montréal and Quebec (see Figure 6) and its contribution is growing steadily. In fact, the Quebec inventory of GHG emissions in 2003 reveals a 20% increase in the road transportation sector in relation to 1990: emissions from light trucks (pickup trucks, panel trucks and SUVs¹⁴) have increased the most. In Canada, GHG emissions from light trucks rose 88% between 1990 and 2002 and a similar trend can be observed in Quebec. The increase of GHG of international origin must also be factored in.

Two reasons explain this situation. First, vehicle fuel consumption has improved only slightly over the past 20 years. For example, in the case of private passenger vehicles, average fuel consumption in 1986 stood at 8.2 L/100 km. By 2004, it had fallen to 7.6 L/100 km, a 7.4% improvement. Conversely, the fuel consumption of light trucks, which stood at 10 L/100 km in 1986, increased to an estimated 10.7 L/100 km in 2004, up 0.7%. Stated more simply, light trucks

Figure 11

Growth in the number of light and heavy trucks operating in Quebec (1990-2003)

	1990	2003
Light trucks	587 575	1 240 576
Heavy trucks	99 607	196 479
Total	687 182	1 437 035

Source: *Développement durable, Environnement et Parcs Québec*, 2006

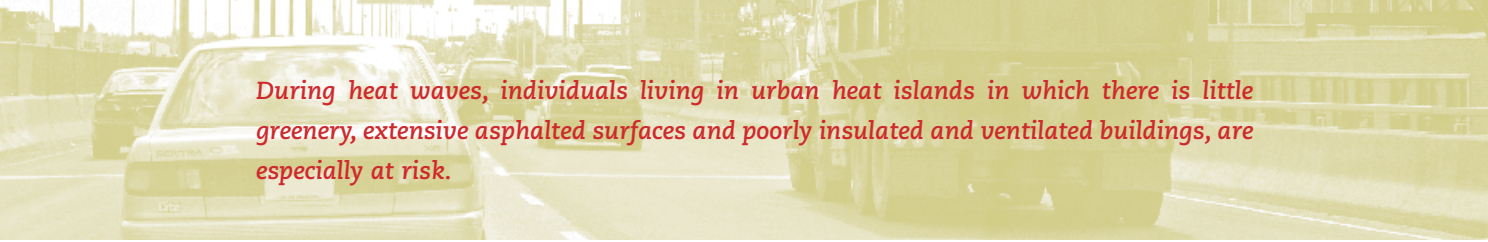
emit on average 40% more GHG per kilometre than cars do. Second, the number of light and heavy trucks operating in Quebec almost doubled between 1990 and 2003 (Figure 11). Therefore, it goes without saying that per capita gasoline consumption has increased considerably.

In the metropolitan area, the proportion of GHG attributable to transportation stands at 47%: it is thus readily apparent that measures aimed at the Quebec transportation sector can contribute extensively to the attainment of the objectives set by the Kyoto Protocol and its subsequent commitments.

Impact of heat waves

If we now turn to the question of heat waves stemming from the increase in GHG emissions, we note that they have direct and indirect effects on health. Heatstroke occurs when the body loses its ability to control its temperature

14. SUV: sport utility vehicle.



During heat waves, individuals living in urban heat islands in which there is little greenery, extensive asphalted surfaces and poorly insulated and ventilated buildings, are especially at risk.

(which is very rare) and is the most dramatic direct effect since it can be fatal. Indeed, in Quebec in 2002, two workers succumbed to heatstroke while performing physically demanding tasks during a heat wave. Exhaustion and cramps are other direct effects, to which must be added problems indirectly attributable to heat waves, which are more frequent. They often result from exacerbation of a chronic medical condition among elderly people, for example, cardiovascular, cerebrovascular, respiratory, neurological and kidney diseases. Individuals who live in urban heat islands in which there is little greenery, extensive asphalted surfaces and poorly insulated and ventilated dwellings, are especially at risk. Individuals who are alone, bedridden or unable to care for themselves are also at greater risk than those living with people who can help them maintain hydration.

For example, the heat wave that struck Europe during the summer of 2003 revealed its devastating effect. According to French public health officials, nearly 15 000 more deaths than the average between August 1 and 20, 2003 were noted. In Paris, maximum temperatures exceeded 35°C for several days and minimum temperatures remained above 23°C almost constantly between August 4 and 12. In addition, on August 11 and 12, the temperature did not fall below 25.5°C.

Environment Canada issues heat wave and high humidity warnings when it expects temperatures of 30°C or over and a Humidex reading of 40 or more. Each summer since 1996, Environment Canada has issued up to five warnings in the metropolitan area. The summer of 2005 was especially hot: for 23 days, the maximum temperature reached 30°C or more, although the Humidex did not always reach 40.

Montréal has not experienced weather as extreme as that in Europe in 2003, but a retrospective analysis made it possible to pinpoint three heat waves over the past 20 years during which 30 to 60 excess deaths per day were recorded, approximately double the daily average: for three days, the average maximum temperature reached or exceeded 33°C and the average minimum reached or exceeded 20°C. The *Plan montréalais de prévention et de protection en cas de chaleur accablante* that the Direction de santé publique established in collaboration with its partners in the health care network and the City of Montréal is based on these thresholds. The plan is intended to avoid an increase in deaths or the aggravation of health problems during heat waves.

Interactions with biological aeroallergens

Aside from the individual health impacts of airborne pollutants and climate changes linked to GHG, interactions

Between 1994 and 2002, the length of the ragweed pollen season increased 44%. Moreover, higher temperatures are believed to promote fungal growth, which affects the health of people who are allergic to mould.

have also been observed among contaminants. In addition, heat also exerts an influence on the health effects of air pollutants. For example, researchers have confirmed that exposure to ozone can increase reactivity to allergens, which appears to explain the impact on asthma. Other researchers believe that certain atmospheric particulates can attach themselves to allergens, thus facilitating their penetration into the lungs.

Climate change also plays a role in the presence of biological aeroallergens, given its impact on growth and the vegetation cycle. Indeed, with warmer springs, the flowering period of certain plant species can occur earlier, thus increasing the proliferation of allergenic plants. For example, the length of the ragweed pollen season increased 44% between 1994 and 2002 in Montréal. Moreover, according to researchers, higher temperatures promote fungal growth, which affects the health of individuals who are allergic to mould. This means that any effort aimed at reducing the levels of pollutants emitted by automobiles or the impact of GHG would affect the level of airborne pollen and mould spores and their effects on health.

We must also mention the increase in the concentration of various airborne pollutants linked to temperature. For example, gasoline and solvents volatilize more extensively at high temperatures, thus increasing the level

of volatile organic compounds (VOC) in the air. Similarly, higher temperatures promote a photochemical reaction between nitrogen oxides (NO_x) and VOC that leads to the formation of ozone, thus contributing to higher ozone levels.

In other words, not only are higher temperatures linked to various health problems among vulnerable individuals but they are also accompanied by a second repercussion in that they contribute to higher concentrations of airborne pollutants, which in turn are linked to health problems among these individuals.

Noise pollution

Noise pollution is another type of pollution that the transportation sector causes, which also has an impact on the health of individuals living near traffic arteries and which has been the subject of many studies. Noise is defined as a sound deemed to be undesirable. A distinction is made between noise in the workplace, whose effects on hearing are well documented, and environmental noise. Indeed, we know that high levels of noise cause a temporary shift in auditory thresholds, which can lead to permanent hearing loss if exposure continues, for example, over several years. We will only examine here impacts other than the auditory impact of environmental noise, which WHO documented thoroughly in 1999.



Environmental noise can hamper speech understanding and the performance of complex tasks such as reading, attention, problem-solving and memorization.

Road, rail and air transportation are one of the main sources of environmental noise, whose level increases with volume and speed. Some 40% of the population of the European Union is deemed to be exposed to a level of road traffic noise exceeding 55 dB(A), which represents moderate discomfort.

The principal effect of environmental noise is interference with sleep. Uninterrupted sleep is considered to be essential to sound physiological and mental functioning. Interference with sleep stemming from noise is manifested not only in difficulty in getting to sleep, frequent waking and changes in sleep stages and the deepness of sleep, but also in certain cardiovascular changes such as higher blood pressure and faster heart rate. These primary effects can have repercussions (or secondary effects) the next day, such as increased fatigue, a feeling of depression and impaired performance. In other words, night environmental noise has pronounced direct effects on sleep, some of which persist the next day during everyday activities.

The mental health effects of long-term exposure have not been documented with certainty because of methodological problems. Some studies nonetheless suggest that environmental noise appears to have an impact on use of tranquillizers and sleeping pills, psychiatric symptoms and number of admissions to psychiatric hospitals.

From a cognitive standpoint, environmental noise can also hamper speech comprehension and the performance of complex tasks such as reading, attention, problem-solving and memorization. For this reason, WHO recommends that neither day care centres nor schools be established near highways or other sources of disruptive noise.

Standards and recommendations in force

Noise is measured in decibels. The decibel (dB) is the unit of measurement of sound level and the decibel A, or dB(A), is the weighted measurement that takes into account the response of the human ear in relation to sound frequency. Norms and recommendations pertaining to environmental noise are expressed in dB(A).

According to WHO, the measurable effects on interference with sleep begin at 30 dB(A) and the threshold outside inhabited places (1 m from the façade of a dwelling) is 45 dB(A), to allow occupants to sleep with the window open (the difference in intensity between the inside and the outside of the dwelling is 15 dB(A)). In addition to constant noise, we must also consider impact noise, which can interfere considerably with sleep.

Since noise can also interfere with language perception in the home, the school or an office, the level of background noise must be 15 dB(A) lower than the level of the voice, which is





50 dB(A). In other words, it must not exceed 35 dB(A). Because noise causes discomfort or inconvenience, it has been calculated that noise levels outside dwellings should not exceed 50 dB(A).

Over the past five years, the DSP has been approached a number of times by residents complaining of noise pollution problems stemming from transportation, both in areas near highways and in central neighbourhoods crossed

by very busy streets. Current data reveal that WHO recommendations are indeed exceeded in residential areas along major urban thoroughfares. It should be noted that the *Premier plan stratégique de développement durable de la collectivité montréalaise* seeks to adopt by 2009 a municipal noise policy that would guarantee for Montrealers a calm, peaceful living environment, and that several of the measures suggested deal with road traffic.



REFERENCES

- American Academy of Pediatrics. 2004. "Policy Statement, Ambient Air Pollution, Health Hazards to Children", *Pediatrics*, vol. 114 (6), p. 1699-1704.
- Andersen, L. B., Schnohr, P., Schroll M. et al. "AI-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work", *Archives of Internal Medicine* 2000, 160 (11), p. 1621-1628.
- Auger, N., Kosatsky, T. 2002. "Chaleur accablante", Direction de santé publique de Montréal, 34 p.
- Bernard, S. M., Samet, J. M., Grambsch, A. et al. 2001. "The Potential Impacts of Climate Variability and Change on Air Pollution-Related Health Effects in the United States", *Environmental Health Perspectives*, vol. 109, suppl. 2, p. 199-209.
- Brauer, M., Hoek, G., Van Vliet, P. et al., 2002. "Air Pollution from Traffic and the Development of Respiratory Infections and Asthmatic and Allergic Symptoms in Children", *American Journal of Respiratory and Critical Care Medicine*, vol. 166, p. 1092-1098.
- Breton, M.-C. et al. "Association entre les concentrations polliniques de l'*Ambrosia s.p.p.* et les consultations pour rhinite chronique à Montréal". Soumis pour publication.
- Brook, R. D., Franklin B., Cascio, W. et al. 2004. "Air Pollution and Cardiovascular Disease", *Circulation*, vol. 109, p. 2655-2671.
- Brunekeerf, B., Holgate, S. T. 2002. "Air pollution and health", *The Lancet*, vol. 360, p. 1233-1242.
- Burnett, R. T., Brook, J. R., Yung, W. T. et al. 1997. "Association between ozone and hospitalization for respiratory diseases in 16 Canadian cities", *Environmental Research*, vol. 72, p. 24-31.
- D'Amato, G., Liccardi, G., D'Amato, M. et al. 2001. "The role of outdoor air pollution and climatic changes on the rising trends in respiratory allergy", *Respiratory Medicine*, vol. 95, p. 606-611.
- Delfino, R., Murphy-Moulton, A., Burnett, R. T. et al. 1997. "Effects of air pollution on emergency room visits for respiratory illnesses in Montréal, Québec", *American Journal of Respiratory and Critical Care Medicine*, vol. 155, p. 569-576.
- Environnement Canada, 2005. *Canada's Greenhouse Gas Inventory*.
- Environnement Canada, 2005. Fine Particles and Ozone in Canada: A Canada-wide Standards Perspective, 2003 National Summary, 32 p.
- Développement durable, Environnement et Parcs Québec. 2006a. *L'ozone et les particules fines : état de la situation au Québec et éléments d'intervention*, 6 p.
- Développement durable, Environnement et Parcs Québec. 2006b. *Inventaire des émissions des gaz à effet de serre en 2003 et évolution depuis 1990*.
- Friedman, M. S., Powell, K. E., Hutwagner, L. et al. 2001. "Impact of Changes in Transportation and Commuting Behaviours During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma", *Journal of American Medical Association*, vol. 285 (7), p. 897-905.



Gauderman, W. J., Avol, E., Gilliland, F. et al. 2004. "The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age", *New England Journal of Medicine*, vol. 351 (11), p. 1057-1067.

Gehring, U., Cyrys, J., Brunekreef, B. et al. 2002. "Traffic-related air pollution and respiratory health during the first two years of life", *European Respiratory Journal*, vol. 19, p. 690-898.

Gent, J. F., Triche, E. W., Holford, T. R. et al. 2003. "Association of Low-Level Ozone and Fine Particles with Respiratory Symptoms in Children With Asthma", *Journal of American Medical Association*, vol. 290 (14), p. 1859-1867.

Goldberg, M. S., Burnett, R. T., Bailar, J. C. et al. 2001a. "The association between daily mortality and ambient air particle pollution in Montreal, Quebec. 1. Non accidental mortality", *Environmental Research*, A86, p. 12-25.

Goldberg, M. S., Burnett, R. T., Bailar, J. C. et al. 2001b. "The association between daily mortality and ambient particle pollution in Montreal, Quebec. 2. Cause-specific mortality", *Environmental Research*, A86, p. 26-36.

Goldberg, M. S., Burnett, R. T., Yale, J.-F. et al. 2006. "Associations between ambient air pollution and daily mortality among persons with diabetes and cardiovascular disease", *Environmental Research*, vol. 100, p. 255-267.

Gilbert, N. L., Goldberg, M. S., Beckerman, B. et al. 2005. "Assessing Spatial Variability of Ambient Nitrogen Dioxide in Montreal, Canada with a Land-Use Regression Model", *Journal Air & Waste Management Association*, vol. 55, p. 1059-1063.

Hémon, D., Jougl, É., Clavel, J. et al. 2003. "Surmortalité liée à la canicule d'août 2003 en France", *Bulletin d'épidémiologie hebdomadaire*, vol. 45-46, p. 221-225.

Hoek, G., Brunekreef, B., Goldbohm, S. et al. 2002. "Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study", *The Lancet*, vol. 360, p. 1203-1209.

Judek, S., Jessiman, B., Steib, D. 2005. *Estimation de la surmortalité causée par la pollution atmosphérique au Canada*, Santé Canada, 10 p.

Kinney, P., Aggarwal, M., Northbridge, M. et al. 2000. "Airborne concentrations of PM_{2.5} and diesel exhaust particles on Harlem sidewalks", *Environmental Health Perspectives*, vol. 108 (3), p. 213-218.

Kunzli, N., Kaiser, R., Medina, S. et al. 2000. "Public-health impact of outdoor and traffic-related air pollution: a European assessment", *The Lancet*, 356 (9232), p. 795-801.

Lavigne, J. 1998. "Ozone", dans *Pollution atmosphérique et impacts sur la santé et l'environnement dans la grande région de Montréal*, Regroupement montréalais pour la qualité de l'air, p. 178-192.



- Levetin, E., Van de Water, P. 2001. "Environmental Contributions to Allergic Disease", *Current Allergy and Asthma Reports*, vol. 1, p. 506-514.
- Levy, J., Houseman, E., Spengler, J. D. et al. 2001. "Fine Particulate Matter and Polycyclic Aromatic Hydrocarbon Concentration Patterns in Roxbury, Massachusetts: A Community-Based GIS Analysis", *Environmental Health Perspectives*, vol. 109 (4), p. 341-347.
- McConnell, R., Berhane, K., Gilliland, F. et al. 2002. "Asthma in exercising children exposed to ozone: a cohort study", *The Lancet*, 359, p. 386-391.
- Morris, R. D. 2001. "Airborne Particulates and Hospital Admissions for Cardiovascular Disease: A Quantitative Review of the Evidence", *Environmental Health Perspectives*, vol. 109, suppl. 4, p. 495-500.
- Pengelly, D., Cheng, C., Campbell, M. 2005. *Toronto Public Health: Influence of Weather and Air Pollution on Mortality in Toronto*, 30 p.
- Pope, C. A., Burnett, R. T., Thun, M. J. et al. 2002. "Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution", *Journal of American Medical Association*, vol. 287 (9), p. 1132-1141.
- Regroupement montréalais pour la qualité de l'air. 1998. *Pollution atmosphérique et impacts sur la santé et l'environnement dans la grande région de Montréal*, 355 p.
- Réseau de surveillance de la qualité de l'air, Ville de Montréal, Rapports annuels 2002-2004.
- Schwartz, J. 2004. "Air Pollution and Children's Health", *Pediatrics*, vol. 113 (4), p. 1037-1043.
- Smargiassi, A., Baldwin, M., Pilger, C. et al., 2005. "Small scale variability of particle concentrations and traffic levels in Montreal: a pilot study", *The science of the total environment*, vol. 338 (3), p. 243-251.
- Smargiassi, A., Berrada, K., Fortier, I. et al., 2006. "Traffic intensity, dwelling value and hospital admissions for respiratory disease among the elderly in Montreal (Canada): a case-control analysis", *Journal of Epidemiology and Community Health*, 60, p. 507-512.
- Thurston, G., Bates, D. 2003. "Air Pollution as an Underappreciated Cause of Asthma Symptoms", *Journal of American Medical Association*, vol. 290 (14), p. 1915-1917.
- World Health Organization, 1999. Guidelines for Community Noise.
- World Health Organization (OMS, UNEP, WMO), 2003. *Climate change and human health-risks and responses*.
- World Health Organization, 2003. *Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide*. Report on a WHO Working Group.
- Yaffe, B. 2004. *Air Pollution Burden of Illness in Toronto*, Toronto Public Health.

3

Heavy Burden

Road Deaths and Injuries, a Heavy Burden





CHAPTER 3

Road Deaths and Injuries, a Heavy Burden

During the course of the 20th century, road accidents became one of the leading causes of death and morbidity in the world, killing or seriously injuring over 20 million people each year. By 2020, observers estimate that injuries stemming from road accidents will be the third cause of lost years of life (death and disabilities included¹⁵), after heart disease and depression. In Quebec, road accidents account for over 50 000 injured people each year, of whom 600 to 700 die.

For the past 30 or so years, a decline has been noted in road deaths despite a concomitant increase in vehicle trips, which represents some degree of success. However, if we focus solely on mortality, the scope of the problem is largely underestimated since this marks only the tip of the iceberg. For example, in Montréal, there are 220 times as many injuries as deaths. Moreover, since 1998, the number of injured individuals has been rising in Montréal and in Quebec, a disturbing trend.

The consequences of accidents

It must be emphasized that road accident tolls rarely take into account the seriousness of injuries, permanent physical sequelae, psychosocial impact and the impact on the quality of life of individuals, which are nonetheless essential factors to be considered. Collisions that cause property damage but no injuries are declared less and less frequently, not to mention innumerable dangerous

15. Disability-adjusted life year (DALY): years of life adjusted for disability. This indicator takes into account two facets, i.e. the number of years of life lost following premature death or a disability. Years of life lost because of disability are weighted according to the level of seriousness of the disability.

situations, for example, at intersections, which engender insecurity that dissuades individuals from resorting to active transportation such as walking and cycling.

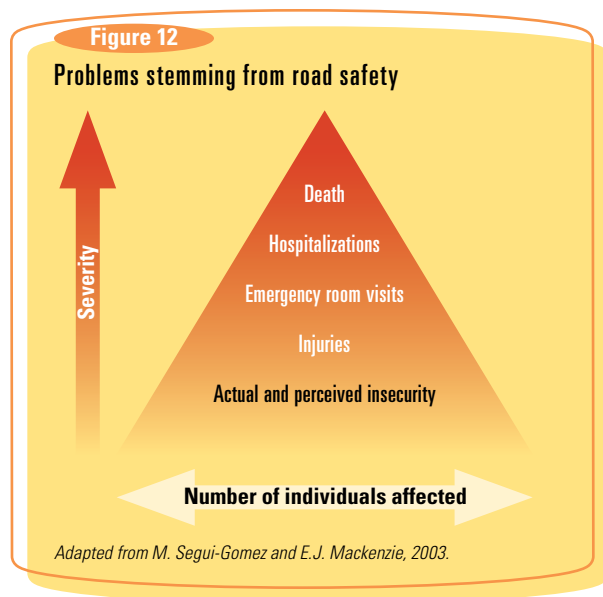
Figure 12 illustrates the seriousness of the impact of road accidents according to the number of individuals affected. Each year, several hundred deaths, several thousand hospitalizations, several tens of thousands of injured persons, over 100 000 declared accidents and millions of quasi-accidents in which collisions are avoided at the last minute are recorded in Quebec.

A major cause of death among young people

The number of individuals in Quebec who die following a road collision has declined, from a maximum of 2 209 in 1973 to a minimum of 615 in 2001 (647 in 2004). This trend is similar to that observed in the other industrialized nations. On the Island of Montréal, where the mortality rate is lower than in rural areas, the number of deaths attributable to road accidents has also fallen, to a minimum of 42 in 2001 (54 in 2004).

Only a minority of individuals injured in collisions dies. Indeed, among the seriously injured, progress in medical care means that the likelihood of death is one-sixth what it was 10 years ago. Overall, roughly 1.2% of individuals injured on Quebec roads die; on the Island of Montréal, the figure is 0.4% (2001-2003).

Road collisions are, nonetheless, a leading cause of mortality among young adults. Road accidents account for one-fifth of deaths in the 5-34 age group and the proportion rises to 29% in the 15-24 age group (2000 and 2001). Contrary to deaths attributable to cardiovascular disease or cancer, which occur above all late in life, road collisions end lives at a younger age (see Figure 13). In Canada, as in the United States, accidental injuries are the leading cause of death in the 1-34 age group,¹⁶ and road collisions rank first.



16. Worldwide, motor vehicle accidents are the second cause of death in the 5-14 age group (after early childhood diseases) and in the 15-29 age group (after HIV/AIDS), and the third cause of death in the 30-44 age group (after HIV/AIDS and tuberculosis). In 2002, in these three age groups, the estimated number of deaths was 130 835, 302 208 and 285 457.



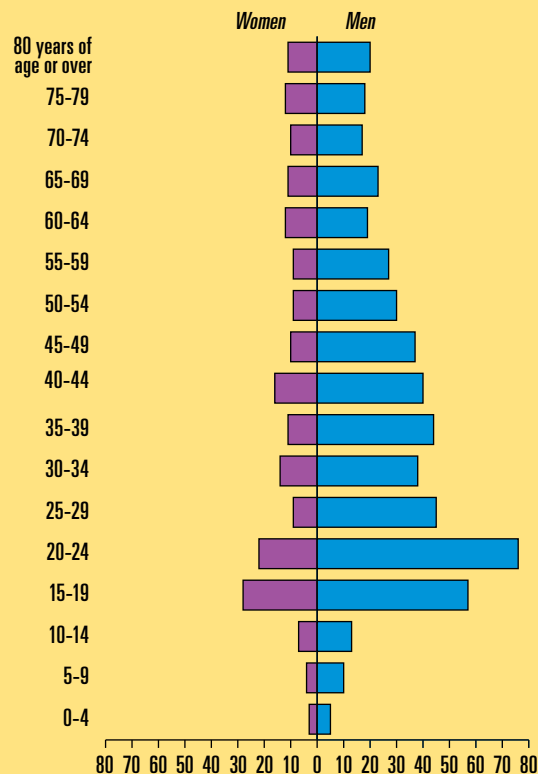
Thousands of hospitalizations

In 2003-2004,¹⁷ over 5 500 hospitalizations of road users injured in Quebec were recorded,¹⁸ more than in each of the two preceding years. The number of

hospitalizations declined in the 1990s, but this change is partly attributable to the reorganization of health care services, which generally reduced recourse to hospitalization in Quebec, as a result of hospital closings and the shift to ambulatory care. For example, between 1992-1993 and 1997-1998, while the number of hospitalizations for road injuries fell 20% among Montrealers, it should be noted that the total number of hospitalizations for short-term physical care also declined by 16%. However, the different trends in the number of hospitalizations for each type of road user cannot be explained by the reorganization of the health care system. In Montréal, pedestrians and cyclists now account for over half of hospitalizations due to road injuries (53% in 2001-2003), slightly higher than previously (45% in 1989-1991).

Figure 13

Annual number of road deaths, by age and sex (2000-2001)



Tens of thousands of road injuries

In Quebec, estimates of the number of persons injured in vehicle accidents are usually based on a single information source: the accident report filled out by the police. It must be emphasized that the integration of different registries, e.g. accident reports, ambulance services and hospitalizations, could increase this figure.

17. The fiscal year for the hospitalization registry runs from April 1 to March 31.

18. In keeping with the usual method, day surgery, hospitalizations in rehabilitation hospitals, long-term care facilities, and so on, are excluded.



In Canada overall, 224 000 road users sustained injuries in 2001, equivalent to more than 600 a day. In Quebec, according to police reports, 56 516 individuals were injured in road accidents in 2003, 12 806 of them on the Island of Montréal. Despite

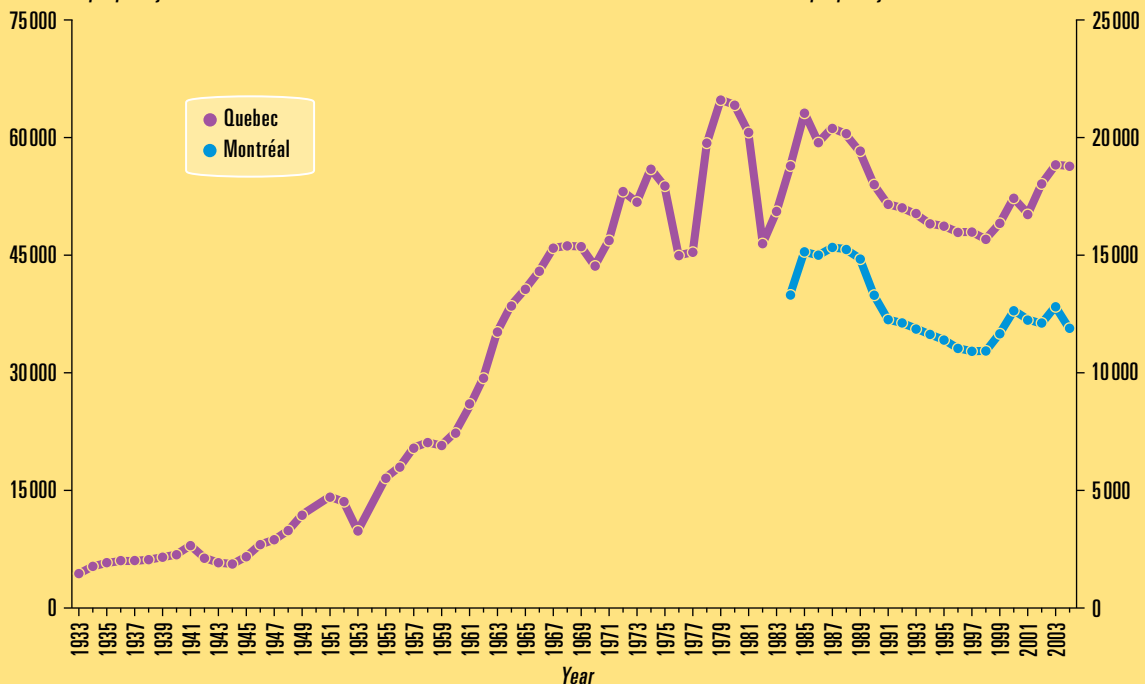
a downturn in the early 1990s, the number of injured persons has been rising recently: the increase observed over the past five years cancels out previous gains (Figure 14).¹⁹

Figure 14

Evolution in the annual number of people injured in road accidents in Quebec and on the Island of Montréal

Number of people injured in road accidents in Quebec

Number of people injured in road accidents in Montréal



Sources: Bourbeau, 1983 and SAAQ annual statistics

19. Calculated for Quebec as a whole, the annual road injury rates (721/100 000 inhabitants in 2001-2003) fell to a level similar to those in the early 1990s (716/100 000 inhabitants in 1991-1993; SAAQ, annual statistics, 1998 to 2003).



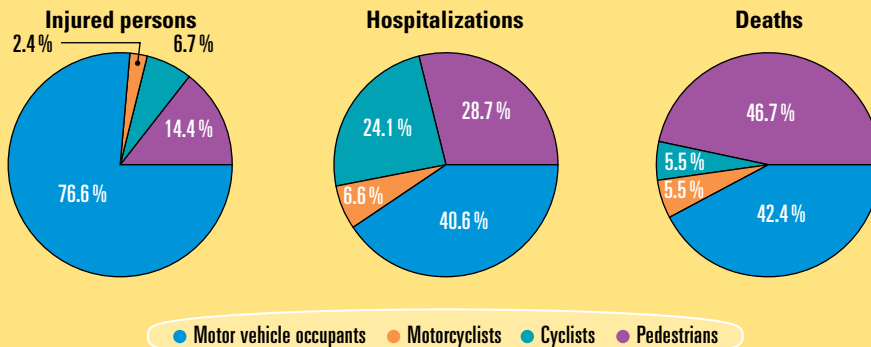
Pedestrians are very vulnerable road users

Pedestrians are extremely vulnerable road users. Indeed, an injured pedestrian is much more likely to die than the occupants of motor vehicles, i.e. twice as likely in Quebec as a whole (2.4% and 1.2%, respectively),²⁰ and six times more likely in Montréal (1.3% and 0.2%).²¹ Among those injured who required ambulance service on the Island of Montréal between 1999 and 2003, 1 pedestrian out of 12 (8.3%) was seriously injured, compared with 1 occupant of a motor vehicle out of 29 (3.4%).

Viewed from another perspective, according to the Montréal police force, pedestrians accounted for 14% of road accident injury victims in 2002-2004 but for 29% of hospitalizations and 47% of deaths among road users (Figure 15). It should also be noted that pedestrians remain in hospital longer, that is, 14 days on average compared with 9 days for motorists in 2003-2004. One-third (33%) of pedestrians spent over two weeks in hospital, as opposed to one-sixth (16%) of motorists. Indeed, since pedestrians are not protected by

Figure 15

Breakdown in the number of injured persons, hospitalizations and deaths among road users (Montréal, 1999-2001)



Sources: SAAQ annual statistics and DSP Montréal

20. Between 2000 and 2002 in Quebec, among the 3 762 pedestrians injured each year, an average of 91 (2.4%) died. Among the 43 110 occupants of motor vehicles injured each year, an average of 520 (1.2%) died (SAAQ, 1988 to 2003 annual statistics).

21. Between 2000 and 2002 in Montréal, among the 1 776 pedestrians injured each year, an average of 24 (1.3%) died. Among the 9 403 occupants of motor vehicles injured each year, an average of 22 (0.2%) died (SAAQ, 1988 to 2003 annual statistics).

a vehicle body, they are more likely to sustain serious injuries in an accident. It would thus make sense to take this risk into account when planning measures to prevent injury or promote active transportation and, more generally, in transportation planning.

Greater numbers of pedestrians are injured in the central boroughs

Depending on the borough, the number of pedestrians injured varies considerably. It is markedly higher in the central boroughs, with the exception of Westmount and Outremont (Figure 16). Various factors explain the higher numbers, including the size and density of the population, the greater number of trips on foot (see Figures 17

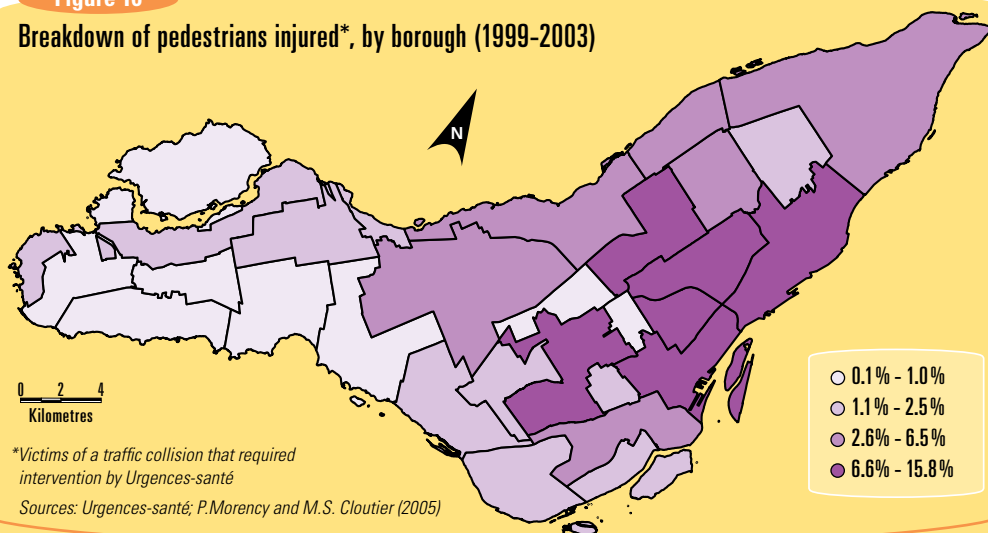
and 30), the higher volume of through traffic, the absence of quality facilities for pedestrians, and so on.

Furthermore, as for most health problems, the breakdown of people injured in road accidents follows that of poverty, which has been known for a long time. In Montréal during the 1980s, the injury rate due to collisions was four times higher among children from the poorest neighbourhoods and six times higher among young pedestrians.

Regardless of the borough, the geographic distribution of pedestrians injured nonetheless reflects the generalization of the problem at many intersections and on many streets

Figure 16

Breakdown of pedestrians injured*, by borough (1999-2003)





(Figure 18). In fact, only one or two injured individuals were counted at the majority of sites involved during the five years under study. In some boroughs, up to one-quarter of intersections have been the site of at least one injured pedestrian: Plateau Mont-Royal, 26%; Rosemont, 23%; Ville-Marie, 24%, and so on. For such a widespread problem it is obvious that prevention measures must be applied to an entire sector and not just one or two targeted intersections.

The economic burden of road accident traumas

In heavily motorized countries such as Canada, it is estimated that the cost of road accident traumas was equivalent

in 2004 to 2% of GNP. For Canadians, this would entail economic losses of between \$10 billion and \$25 billion.

Direct and indirect costs must be taken into account when evaluating the cost of road traumas. According to a study conducted in Canada, the direct costs, above all for medications, prosthetic devices and medical and paramedical services, stood at \$375 million in 1995. As for the indirect costs—loss of income stemming from premature death, hospitalization, disability, and so on—the same study set the costs at \$966 million for deaths and \$329 million for disabilities, for a total of \$1.670 billion (direct and indirect costs). According to another study, the indirect costs of deaths reached \$1.556 billion

Figure 17

Proportion of dwellings without a car according to sector

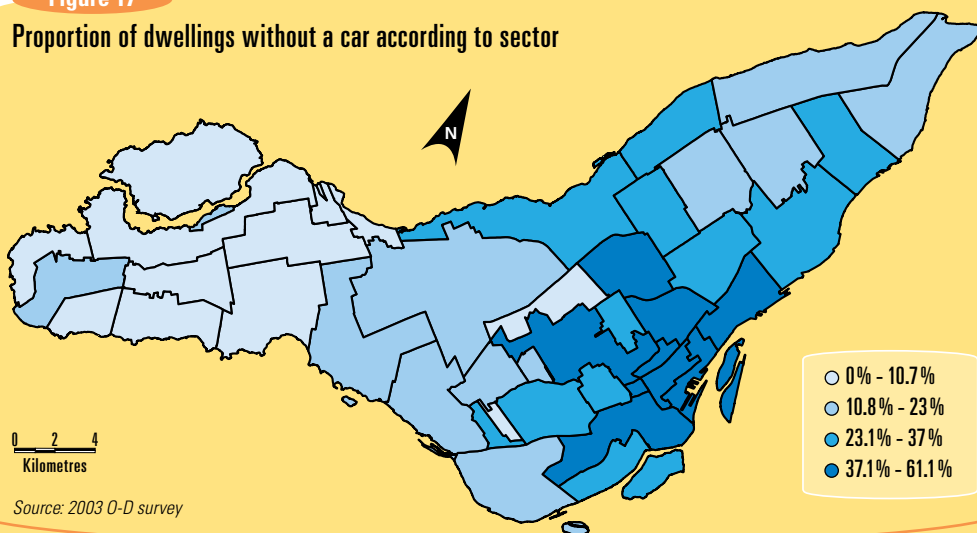




Figure 18

Breakdown of pedestrians injured* in the borough of Ville-Marie/Centre-Sud (1999-2003)



* Victims of a traffic collision that required intervention by Urgences-santé

Source: P. Morency and M.S. Cloutier (2005)



Road accident traumas represent a very heavy economic burden for individuals and institutions in Quebec and everywhere in Canada.

in 1998. The two studies do not take into account property damage,²² which partly explains the apparent discrepancy with the figures cited earlier. In Quebec alone, in 2000 the cost of road accidents was set at \$2.642 billion, including \$778 million due to lost production, \$401 million for compensation and health costs (reimbursed by the SAAQ), and \$1.463 billion for payment of property damage.

The upshot is that, even though estimates vary because they take into account different factors, road accident traumas represent a very heavy economic burden for individuals and institutions in Quebec and everywhere in Canada.

Contributing factors

A basic factor: the vehicle's energy

As is true of infectious diseases, injuries result from the interaction between an agent and a host in a given environment. In the case of road accident injury victims, the agent involved is not a virus or a bacterium, but rather a moving vehicle. Damage results from the transfer of energy by the vehicle to objects and individuals, which is why a heavier vehicle or one travelling at a higher speed causes more damage. Consequently, various strategies make it possible to reduce injuries: reduce

the amount of energy accumulated (e.g. lower speed), reduce the rate of transfer of energy (e.g. crumple zones), separate the agent and the host in time or space (e.g. cycle paths), and so on.

To examine the numerous factors involved, researchers resort to Haddon's Matrix, which distinguishes three main categories of factors—individual factors and factors related to the vehicle and the environment—and the point at which they intervene: before, during or after the collision (Figure 19). For each of these factors that reduce or increase the likelihood of accidents and injuries, several interventions are possible.

Behavioural risk factors

Among the types of behaviour that increase the likelihood of accidents and injuries, the best known are failure to use a seatbelt, impaired driving, speeding and, overall, failure to comply with the *Highway Safety Code*. Transport Canada estimates that 715 lives would be saved in Canada by 2010 if the rate of seatbelt use increased from 89% to 95%. According to the SAAQ, alcohol still accounts for nearly one-third (30%) of deaths and, according to police reports, speeding is the primary cause of approximately one-quarter (23%) of deaths and roughly 6 500 injuries each year in Quebec. However, these

22. The two studies consider health costs, e.g. injuries, in a societal perspective, that is, they include both public and private expenditures but not the costs of property damage stemming from collisions (vehicles, infrastructure, property, and so on).



Figure 19

Examples of the factors involved (Haddon's Matrix)

Phase	Category of determinant and target		
	Host (person)	Agent (vehicle)	Physical and sociocultural environment
Pre-collision	Type of driving, compliance with the <i>Highway Safety Code</i>	Quality of brakes, tires, blind spots	Roads, pedestrian facilities, cycle paths, police surveillance
Collision	Cycle helmet, seatbelt	Air bags, crumple zone*	Ductile energy absorption structure
Post-collision	Physical condition of injured parties, age, notions of first aid	Risk of fire	Promptness of ambulance service, efficacy of health care system

* A device to protect the occupants at the front and back of the vehicle that allows part of the vehicle to crumple in order to absorb energy resulting from rapid deceleration in the event of a collision and to maintain intact the passenger compartment.

figures overlook several other factors, for example infrastructure and vehicle safety.

Obviously, behaviour is not solely contingent upon deliberate personal choices or individual knowledge, attitudes and skills. It is also influenced by social norms and the physical, institutional and economic environment. Speed, for example, is linked to the perception of risk of being in an accident, the level of police surveillance, road signs, the layout of streets, and so on. In addition, speed is sustained and encouraged by advertising and the growing power of vehicles.

To modify such behaviour, authorities often resort to communications and social marketing strategies, which, un-

fortunately, are hardly effective in the absence of complementary strategies such as legislation, police surveillance and the enhancement of vehicles or the environment. The right turn on red (RTOR) pilot project launched in 2001 in Quebec confirms this observation. Indeed, despite an extensive information and awareness campaign organized throughout the duration of the project, the proportion of right turns on red in compliance with the norms steadily declined, from 38% in April to 30% in May, 24% in June and 22% in October. It should also be emphasized that awareness campaigns and educational programs are not very effective ways to enhance the safety of pedestrians, above all children, especially



because of the complexity of the skills that come into play when crossing a street.

For whom are vehicles being improved?

During the 20th century, vehicle safety was considerably enhanced through seatbelts, inflatable airbags, crumple zones, and so on. Despite these devices, not all vehicles are equally safe, as indicated by the great variation in mortality rates by type of vehicle and the results of crash tests.

Despite firmly rooted popular belief, the biggest, heaviest vehicles are not necessarily the safest, whether for their occupants or other road users. This observation is crucial from a public health standpoint, since road safety concerns the vehicle's driver and passengers but

also other road users in the event of a collision. In the late 1990s, mortality rates were higher for the drivers of Canada's best-selling SUV, which weighed roughly 1 700 kg, than for the drivers of the best-selling car, which weighed approximately 1 060 kg.²³ In the United States, not only is the mortality rate for SUV drivers not lower than that for the drivers of mid-sized cars but, in relation to intermediate and four-door cars, SUVs and light trucks cause two to four times as many deaths among other drivers. In the event of a collision with a pedestrian, even at slow or average speed, the likelihood of serious injuries or death is higher when an SUV is involved (Figure 20).

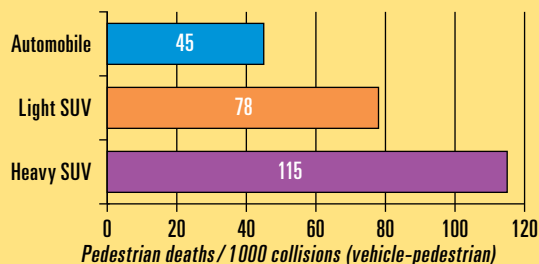
Technological improvements to vehicles that do not demand a deliberate action by the occupants are usually the most effective since they are independent of the driver's level of attention or a specific behaviour (e.g. the inflatable airbag). However, it must also be noted that virtually all technological advances, however beneficial they are for the vehicle's occupants, do not afford additional protection to pedestrians and cyclists.

Traffic flow and automobile trips

Several examples illustrate the link between growth in the number of motor vehicles and the number of road

Figure 20

Risk of death for pedestrians, by category of vehicle



Taken from Lefler, Gabler (2004)

23. In 1999, 24 928 Ford Explorers and 58 122 Honda Civics were sold in Canada (Industry Canada, 2002). Between 1995 and 1998 in the United States, the death rate among drivers per million vehicles stood at 79 in the case of SUVs, i.e. 122 and 59 for two- and four-wheel drive vehicles, but was only 56 in the case of cars, i.e. 68 and 47 for two- and four-door models.



accident injury victims. Starting in the 1950s in Quebec, growing motorization was reflected in the road accident toll, which shot up (Figure 14).

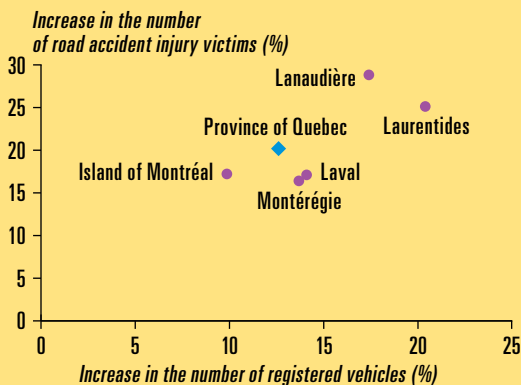
Even today, more extensive travel during periods of economic prosperity leads to a higher road accident toll. In East Germany, the road mortality rate quadrupled between 1989 and 1991, after the fall of the Berlin Wall. Between 1998 and 2003, in the Montréal area, the road accident toll worsened to a greater degree in the Lanaudière and Laurentides regions, the two regions that experienced the biggest growth in the number of motor vehicles (Figure 21). Moreover, it is known that the number of insurance claims goes hand in hand with the

number of kilometres travelled and that there are also more road accident injury victims during rush hour (Figure 22). Many experts believe that a reduction in traffic flow is an ideal way to improve the road accident toll.

If we focus on distance travelled, several surprising observations arise with respect to pedestrians and cyclists. In England, part of the decrease in mortality among pedestrians may simply be attributable to a reduction in walking. In the same perspective, in Quebec, the relative stability in the number of pedestrians injured over the past 10 years can hardly be deemed a success (4 116, 4 184 and 3 966 pedestrians injured in 1983, 1993 and 2003). Furthermore, while the likelihood of a pedestrian's being struck by a vehicle increases with the volume of traffic, it sometimes diminishes with the number of pedestrians, perhaps because motorists adapt their driving when pedestrians are more numerous. It should also be noted that since active transportation is beneficial for health, a reduction in distance travelled on foot or by bicycle is obviously not a public health objective, quite the reverse.

Figure 21

Recent growth in the number of road accident injury victims and the number of motor vehicles (1998-2003)



Source: SAAQ (1998-2003 annual statistics)

Is the physical environment dangerous or protective?

Numerous factors in the road environment influence the likelihood of collisions and injuries: road design, road markings, road signs, lighting, and

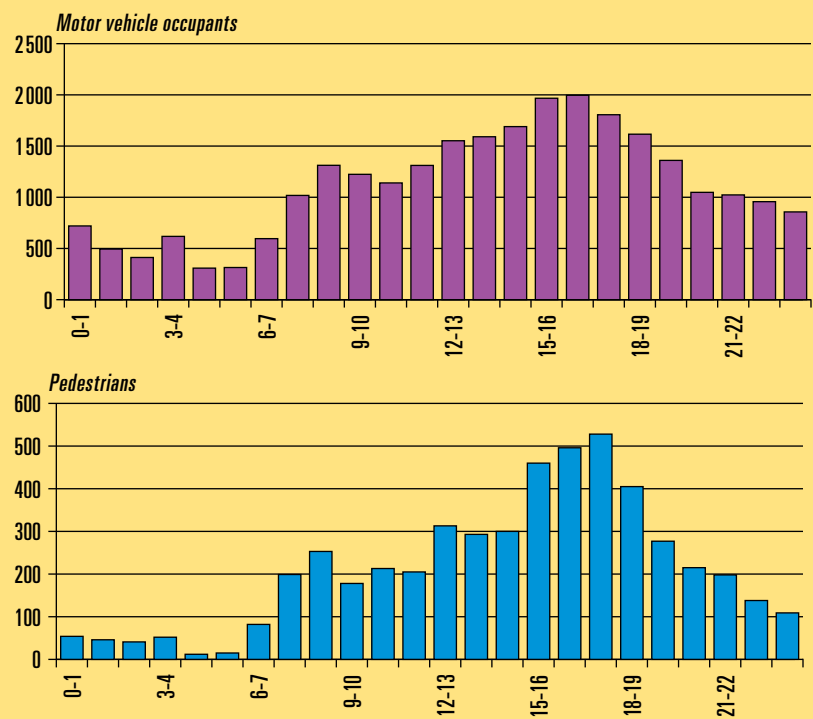


so on. The quality of urban planning and infrastructure is just as important to pedestrians and cyclists as it is to motorists. The safety of young pedestrians and cyclists is especially dependent on the environment. The identification of dangerous sites at which numerous collisions and

injuries occur is usually a means of designating sites where improvement of infrastructure is a priority. However, since more than 90% of injuries occur elsewhere, only measures geared to a neighbourhood or an entire city can really reduce the total number of injured people.

Figure 22

Breakdown of road accident injury victims depending on the time of day (Montréal, 1999-2003)



* Accident injury victims who benefited from intervention by an ambulance service
 Source: Urgences-santé; P. Morency and M.S. Cloutier (2005)



In urban areas, a series of environmental measures aimed at reducing the volume and speed of cars, grouped under the heading traffic calming, are

deemed effective to reduce the frequency of collisions and the number of road accident injury victims. These measures, whose effectiveness has

Figure 23

Examples of layouts that reduce neighbourhood traffic problems

Median barriers on a major street prevent left turn entries to the neighbourhood or traffic on a local street from crossing from one neighbourhood to another; offer pedestrians a protected area.

Circle in the middle of an intersection provides a visual impression of street discontinuity and compels vehicles to go around it, which reduces speed.

Cul-de-sac prevents entries to or exits from the neighbourhood.

Chokers narrow the street, slow traffic, prevent motorists from parking near the intersection, and increase the visibility and safety of pedestrians.

Channel forces right turns and prevents through traffic.

No right turn signs prevent use of shortcuts and through traffic.

Semi-diverters prevent traffic from entering the neighbourhood but permit exits.

Diverters force all traffic to turn at the intersection.

One-way out streets prevent cars from entering but allow exits from the neighbourhood.

Adapted from D.T. Smith, D. Appleyard et al. (1980), and the Transportation Association of Canada (2001).



been reported for over 30 years, include a full array of initiatives, including traffic circles, median barriers, narrow lanes, speed humps, advanced sidewalks at intersections, curb build-outs, raised crosswalks, 30-km/h zones, and so on (Figure 23). In addition to reducing insecurity among all road users, these measures facilitate walking and cycling, two modes of active transportation that are beneficial to health. Countries that have integrated these measures into their transportation policies have not only radically reduced the number of road accident injury victims and deaths but have broadened recourse to modes of active transportation.

The role of regulations

To be effective and contribute to the improvement of the road accident toll, regulations must not only be publicized but must be applied and penalties imposed when they are infringed. For example, while the first statute making seatbelt use compulsory was promulgated in 1976, only 53% of Quebecers were using seatbelts in 1985. In 1987, following a program that combined advertising and police surveillance, the proportion rose to 86%. Currently, most motorists do not respect speed limits although almost all drivers know and accept them, and would deem it justified to step up policing operations. Similarly, few motorists respect the

stop zone at red lights and stop signs, and priority for pedestrians at reserved pedestrian crossings.

Aside from the *Highway Safety Code*, which covers road users, an array of regulations is aimed at transportation infrastructure. In other words, the managers of the road network are also subject to standards that they are responsible for applying to ensure the quality of roads, sidewalks, intersections, and so on. For example, in Montréal, the prohibition on parking less than 5 m from intersections is not applied. Furthermore, as the DSP noted in its brief submitted at public hearings, the prohibition on RTOR must be maintained throughout Montréal. The burden of road accident injury victims is also linked to decisions respecting land use, land-use planning and road construction, which determine the extent of urban sprawl, mode of transportation and the number of automobile trips and distance covered.

The role of the automotive industry

To promote automobile sales, advertising emphasizes technological innovations that bolster safety even if its main objective is sales, a goal that is largely achieved in Canada and the United States. Between 1998 and 2003 in Quebec, the number of motor vehicles increased by over 13%, which added roughly 560 000 vehicles on the roads, in relation to a 2% growth in the



Between 1998 and 2003 in Quebec, the number of motor vehicles increased by over 13%, which added roughly 560 000 vehicles on the roads, in relation to a 2% growth in the population, i.e. approximately 130 000 individuals.

population, or approximately 130 000 individuals. The industry spares no effort to maintain this trend, which is contrary to the strategies proposed to improve the road accident toll.

Another aggravating factor is that the power of vehicles has increased enormously over the past 20 years. From 1984 to 2002, the power of new vehicles sold in Quebec rose from 95 horsepower to 170 horsepower, a 79% increase, while the time required to accelerate from 0 to 100 km/h fell from 13.5 to 9.7 seconds, or 28% on average. These trends affect all categories of vehicles, including compacts. Furthermore, using performance as a justification is one of the key selling points, even for big utility vehicles, despite the publicly acknowledged impact of speeding on the road accident toll.²⁴

If we examine the marketing aspect of the question, we note that the budgets used to “sell” speed exceed by far the funds that government allocates to minimize the impact of speed on the road accident toll. It must also be noted that the industry centres its output and advertising on certain kinds of vehicles. The promotion of SUVs has a harmful impact on the road accident toll, not only because the mortality rate of

motorists is higher with certain SUVs but also because of the consequences of collisions for other motorists and pedestrians (Figure 20).

Improvement of health services

In recent decades and especially during the 1990s, the health care services offered to victims of collisions have advanced considerably. Pre-hospitalization services are provided more promptly and are more appropriate, referral systems to designated hospitals have been established, new medical technologies have emerged, and so on. While the improvement in health care services obviously does not affect the frequency of accidents, it appreciably reduces their after-effects. At an equivalent level of severity, mortality was halved in Quebec between 1987 and 1993 following the establishment of a network of traumatology centres. This trend continues: today, only 8% of serious road accident injury victims die, six times less than 10 years ago.

Avoidable tragedies

As the headlines of major daily newspapers reveal, road accidents are sometimes spectacular and often tragic. Governments and individuals



24. It is well known that speed contributes to accidents that could have been avoided at a lower speed. When speed doubles, the distance travelled during reaction time is twice as high and braking distance is four times as high. In addition to increasing the risk of accident, the vehicle's speed considerably increases the likelihood of death or serious injury. The likelihood of the driver's dying when the vehicle is going 50 km/h at the time of impact is twice as high as at 40 km/h and 20 times higher than at 20 km/h. For a pedestrian who is struck down, the risk of being killed is 10% if the car is travelling at 20 km/h, 30% at 40 km/h, 85% at 60 km/h... (Marret, J.L., 1994).



Hundreds of thousands of automobiles invade Montréal streets every day, which poses an unquestionable threat to Montrealers' health, with over 12 000 traffic accident injury victims every year including, on average, five pedestrians per day.

must bear enormous costs. However, the burden of road accidents is largely underestimated and the causes are unrecognized by the public, aside from a few risk factors such as impaired driving and speeding.

Contrary to a commonly held view, road “accidents” do not stem from chance or bad luck. Hundreds of thousands of automobiles invade Montréal streets every day, which poses an unquestionable threat to Montrealers' health, with over 12 000 traffic accident injury victims each year including, on average, five pedestrians per day. Most of these injuries are avoidable since an array of effective solutions exists. Generally speaking, any reduction in the number of automobiles and the speed at which they travel would improve the road accident toll. We should note also that the development of roads and intersections could better take into account the safety of Montrealers, which is often sacrificed or subordinated to the free flow of traffic.



REFERENCES

- Agran, P. F., Castillo, D. N., Winn, D. G. 1990. "Limitations of data compiled from police reports on pediatric pedestrian and bicycle motor vehicle events", *Accident Analytical Preview*, 22 (4), p. 361-370.
- Bergeron, R. 1999. *Le livre noir de l'automobile ; exploration du rapport malsain de l'homme contemporain à l'automobile*, Éditions Hypothèse, Montréal, 435 p.
- Bordeleau, B. 2003. *The cost of road accident in Québec and changes from 1985 to 2000*, Société de l'assurance automobile du Québec.
- Bourbeau, R. 1983. *Les accidents de la route au Québec, 1926-1978*, Presses de l'Université de Montréal.
- Brault, M. and Letendre, P. "Évolution des comportements et attitudes face à la vitesse au Québec entre 1991 et 2002", Société de l'assurance automobile du Québec, Service des études et des stratégies en sécurité routière.
- Bunn, F., Collier, T., Frost, C. et al. 2003. "Area-wide traffic calming for preventing traffic related injuries", *Cochrane Database Systematic Review*, (1), CD003110.
- Bunn, F., Collier, T., Frost, C. et al. 2003. "Traffic calming for the prevention of road traffic injuries: systematic review and meta-analysis", *Injury Prevention*, vol. 9 (3), 200-204.
- Buzbee, W. W. 2003. "Urban Form, Health, and the Law's Limits", *American Journal of Public Health*, vol. 93 (9), p. 1395-1399.
- Centers for Disease Control and Prevention. 1999. "Motor-Vehicle Safety: A 20th Century Public Health Achievement", *Mortality and Morbidity Weekly Review*, 48 (18), 1-369-373.
- Chapleau, R. 1994. "Les pieds, les pauvres et le métro", *Routes et transports*, vol. 24, p. 35-46.
- Choinière, R. 2003. *La mortalité au Québec : une comparaison internationale*, Institut national de santé publique du Québec.
- Dhillon, P. K., Lightstone, A. S., Peek-Asa, C. et al. 2001. "Assessment of hospital and police ascertainment of automobile versus childhood pedestrian and bicyclist collisions", *Accident Analytical Preview*, 33 (4), p. 529-537.
- DiGiuseppi, C., Roberts, I., Li, L. 1997. "Influence of changing travel patterns on child death rates from injury: trend analysis", *British Medical Journal*, 314 (7082), p. 710-713.
- Direction de santé publique de Montréal, 2002. Mémoire sur le Virage à droite au feu rouge, Déposé à la Commission spéciale du conseil pour l'étude de la pertinence de l'implantation du virage à droite au feu rouge sur le territoire de la Ville de Montréal, Régie régionale de la santé et des services sociaux de Montréal-Centre, 8 p.
- Dougherty, G., Pless, B., Wilkins, R. 1990. "Social Class and the Occurrence of Traffic Injuries and Deaths in Urban Children", *Canadian Journal of Public Health*, 81, p. 204-209.



- Duperrex, O., Bunn, F., Roberts, I. 2002. "Safety education of pedestrians for injury prevention: a systematic review of randomised controlled trials", *British Medical Journal*, 324 (7346), p. 1129.
- Duperrex, O., Roberts, I., Bunn, F. 2002. "Safety education of pedestrians for injury prevention", *Cochrane Database Systematic Review*, (2), CD001531.
- Elvik, R. 2001. "Area-wide urban traffic calming schemes: a meta-analysis of safety effects", *Accident Analytical Preview*, v. 33, p. 327-336.
- Ewing, R. 1999. *Traffic calming; state of the practice*, Institute of transportation engineers, Federal Highway Administration.
- Ewing, R., Schieber, R. A., Zegeer, C. V. 2003. "Urban Sprawl as a Risk Factor in Motor Vehicle Occupant and Pedestrian Fatalities", *American Journal of Public Health*, 93 (9), p. 1541-1545.
- Frumkin, H. 2002. "Urban Sprawl and Public Health", *Public Health Report*, 117(3), p. 201-217.
- Gielen, A. C., Sleet, D. 2003. "Application of Behavior-Change Theories and Methods to Injury Prevention", *Epidemiology Review*, 25, p. 65-76.
- Gordon, J. E. 1949. "The Epidemiology of Accidents", *American Journal of Public Health*, 39, p. 504-515.
- Haddon, W. Jr. 1974. Editorial : "Strategy in preventive medicine: passive vs active approaches to reducing human wastage", *Journal of Trauma*, 14 (4), p. 353-354.
- Haddon, W. Jr. 1973. Energy damage and the ten countermeasure strategies, *Journal of Trauma*. 13 (4), p. 321-331.
- Health Canada. 1997. *For the safety of Canadian children and youth; from injury data to preventive measures*, 291 p.
- Health Canada. 1998. *The Economic Burden of Illness in Canada*, 1998 (ebic-femc.phac-aspc.gc.ca).
- Hamel, D. 2001. *Évolution des traumatismes au Québec de 1991 à 1999*, Institut national de santé publique du Québec, 462 p.
- Hamel, D. et Pampalon, R. 2002. *Trauma and deprivation in Québec*, Institut national de santé publique du Québec.
- Industry Canada. 2002. *Automotive Industry Statistics—2001*, Aerospace and Automotive Branch.
- Insurance Institute for Highway Safety. 1998. *Special issue: Crash compatibility. Status Report*, vol. 33 (1), p. 1-11.
- Insurance Institute for Highway Safety. 2000. *Special issue: driver death rates. Status Report*, vol. 35 (7), p. 1-7.



- Jacobsen, P. L. 2003. "Safety in numbers: more walkers and bicyclists, safer walking and bicycling", *Injury Preview*, 9 (3), p. 205-209.
- Joly, M. F., Foggin, P. M., Pless, I. B. 1991a. "Geographical and socioecological variations of traffic accidents among children", *Social Science Medicine*, 33 (7), p. 765-769.
- Joly, M. F., Foggin, P. M., Pless, I. 1991b. "Socioecological determinants of the risk of accidents in young pedestrians", *Revue d'Epidémiologie et de Santé publique*, 39 (4), p. 345-351.
- Joly, M. F., Foggin, P. M., Zvagulis, I. et al. 1989. "Bicycle accidents among children in the urban environment", *Canadian Journal of Public Health*, vol. 80 (5), p. 351-354.
- Joly, M. F., Joly, P., Bergeron, J. et al. 1991. "Exposure to the risk of traffic accidents, a fundamental epidemiological parameter, and one difficult to measure", *Revue d'Epidémiologie et de Santé publique*, vol. 39 (3), p. 307-313.
- Laflamme, L., Diderichsen, F. 2000. "Social differences in traffic injury risks in childhood and youth – a literature review and a research agenda", *Injury Preview*, 6 (4), p. 293-298.
- Langley, J. D., Dow, N., Stephenson, S. et al. 2003. "Missing cyclists", *Injury Preview*, 9 (4), p. 376-379.
- Lefler, D. E., Gabler, H. C. 2004. "The fatality and injury risk of light truck impacts with pedestrians in the United States", *Accident Analytical Preview*, 36 (2), p. 295-304.
- Lieberman, M., Mulder, D. S., Lavoie, A. et al. 2004. "Implementation of a trauma care system: evolution through evaluation", *Journal of Trauma*, 56 (6), p. 1330-1335.
- Litman, T. 2003. "Integrating Public Health Objectives in Transportation Decision-Making", *American Journal of Health Promotion*, 18 (1), p. 103-108.
- Litman, T. 2004. *Distance-based vehicle insurance feasibility, cost and benefits - Comprehensive technical report*, Victoria Transport Policy Institute (www.vtpi.org).
- Marret, J. L. 1994. *En vitesse... ou en sécurité? Éléments de compréhension et pistes de réflexion*, Société de l'assurance automobile du Québec.
- Marret, J. L. 1996. *Les aménagements urbains sont-ils faits pour les piétons?* Tiré des textes du colloque "Sécurité dans les transports. Les piétons : les connaît-on?", 13 février 1996, Association québécoise des transports et des routes.
- Messier, S., Bourbeau, R. 1989. *Les sites dangereux sur l'île de Montréal et les accidents de la circulation routière 1984-1986*, Centre de recherche sur les transports, Université de Montréal.
- Ministère des transports du Québec, 2001. *Politique de sécurité dans les transports (2001-2005) volet routier*, Gouvernement du Québec, 112 p.
- Mohan, D., Roberts, I. 2001. "Global road safety and the contribution of big business", *British Medical Journal*, 323 (7314), p. 648.



- Morency, P., Cloutier, M. S. 2005. *Distribution géographique des blessés de la route sur l'île de Montréal ; cartographie pour les 27 arrondissements*. Direction de santé publique de Montréal.
- Morency, P. 2003. *La nouvelle statistique : le bilan routier montréalais s'améliore-t-il vraiment?* Direction de la santé publique de Montréal-Centre (www.santepub-mtl.qc.ca).
- Peden, M., Scurfield, R., Sleet, D. et al. 2004. *Rapport mondial sur la prévention des traumatismes dus aux accidents de la circulation*, OMS, Genève.
- Peek-Asa, C., Zwerling, C. 2003. "Role of Environmental Interventions in Injury Control and Prevention", *Epidemiology Review*, 25, p. 77-89.
- Pelletier, G. 1999. *L'hospitalisation pour soins de courte durée au Québec, statistiques évolutives 1982-1983 à 1997-1998*, Collection Données statistiques et indicateurs, n° 36, Québec, MSSS, 204 p.
- Pless, I. B., Verreault, R., Arsenault, L. et al. 1987. "The epidemiology of road accidents in childhood", *American Journal of Public Health*, 77 (3), p. 358-360.
- Pucher, J., Dijkstra, L. 2003. "Promoting Safe Walking and Cycling to Improve Public Health: Lessons from The Netherlands and Germany", *American Journal of Public Health*, 93 (9), p. 1509-1516.
- Richter, E. D., Barach, P., Ben, M. E. et al. 2001. "Death and injury from motor vehicle crashes: a public health failure, not an achievement", *Injury Preview*, 7 (3), p. 176-178.
- Robert, M., Galon-Kozakiewicz, J. 1994. "Une place pour le piéton, perspective urbanistique", *Routes et transports*, p. 47-51.
- Roberts, I., Campbell, F., Hollis, S. et al. 1996. *Reducing accident death rates in children and young adults: the contribution of hospital care*, Steering Committee of the Major Trauma Outcome Study Group, *British Medical Journal*, vol. 313 (7067), p. 1239-1241.
- Robertson, L. S. 1996. "Reducing death on the road: the effects of minimum safety standards, publicized crash tests, seat belts, and alcohol", *American Journal of Public Health*, 86 (1), p. 31-34.
- Rosman, D. L., Knuiman, M. W. 1994. "A comparison of hospital and police road injury data", *Accident Analytical Preview*, 26 (2), p. 215-222.
- Ross, M., Wenzel, T. 2002. "An Analysis of Traffic Deaths by Vehicle Type and Model", American Council for an Energy-Efficient Economy.
- Sahai, V. S., Ward, M. S., Zmijowskyj, T., Rowe, B. H. 2005. "Quantifying the iceberg effect for injury: using comprehensive community health data", *Canadian Journal of Public Health*, sept.-oct., 96 (5), p. 328-332.
- Sampalis, J. S., Denis, R., Frechette, P. et al. 1997. "Direct transport to tertiary trauma centers versus transfer from lower level facilities: impact on mortality and morbidity among patients with major trauma", *Journal of Trauma*, 43 (2), p. 288-295.



- Sampalis, J. S., Denis, R., Lavoie, A. et al. 1999. "Trauma care regionalization: a process-outcome evaluation", *Journal of Trauma*, 46 (4), 565-79, discussion p. 579-581.
- Sampalis, J. S., Lavoie, A., Williams, J. I. et al. 1993. "Impact of on-site care, prehospital time, and level of in-hospital care on survival in severely injured patients", *Journal of Trauma*, 34 (2), p. 252-261.
- Sandels, S. 1970. "Young children in traffic", *British Journal of Educational Psychology*, 40 (2), p. 111-116.
- Segui-Gomez, M., MacKenzie, E. J. 2003. "Measuring the Public Health Impact of Injuries", *Epidemiology Review*, 25, p. 3-19.
- Sergerie, D. et al. 2005. *La vitesse au volant : son impact sur la santé et des mesures pour y remédier - Synthèse des connaissances*, INSPQ, 130 p.
- Smart Risk. 1998. "The economic burden of unintentional injury in Canada", Health Canada, Ministry of Health of Ontario, KFL & A Health unit.
- Smith, D. T., Appleyard, D. et al. 1980. "State of the Art: Residential Traffic Management", U.S. department of transportation, FHWA.
- Société de l'assurance automobile du Québec. 2003. *L'alcool au volant, comprendre ses effets*, 32 p.
- Société de l'assurance-automobile du Québec. 1989-2004. *Accidents, parc automobile, permis de conduire : bilans annuels*.
- Transportation Association of Canada (1999). *Canadian Guide to Neighbourhood Traffic Calming*.
- Transport Canada, *Road Safety Vision 2010*, 2002 annual report, March 2004.
- Vélo Québec. 2003. *Guide technique d'aménagement des voies cyclables*, 3^e éd., 136 p.
- Winston, F. K., Rineer, C., Menon, R. et al. 1999. "The carnage wrought by major economic change: ecological study of traffic related mortality and the reunification of Germany", *British Medical Journal*, 318 (7199), p. 1647-1650.
- Yates, D. 1998. "Improving post-impact care - a form of injury prevention", *Injury Prevention*, 4, (4 Suppl.), p. S42-S45.

4

Active

Health

Urban Transportation

Active Transportation and Sedentariness

Urban Transportation

Health



Urban Transportation

Sedentariness

Health



CHAPTER 4

Active Transportation and Sedentariness

While it has been established that modes of active transportation such as walking and cycling represent a form of physical activity that is beneficial to health, conversely, sedentariness²⁵ has a negative impact. We will examine the impact of sedentariness on the health of the population and the attendant economic burden, the scope of the problem and recent trends observed with regard to physical activity during leisure time and for transportation. We will see that utilitarian walking and cycling make an essential contribution to the attainment of the desired level of physical activity in the population overall.

The problem of sedentariness is determined by factors of an individual nature, such as attitudes and behaviour, but also by environmental factors. To illustrate the importance and urgency of organizing our communities to foster walking and cycling as modes of transportation, we will evaluate the association among urban planning, mode of transportation and certain health parameters, including obesity and hypertension. Various studies reveal three unavoidable dimensions related to urban planning: the variety of destinations or mixed nature of functions, the distance to be travelled, and the safety of the route. We will also examine the modes of transportation that children use to go to school, in particular because transportation habits start to develop at school age. To conclude, we will briefly focus on the long-term beneficial effects of physical activity and active transportation on health and recommendations pertaining to physical activity.

²⁵ Sedentariness is characterized by a gradual reduction in physical effort in most of our daily activities. It can be defined as a lack of minimal physical activity that satisfies the body's needs.



In 2002, WHO estimated at 1.9 million per year worldwide the number of deaths due to sedentariness and, in Canada, in 1995 an estimated 21 000 premature deaths were directly attributable to sedentariness.

The impact of sedentariness

Sedentariness doubles the risk of being overweight and obese and increases the risk of developing many other diseases. Indeed, sedentary individuals are almost twice as likely to suffer from cardiovascular disease. Furthermore, they are at greater risk of developing certain cancers, diabetes and high blood pressure. As if that were not alarming enough, certain diseases linked to obesity, such as type II diabetes, which usually occurs among adults, are now appearing among children. In industrialized countries, sedentariness is the second risk factor that causes the greatest number of lost years of life, after smoking. In 2002, WHO estimated at 1.9 million per year worldwide the number of deaths due to sedentariness and, in Canada, in 1995 an estimated 21 000 premature deaths were directly attributable to sedentariness.

The economic burden

The costs of sedentariness can be evaluated in different ways. For example, Canadian researchers have examined the impact of sedentariness on several diseases, including cardiovascular disease, diabetes and certain cancers. They estimate that sedentariness accounts for \$2.1 billion in health care costs (between \$1.4 billion and \$3.5 billion, depending on the scenarios), equivalent to 2.5% of these costs, not far behind smoking (3.8%).

Another calculation consists in assessing the cost of diseases in relation to being overweight and obese, given their direct link to sedentariness. In 2001 in Canada, health care costs attributable to chronic diseases linked to weight reached an estimated \$1.6 billion, to which must be added \$2.7 billion in indirect costs.

The Association pour la santé publique du Québec spurred the establishment of the Groupe de travail provincial sur la problématique du poids (GTPPP), which has sounded the alarm. To reduce obesity's impact on health and the economy, the GTPPP has proposed, among other things, to step up the modification of the physical and social environment to promote a more active way of life. We will come back to the measures that make it possible to attain such an objective.

Half of Quebecers are obese or overweight

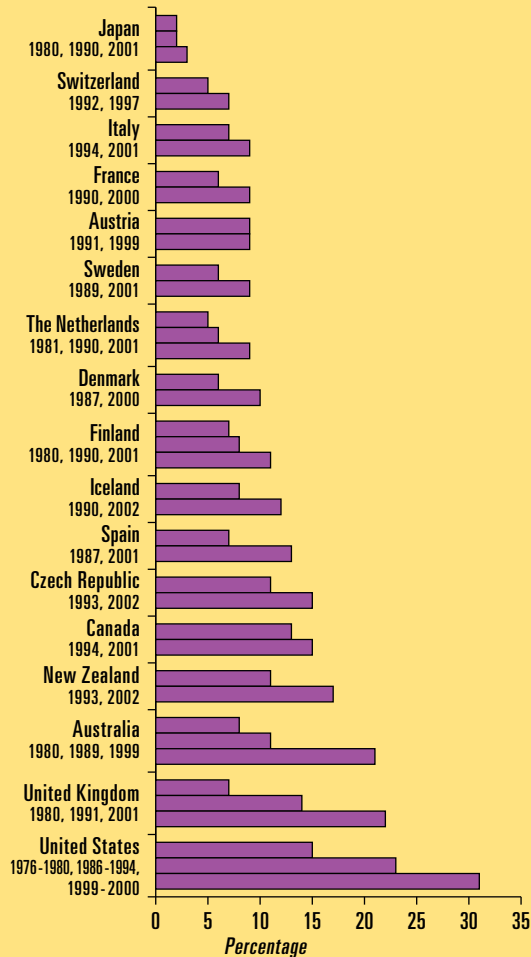
In OECD countries, obesity rates are rising, as Figure 24 reveals. Generally speaking, the increase is affecting all countries without exception, led by the United States. Canada is not far behind, while Italy, Sweden, Denmark and the Netherlands have the lowest obesity rates. We will examine later the relative importance of active transportation in these countries.

The 2004 *Canadian Community Health Survey* reveals that 34.5% of Quebecers 18 years of age or over are overweight



Figure 24

Evolution in obesity rates in the adult populations of OECD countries



Source: OECD Health Data 2003 (varied survey methods)

and 21.8% are deemed to be obese, with a body mass index (BMI)²⁶ of $\geq 30 \text{ kg/m}^2$. In short, over half (56.3%) of the population is carrying excess weight. The difference between the sexes is confirmed only for being overweight, that is, 28.0% of women and 41.2% of men. The frequency of obesity is fairly similar among women (22.7%) and men (20.0%). While the situation is less critical than in the United States, where 30% of the population is obese, it is clear that the obesity rate is rising in Quebec, where it almost doubled between 1987 and 2003.

Children are also affected by excess weight: in Quebec in 2004, 15% of children were overweight and 7% were obese, which represents over one child in five. As is true of adults, the upward trend is also apparent among Canadian children (Figure 25).

Lifestyle choices offer one explanation for being overweight and obese. In Canada, for example, being overweight is more prevalent in the suburbs and in rural areas than in city cores. Varying levels of physical activity might partly explain this difference. Some experts maintain that energy expenditure inherent in the way of life of industrialized societies is so minimal that it almost impossible to eat normally

26. Body mass index (BMI) is used to determine weight categories. It is calculated by dividing body weight in kilograms by the square of one's height in metres. A BMI of 25 kg/m^2 or more indicates that the individual is overweight and as of 30 kg/m^2 or more the individual is considered to be obese.



Figure 25

Prevalence of excess weight and obesity in the 2-17 age group (Canada)

	Excess weight	Obesity
1978-1979	12 %	3 %
2004	18 %	8 %

Source: ASPQ, 2005

without gaining weight. This deficit is estimated at between 300 and 800 calories a day: in other words, it would take, on average, one to three hours of walking per day to preserve energy balance and thus maintain body weight.

Physical activity

Physical activity is obviously not confined to leisure activities but is part of everyday life, e.g. household tasks, work, travel, and so on. In general, the physical demands stemming from work and household tasks diminished greatly in industrialized countries during the 20th century. On the other hand, the picture is brighter with regard to leisure time physical activity.

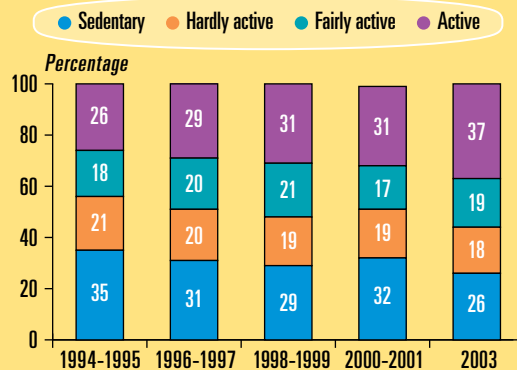
Leisure time physical activity

Leisure activities have become more vigorous in Canada over the past 20 years. Indeed, an increase has been observed in the proportion of the population that manages to integrate into

its leisure activities at least 30 minutes a day of moderately intense physical activity at least five days a week, as recommended by several international public health agencies. This proportion increased from 20% to 40% between 1980 and 2002. The situation is similar throughout Quebec, since 4 adults out of 10 (37%) engaged in a moderately intense leisure time physical activity at least three times a week in 2003. Figure 26 illustrates the evolution of trends in Quebec. It has been noted that the percentage of Quebecers 18 years of age or over engaging in active leisure activities increased from 26% in 1994-1995 to 37% in 2003.²⁷ According

Figure 26

Evolution in the level of leisure time physical activity, individuals 18 years of age or over (Quebec, 1994-1995 to 2003)



Figures 26, 27 and 28 have been adapted from B. Nolin and D. Hamel, INSPQ (2005)

27. The variance between 2003 and the previous years is partly attributable to a slightly different data-collection methodology, but the increase observed remains valid.



to the section devoted to Montréal in the 2000-2001 *Canadian Community Health Survey*, 39% of the population 12 years of age or over engages in at least 30 minutes of leisure time physical activity per day. However, while recent trends are encouraging, roughly 60% of the population nevertheless does not derive the full benefits of daily leisure time physical activity.

A Quebec team sought to ascertain whether living in a rural community rather than in a city is linked to differences in health and well-being. While this study does not target active transportation as such, it does describe the frequency of leisure time physical

activity by place of residence, i.e. urban, rural or intermediate.²⁸ The findings reveal that a bigger percentage of the population manages to be active during leisure activities in urban areas than in rural or intermediate areas, e.g. the suburbs of Montréal.

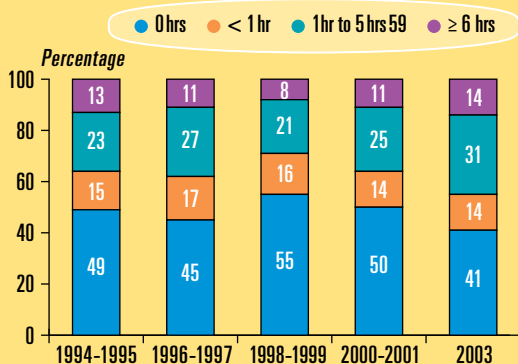
Active transportation: walking or cycling

To describe a population's level of physical activity, we must also take into account active transportation, i.e. utilitarian travel on foot or by bicycle. For example, in 1998, the proportion of Quebecers 15 years of age or over who reached the minimum level of physical activity recommended increased from 43% to 54%, when active transportation is added to leisure time physical activity. The contribution made by active transportation to the attainment of the recommended volume of physical activity is thus decisive.

While, since 1994, the proportion of adults who walked at least one hour per week tended to decline, the opposite has been true since 2001. Despite this improvement, a majority of Quebec adults (55%) walk less than one hour per week (Figure 27). A similar proportion of men (43%) and women (40%) say that they do not rely

Figure 27

Walking as a means of travel: weekly duration, individuals 18 years of age or over (Quebec, 1994-1995 to 2003)



28. The term "urban" applies here to a metropolitan area, e.g. Montréal or Québec City, or a census agglomeration, e.g. Trois-Rivières, while the term "rural" refers to rural areas and small cities located outside the commuting zone, i.e. the zone where 50% or more of workers migrate each day toward the city core.



at all on walking as a mode of travel. In short, a marked proportion of the population does not take advantage of the opportunity that walking affords to expend energy.

Young people walk more, on average, than adults do. From 1994-1995 to 2003, the proportion of Quebecers between 12 and 17 years of age who walked more than one hour per week increased from 41% to 59%. However, in 2003, more than two young people out of five walked less than one hour per week (Figure 28).

According to a Vélo-Québec survey devoted to adults, one cyclist out of five (20%) uses a bicycle for utilitarian travel, 14% as the principal mode of transportation, and 6% on an occasional basis. Overall, this survey reveals that

Figure 28

Walking as a means of travel: weekly duration, 12 to 17 year-olds (Quebec, 1994-1995 to 2003)

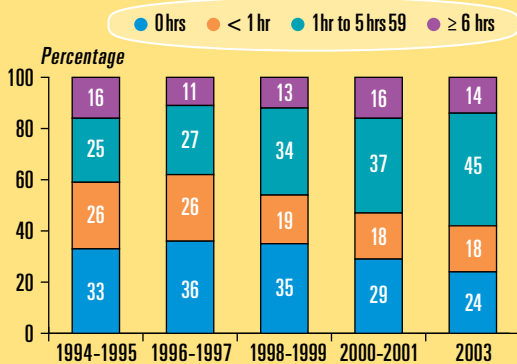
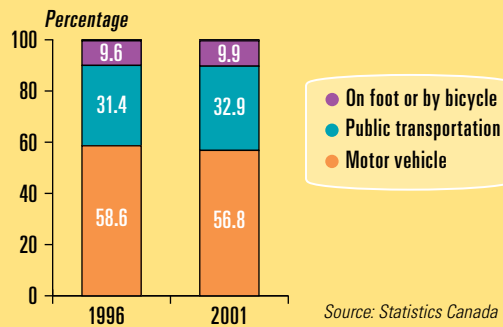


Figure 29

Breakdown of Montrealers, by mode of transportation used to go to work



over 500 000 Quebecers occasionally or regularly engage in cycling as a form of active transportation.

The proportion of individuals who cycle is obviously higher among those who do not have access to an automobile, e.g. young adults and city dwellers. Recourse to walking as a means of travel is also more frequent in urban than rural areas: in Montréal, just over half (52%) of adults walk one hour or more per week.

Although a majority of workers in Montréal go to work by car, 1 worker in 10 walks or cycles to work. This figure does not include people who walk to take public transportation (Figure 29). Striking discrepancies are apparent, however, in different neighbourhoods. In relation to the neighbourhoods at either end of the Island of Montréal, recourse to active transportation



is more extensive in the central neighbourhoods (Figure 30). This may be attributable, among other things, to higher population and employment density and more extensive mass transit services in these areas.

Active transportation and obesity

In the Western countries where obesity rates are lower than in Canada and the United States, active transportation is much more widespread, which once again illustrates the link between sedentariness and obesity. For example, the modal share of active transportation stands at 28% in Italy, 39% in Sweden, 41% in Denmark, and 46%

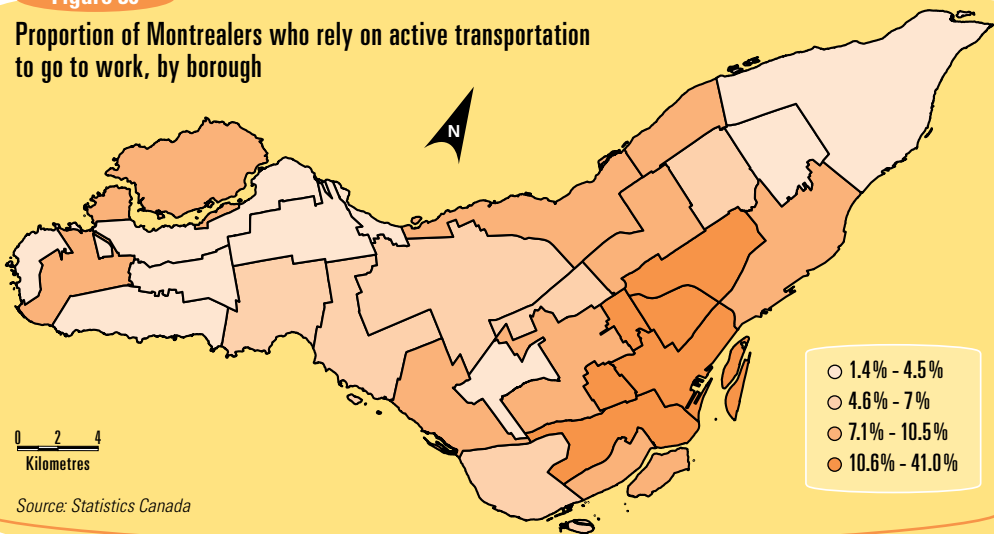
in the Netherlands, but only 12% in Canada and 7% in the United States (Figure 31). Indeed, obesity is more prevalent in industrialized nations in which the modal share of active transportation is the lowest, i.e. the United States, England and Canada (Figure 32).

Urban planning plays a decisive role

Individual factors alone cannot, of course, explain the level of physical activity of a population and its reliance on active transportation. In the 21st century, occupational and household physical activities only play a negligible role for a majority of Quebecers. While leisure time

Figure 30

Proportion of Montrealers who rely on active transportation to go to work, by borough



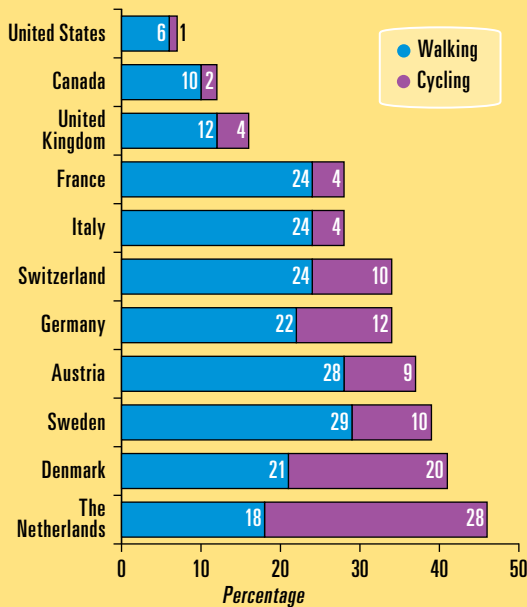
Source: Statistics Canada



physical activity has become more widespread, it is still not practised sufficiently. Active transportation could overcome the shortcomings noted. However, the manner in which cities are organized and the quality of urban planning affect recourse to walking and cycling as modes of transportation. Studies focusing on facets of urban planning likely to affect active transportation are fairly recent. While they are few in number,

Figure 31

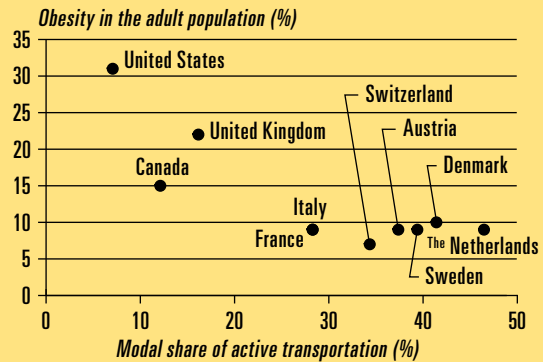
Modal share of walking and cycling in travel in North America and Europe (1995)



Source: Pucher and Dijkstra (2003)

Figure 32

Obesity and modal share of active transportation in various industrialized nations



they are nonetheless highly revealing of the key role that urban planning plays in this respect.

Regardless of age, the reasons for travel are obviously highly diverse (work, school, shopping, leisure activities, entertainment, friends, health care, and so on). Some of the reasons are, of course, more restrictive than others, e.g. carrying a load, taking somebody home, and so on. Figure 33 illustrates the trips for which Canadians choose different modes of active transportation.

To enable residents to reach a variety of destinations near their homes, urban planning must allow for mixed functions, that is, the coexistence in a same zone of businesses, small service enterprises (often located on the ground floor of buildings), leisure and entertainment centres and different



types of housing (single-family dwellings, row houses, apartments, and so on). In Montréal, the density, variety and type of destinations possible in a neighbourhood are linked to residents choosing to walk to work. An American study measured the level of daily physical activity by means of a pedometer and noted a positive link with the total number of destinations located within walking distance of the home.

Figure 33

Preferred destinations of active transportation users

Rank	Walking	Cycling
1	Errands & leisure activities	Leisure activities, friends & family
2	Friends and family	Educational institutions
3	Educational institutions	Workplace
4	Workplace	Errands

Sources: *Environics* and *Vert l'action* (1998)

The degree of urban sprawl also plays a role. A noteworthy study calculated an urban sprawl index for over 500 counties and cities in the United States, based in particular on population density and mixed functions, as both factors are closely linked. Generally speaking, the number of potential destinations increases with population or employment density in a given

sector, as does diversity of modes of transportation available. Mention should be made of three observations in the study, which took into account confounding variables such as sex, ethnic origin, age and education:

- The number of minutes devoted to leisure walking varies directly with the urban sprawl index. Residents of more densely population zones engage more extensively in leisure walking than residents of less densely populated zones. The difference observed is not very big but is nonetheless statistically significant. For example, the residents of New York, the most densely populated county in the United States, walk 79 minutes more a week than the residents of Geauga County, Ohio, the least densely populated. The likelihood of attaining the recommended level of physical activity is also higher in more densely populated counties.
- Body mass index (BMI) and the likelihood of being obese increase as the urban sprawl index rises.
- The likelihood of suffering from hypertension is higher in the less densely populated counties.

Furthermore, in 2004, an American team conducted a cross-sectional study²⁹ of nearly 11 000 subjects:

29. A study that examines the relationship between a disease or other health characteristics and other variables found in a population at a given time.



In sectors where over 95% of residents go to work by car, 54% of the population is overweight.

researchers collected data by telephone interview on the respondents' weight and height (to calculate BMI) and evaluated transportation habits by asking respondents to keep a journal for two weeks and to record in it the duration of trips by car and the distance covered in the case of utilitarian walking. The researchers established 1-km perimeters around the residences to describe their pedestrian potential by means of three indicators, i.e. the network's connectivity, net residential density³⁰ and the mixed nature of functions.³¹ This study led the researchers to make two observations that speak for themselves.

- The three indicators of pedestrian potential are interrelated but it is the mixed nature of functions, i.e. the number of stores, offices and common destinations within walking distance, that is the most striking. A reduction of nearly 7% in the likelihood of being obese has been noted when the mixed nature of a neighbourhood increases from 0 (houses only) to 0.25 (mainly residences with a few stores or businesses nearby).
- There is a link between transportation habits and the likelihood of being obese. Indeed, each kilometre travelled every day on foot is linked

to a reduction of nearly 5% in the likelihood of being obese. Inversely, each additional 60-minute segment per day spent in a motor vehicle as driver or passenger corresponds to a 6% increase in the likelihood of being obese.

Another study conducted by the same team focused on the relationship between urban structure and physical activity but measured physical activity and classified neighbourhoods according to a "walkability" index. The findings reveal that the likelihood of engaging in 30 minutes or more of moderate physical activity per day is 2.4 times higher in sectors where the "walkability" index is highest.

Another study, the Canadian Population Health Initiative (CPHI), also examined the link between weight and transportation habits. The study noted that in sectors where over 95% of residents go to work by car, 54% of the population is overweight (BMI equal to or higher than 25). In sectors where less than 60% of residents rely on automobiles to go to work, 42% of the population is overweight. Moreover, reliance on mass transit and cycling displays an inverse relationship: the more residents rely on these modes of transportation, the less overweight they are.

30. Net residential density is equivalent to the number of persons per residential acre in a given census area.

31. The built environment was evaluated by means of digital aerial photographs and urban planning data.



More walking means less weight

Researchers observed that the residents of so-called traditional neighbourhoods organized according to a gridiron plan made, on average, six trips on foot per month to stores, compared with one or two trips in suburban neighbourhoods organized according to a dead-end street plan (each trip was estimated at 1.7 km).

Another study devoted to a revitalized neighbourhood that became better suited to walking noted that, in relation to an unmodified neighbourhood, residents replaced car travel with walking for roughly 10 km per month, equivalent to 2.5 km (or 30 minutes) of walking per week. Over one year, this is equivalent for someone weighing 68 kg to expending between 3 000 kcal and 6 000 kcal, which would enable the individual to lose or avoid gaining between 0.39 and 0.79 kg. Over a period of 30 years, this energy expenditure would make it possible to avoid 13.6 kg in excess weight. Applied to the population overall, this preventive measure could have a considerable impact.

Other factors that favour active transportation

Distances to be travelled

While distance alone does not fully explain walking habits, it certainly defines their limitations. Thus, distance and duration, which are closely linked, are deemed to be the two main obstacles³² to active transportation.

There is general agreement that trips of 8 km or less by bicycle and 3.2 km or less on foot are thresholds at which individuals resort to these modes of active transportation. Beyond those distances, active transportation is used, above all, in combination with other modes of transportation, e.g. walking and the bus, cycling and the commuter train, and so on.

Two Canadians out of three (67%) live less than 30 minutes on foot (2.5 km) from at least one habitual destination and 84%, less than 30 minutes by bicycle (8 km), but these percentages decline in the case of distance to be travelled to go to work. For example, according to the 2001 Census, in the Montréal area, 34% of workers travel less than 5 km to go to work, 41% between 5 km and 14.9 km, 17% between 15 km and 24.9 km, and 8% must travel 25 km or more. Thus, the majority of workers living in Montréal cannot opt for walking alone and one-quarter of them must travel at least 15 km. Furthermore, this distance, estimated “as the crow flies,” does not provide information on the user-friendliness of the actual route.

The connectivity of the road network, that is, the level at which it is easy to reach a destination without detours, is another key factor. The traditional gridiron plan found in Montréal’s oldest neighbourhoods, characterized by

32. Climatic factors are also an obstacle, but certain layouts can mitigate their dissuasive effects, e.g. covered bicycle parking lots.



parallel streets, rectilinear quadrangles and numerous right-angle intersections, offers good connectivity. However, this plan makes the neighbourhoods susceptible to through traffic by non-residents, which can compromise pedestrian safety. Another more recent urban plan consists in curvilinear streets and dead-ends, which considerably lengthens trips and can discourage residents from walking and cycling. On the other hand, this type of local road network, typical of post-war suburbs, recovers part of the space given over to streets and makes for safer neighbourhoods as traffic is lighter and vehicle speeds are slower. For new developments, the Canada Mortgage and Housing Corporation

(CMHC) proposes a quadrant called a fused grid that satisfies several interests, including that of fostering active trips that are effective from the standpoint of duration and distance (Figure 34). In old neighbourhoods, only the widespread application of traffic-calming measures might make it possible to take advantage of their full pedestrian potential by enhancing safety (Figure 23).

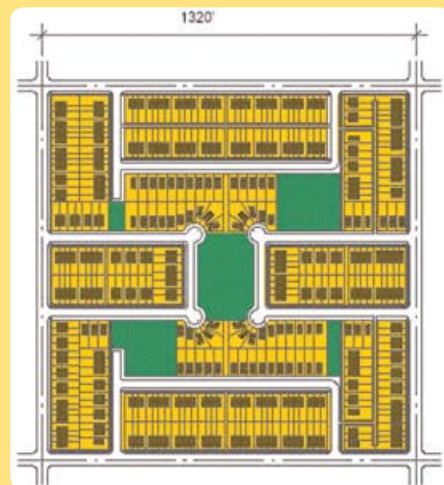
In addition to all of these environmental factors, the assessment of distance as an obstacle to active transportation varies among individuals according to each one's physical condition, individual attitudes to physical activity, the nature of the destination, and so on. Leaving aside these variations,

Figure 34

The fused grid and its characteristics

- Significant area covered by green spaces
- Pedestrian safety
- Absence of through traffic
- Proximity of services

Source: SCHL, 2001





Despite their interest in walking more (82%) and cycling more often (66%), Canadians believe that there are obstacles to active transportation, and road traffic is a daunting one.

we might reasonably assume that the farther away the destination is, the less likely it is that individuals will resort to active transportation. Many other facets of urban planning obviously affect the user’s perception and recourse to walking and cycling. For example, at equal distances, a route along a street lined with attractive store windows, awnings and street furniture will seem shorter than an unadorned route along the walls of windowless buildings.

Safety along the route

Perceived and objective safety while walking and cycling is closely linked to design of urban space, behaviour of various street users, and quality of transportation infrastructure. To these

factors must be added the importance that individuals attribute to signs of some degree of social disorder, e.g. graffiti, broken windows, barred windows, garbage, and so on.

Despite their interest in walking more (82%) and cycling more often (66%), Canadians believe that there are obstacles to active transportation, and road traffic is a daunting one. Surveys speak for themselves. Over two-thirds of Canadians would be willing to spend at least 30 minutes cycling to work if there were bicycle paths. Even experienced cyclists choose their routes carefully, almost always bearing in mind the volume and speed of traffic, road conditions and the configuration of the network of bicycle paths, three key factors in the assessment of a route’s safety. Indeed, even though more and more Canadians want to cycle, stress and fear linked to road safety can override any feeling of pleasure.

If we examine the role of bicycle lanes, they are obviously viewed as a facilitating factor, especially those dedicated solely to bicycles.³³ However, there are many other solutions to enhance the safety of cyclists, especially measures centred on the road network, such as layouts that make it easier to cross intersections or, in general, traffic-calming measures to reduce motorists’

Figure 35

Modes of transportation used to go to school (Quebec, 1999)

	9 years of age	13 years of age	16 years of age
Walking only	40,5 %	15,3 %	13,1 %
Partly on foot	8,0 %	6,2 %	5,7 %
School bus	33,3 %	51,7 %	56,1 %
Metro or bus	1,2 %	11,4 %	13,9 %
Automobile	14,4 %	7,4 %	5,0 %
Several vehicles	2,8 %	8,0 %	6,1 %

Source: Enquête sociale et de santé auprès des enfants et des adolescents québécois 1999, Quebec, 2002

33. Unlike a bicycle path that is simply marked off along a traffic lane, the dedicated bicycle lane is physically separated from lanes reserved for automobile traffic.



speeds in residential neighbourhoods. Other measures related to urban planning can facilitate safe access on foot or by bicycle to very heavily frequented destinations such as metro stations, hospitals, universities, office buildings, green spaces, schools, and recreational and community centres.

Walking to school

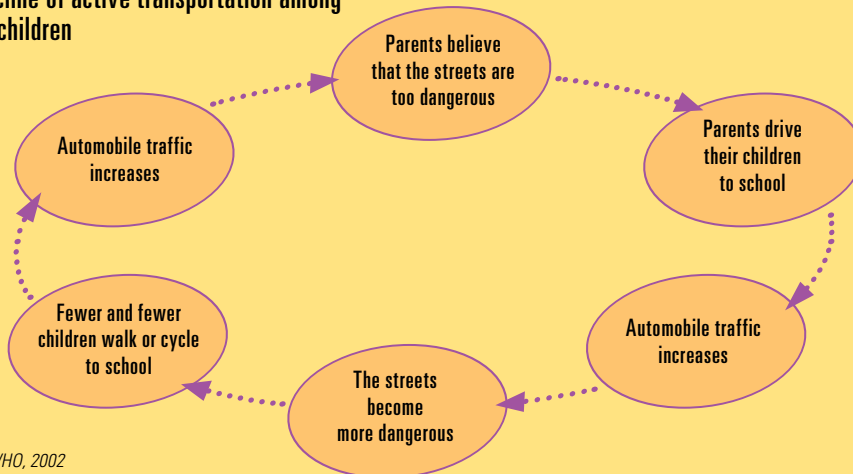
A neighbourhood that is not very favourable to active transportation will appreciably limit children's ability to achieve the recommended volume of physical activity. Active transportation plays such an important role that in 1999, the World Health Organization elaborated a strategy entitled *Transport, Environment and Health*, which focused

in particular on school children and the elderly. In Quebec in 2003, 4 children out of 10 did not achieve the recommended volume of physical activity and, as Figure 35 shows, most children go to school by bus or car. Moreover, this proportion increases with age, and when children reach the age at which they can choose a mode of transportation, they will be more inclined to choose motor transport. Since children are the adults of tomorrow, the promotion of active transportation at an early age is a strategy that must not be overlooked.

The same trend is apparent in the Montréal area. The modes of transportation used by school children between 6 and 12 years of age can be

Figure 36

The decline of active transportation among school children



Source: WHO, 2002



broken down as follows: walking (39%), automobile (29%) and school bus (27%). Thus, nearly 6 children out of 10 rely on motor transport.

However, this situation could change if urban planning took greater account of parents' concerns. Indeed, of the parents of children aged 6 to 12 years who were questioned, 66% deem the establishment of safe routes to be very relevant and 22%, fairly relevant to their agreeing to allow their children to go to school by means of active transportation. Figure 36 clearly illustrates the vicious circle that results from this issue.

The long-term benefits of active transportation

The long-term benefits of physical activity are, generally speaking, well known. Such benefits are of various orders and might be summarized as follows: physical activity, while it helps to prevent premature death, also maintains muscular strength and the smooth operation of the joints and contributes to alleviating depression and anxiety and generally enhancing mood and a feeling of well-being.

Until now, few studies have succeeded in independently isolating active transportation's specific contribution to health and, in particular, its long-term beneficial effects. This situation

is due to the fact that reliance on active transportation to go to work is, for all intents and purposes, marginal in several countries where research devoted to physical activity and health is nonetheless extensive.

In Denmark, for example, where active transportation is very popular, 46% of adults 25 years of age or over cycle to work year round and 70% do so during the summer. Longitudinal studies³⁴ that take into account all other risk factors, including leisure time physical activity, reveal that Danish adults who do not cycle to work display a general mortality rate 40% higher than that of adults who cycle to work. These findings focus on a population that devotes on average three hours per week to active transportation, a duration that is easy to achieve. In China, over 90% of men and 80% of women walk or cycle to work. In Tianjin, the third largest city in China, workers who rely on a mode of active transportation display lower levels of total cholesterol, LDL (bad) cholesterol and triglycerides in the blood and higher levels of HDL (good) cholesterol than workers who take the bus.

As noted earlier, active transportation does not apply solely to adults going to work. A study conducted in Tokyo among the elderly reveals that the proximity of facilities that encourage

34. Such studies follow a given population over a certain period of time.



Recommendations concerning physical activity

Although there is a lack of specific recommendations concerning active transportation, scientists agree on the level of physical activity that is beneficial to health, which can be defined by frequency, duration, intensity and number of steps taken. Here is an overview.

Adults should incorporate into their daily schedule at least 30 minutes of moderate physical activity, which helps to prevent weight gain. It has been calculated that 10 000 steps during the day easily meets the recommended volume of activity.

Generally speaking, children should engage in a total of 60 minutes of moderately intense physical activity per day. Some of these activities, carried out at least twice a week, should help to maintain or improve muscular strength, flexibility and healthy bones.

Individuals 65 years of age or over should engage regularly in activities such as walking and add exercises geared to flexibility, balance and muscle tone.

It has been noted that physical activity must be part of our daily activities at any age. Since only 40% of Quebecers are sufficiently active in their leisure pursuits, modes of active transportation such as walking increase this level markedly. Walking, the most frequent physical activity, offers a pleasant, useful form of exercise that is free of charge, especially for individuals with hectic schedules and those who do not like sports or exercise.

walking enhances longevity. Another study conducted in Japan demonstrates the contribution of utilitarian walking to the reduction of health care costs: according to this study, medical

costs vary significantly depending on whether individuals walk less than 30 minutes per day, between 30 minutes and one hour, or one hour or more.

As we have seen throughout this chapter, different forms of active transportation imply numerous long-term benefits for health. We now know that, beyond active leisure activities, utilitarian physical activity alone makes it possible to enjoy all of the attendant benefits. The development of neighbourhoods, especially in terms of density and mixed functions, can act as an appreciable incentive or disincentive in this regard.



REFERENCES

- Association pour la santé publique du Québec (ASPQ). 2005. Groupe de travail sur la problématique du poids (GTPPP), *Les problèmes reliés au poids au Québec : un appel à la mobilisation*, ASPQ, éditions Décembre.
- Bouchard, C. 2000. *Physical activity and obesity*, Champaign, Human Kinetics Publishers Inc.
- Breus, M. J. and O'Connor, P. J. 1998. "Exercise-induced anxiolysis: a test of the «time out» hypothesis in high anxious females", *Medicine and Science in Sports and Exercise*, July, 30(7), p. 1107-12.
- Canada Mortgage and Housing Corporation (CMHC). 1999. Fisher S. *Impact of Urban Form and Travel Accessibility on Private Vehicle Use*, Research Highlights, Socio-economic Series, n° 49.
- Canada Mortgage and Housing Corporation (CMHC). 2001. Grammenos, F., Pogharian, S. and Tasker-Brown, J. *Learning from Suburbia: Residential Street Pattern Design*, Research Highlights, Socio-economic Series, n° 75.
- Canadian Institute for Health Information. 2006. *Improving the Health of Canadians: Promoting Healthy Weights*, 131 p.
- Cavill, N., Biddle, S. and Sallis, J. F. 2001. "Consensus statement: Health enhancing physical activity for young people: statement of United Kingdom expert consensus conference", *Pediatric Exercise Science*, 13, 12-25.
- Craig, C.L., Russell, S. J., Cameron, C. et al. 2004. "Twenty-year trends in physical activity among Canadian adults", *Canadian Journal of Public Health* 2004, 95 (1), p. 59-63.
- Dannenberg, A. L., Jackson, R. J., Frumkin, H. et al. 2003. "The Impact of Community Design and Land-Use Choices on Public Health: a Scientific Research Agenda", *American Journal of Public Health*, 93 (9), p. 1500-1508.
- Environics et Vert l'action. 1998. *Étude nationale sur le transport actif, Rapport sommaire*, Environics.
- Ewing, R., Cervero, R. 2001. "Travel and the Built Environment - A Synthesis", *Transportation Research Record*, 1780 (01-3515), p. 87-114.
- Ewing, R., Schmid, T. L., Killingsworth, R. E. et al. 2003. "Relationship between urban sprawl and physical activity, obesity, and morbidity", *American Journal of Health Promotion*, 18 (1), p. 47-57.
- Frank, L., Andersen, M. A., Schmid, T. L. 2004. "Obesity Relationships with Community Design, Physical Activity and Time Spent in Cars", *American Journal of Prevention Medicine*, 27 (2), p. 87-96.
- Frank, L. Schmid, T. L., Sallis J. F. et al. 2005. "Linking Objectively Measured Physical Activity with Objectively Measured Urban Form", *American Journal of Preventive Medicine*, 28 (2S2), p. 117-125.



- Frumkin, H., Frank, L., Jackson, R. 2004. *Urban sprawl and public health*, Island Press.
- Groupe Vélo et Échos Sondage. 2003. *Habitudes de déplacement des enfants du primaire*, Montréal.
- Handy, S. L. 1993. *Regional Versus Local Accessibility: Implications for Nonwork Travel*, The University of California Transportation Center, University of California at Berkeley, Report 234.
- Handy, S. L. 1996. "Urban Form and Pedestrian Choices: Study of Austin Neighbourhoods", *Transportation Research Record*, 1552, p. 135-44.
- Hu, G., Pekkarinen, H., Hanninen, O. et al. 2002. "Relation between commuting, leisure time physical activity and serum lipids in a Chinese urban population", *Annals of Human Biology*, 28 (4), p. 412-21.
- James, W. P. T. 1995. "A public health approach to the problem of obesity", *International Journal of Obesity*, 19, p. S37-S45.
- Katzmarzyk, P. T., Gledhill, N., Shephard, R. J. 2000. "The economic burden of physical inactivity in Canada", *Canadian Medical Association Journal*, 163 (11), p. 1435-1440.
- King, W. C., Brach, J. S., Belle, S. et al. 2003. "The Relationship Between Convenience of Destinations and Walking levels in Older Women", *American Journal of Health Promotion*, Sept., 18 (1), p. 74-82.
- Kino-Québec. 2002. *L'activité physique, déterminant de la qualité de vie des personnes de 65 ans et plus. Avis du comité scientifique de Kino-Québec*, Gouvernement du Québec.
- Kubilins, M. A. 1999. *Designing functional streets that contribute to our quality of life*, Charlotte, North Carolina, Kubilins Transportation Group, Transportation Research Board, Circular E-C019: Urban Street Symposium.
- Ledoux, M. and Rivard, M. 2001. "Poids corporel", *Enquête sociale et de santé 1998*, Institut de la statistique du Québec, Collection la santé et le bien-être, Les publications du Québec, Sainte-Foy, p. 185-199.
- Martinez, J., Pampalon, R., Hamel, D. et al. 2004. *Vivre dans une collectivité rurale plutôt qu'en ville fait-il vraiment une différence en matière de santé et de bien-être?* Institut national de santé publique du Québec.
- Mayer, M., Roberge, D. 2002. "Perception de l'environnement social : quartier ou voisinage", *Enquête sociale et de santé auprès des enfants et des adolescents québécois 1999*, Institut de la statistique du Québec, Québec, p. 137-152.
- McCann, B. A., Ewing, R. 2003. *Measuring the health effects of sprawl - A national analysis of physical activity, obesity and chronic disease*, Smart Growth America - Surface Transportation Policy Project.



- Mongeau, L., Aubin, J., Odet, N. et al. 2005. *Le poids des Québécois 1987 à 2003*, INSPQ et Institut de la statistique du Québec.
- Murray, C. et Lopez, A. 1996. "The Global Burden of Disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020", Cambridge, Harvard University Press, *Global Burden of Disease and Injury Series*, Volume 1.
- Nakahara, S., Nakamura, Y., Ichikawa, M. et al. 2004. "Relation between increased numbers of safe playing areas and decreased vehicle related child mortality rates in Japan from 1970 to 1985: a trend analysis", *Journal of Epidemiology and Community Health*, 58 (12), p. 976-981.
- Noël, N. 2003. *Stratégies de déplacement, espaces d'action et usage de la bicyclette*, Innovation Transport, p. 3-11.
- Nolin, B., Pampalon, R., Hamel, D. 2005. *Marche et bicyclette utilisées comme moyen de transport au Québec : un regard selon les milieux de vie*, Québec, INSPQ, JASP, Québec, novembre.
- Nolin, B., Prud'homme, D., Godin, G. et al. 2002. *Enquête québécoise sur l'activité physique et la santé 1998*, Institut national de santé publique du Québec, Institut de la statistique du Québec, Kino-Québec.
- Powell, K. E. et Blair, S. N. 1994. "The public health burdens of sedentary living habits: theoretical but realistic estimates", *Medicine and Science in Sports and Exercise*, July, 26 (7), p. 851-856.
- Pucher J. and Dijkstra L. 2003. "Promoting Safe Walking and Cycling to Improve Public Health: Lessons from The Netherlands and Germany", *American Journal of Public Health*, 93 (9), p. 1509-1516.
- Saelens, B. E., Sallis, J. F., Frank, L. D. 2003. "Environmental Correlates of Walking and Cycling: Findings from the Transportation, Urban Design, and Planning Literatures", *Annals of Behavioral Medicine*, 25 (2), p. 80-91.
- Schoeller, D. A., Shay, K. and Kushner, R. F. 1997. "How much physical activity is needed to minimize weight gain in previously obese women ?" *American Journal of Clinical Nutrition*, 66, p. 551-556.
- Statistics Canada. 2003. "Where Canadians work and how they get there", 2001 Census, Analysis series, Census Operations Division, Statistics Canada.
- Transportation Research Board (TRB). 2001. *Making transit work: Insight from Western Europe, Canada and the United States*, Washington, DC, National Academy Press.
- Tsuji, I., Takahashi, K., Nishino, Y. et al. 2003. "Impact of walking upon medical care expenditure in Japan: the Ohsaki cohort study", *International Journal of Epidemiology*, 32, p. 809-814.
- Tudor-Locke, C., Bassett, D. R. Jr. 2004. "How many steps/day are enough? Preliminary pedometer indices for public health", *Sports Medicine*, 34 (1), p. 1-8.



U.S. Department of Transportation, Federal Highway Administration (USDTHA). 1992. *National Bicycling and Walking Study - Case Study n° 1 - Reasons Why Bicycling and Walking Are Not Being Used More Extensively As Travel Modes*, Report n°: FHWA-PD-92-041.

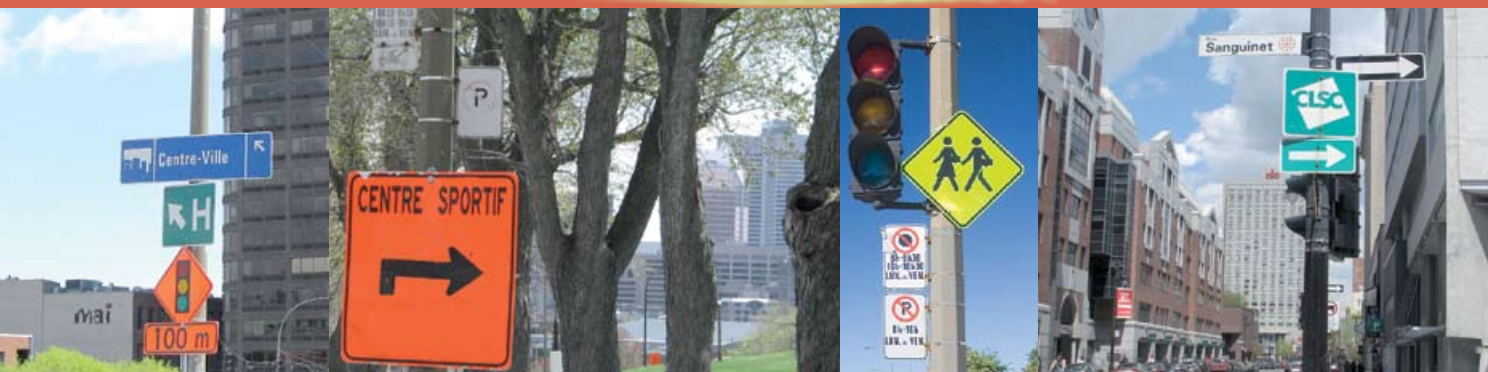
U.S. Department of Health and Human Services. 1996. *Physical Activity and Health: A Report of the Surgeon General*, Ed. Centers for Disease Control and Prevention Department of Health and Human Services, Atlanta, GA, U.S., National Center for Chronic Disease Prevention and Health Promotion, p. 1-278.

Vélo Québec. 2001. *L'état du vélo au Québec en 2000*.

Victoria Transport Policy Institute. 2005. *Land Use Impact on Transport. How Land Use Patterns Affect Travel Behavior*, 22 p.

World Health Organization (WHO). 2002. *A physically active life through everyday transport with a special focus on children and older people and examples and approaches from Europe*, Davis, A. et al., Regional Office for Europe, 47 p.

Transportation & **Social Exclusion:**
New Perspectives
on a **Long-Standing Problem**



CHAPTER 5

Transportation & **Social Exclusion:** **New Perspectives** on a **Long-Standing Problem**

Transportation is at the centre of economic and social exchanges. Far from being just one service among others, it is instead key to gaining access to all other services, a condition that is usually necessary to engage in employment, and an essential instrument of social participation.³⁵ Inequalities in access to transportation thus risk engendering inequalities in all other respects. However, the links between transportation problems and social exclusion have been poorly documented, especially in North America, except perhaps with regard to the mobility of certain “disadvantaged” groups, especially the disabled. Legislative provisions and documents elaborated in Quebec in recent years to guide public intervention in the fight against poverty and social exclusion have also largely overlooked links with the problem of transportation.

On the other hand, major breakthroughs in understanding this problem have been made in Europe in recent years. In the United Kingdom in particular, the work of the Social Exclusion Unit (SEU) and studies and inquiries conducted by the Department for Environment, Transport and the Regions (DETR) have collected a body of empirical data to document the principal dimensions of transportation and, more broadly speaking, of accessibility from the standpoint of social inequalities.

In Montréal, since 1998, as our first annual report shows, the Direction de santé publique de Montréal has focused on social inequalities as a key determinant in the overall health of the population. In the wake of European studies that show the relevance of examining transportation systems and policies from the perspective of social inequalities,³⁶ we must devote more attention to this situation to ascertain its importance in the Montréal context and, if need be, to examine its effect on health and well-being.

35. We would like to note our colleague Claudine Christin's reflection on this topic.

36. This report focuses on social inequalities from the angle of inequalities linked to income, sex, ethnic origin, and so on.

Transportation puts a severe strain on a significant portion of the family budget that varies inversely to income: in the United States in 2003, households in the lowest income quintile spent 34.9% of their pre-tax income on transportation, compared with 11.4% for households in the highest income quintile.

The predominance of the automobile

Despite obvious differences between Europe and North America, between London and Montréal, we have good reason to believe that here as well, the organization of transportation can engender inequalities with respect to access likely to lead to social and health inequalities. In recent decades, the number of motor vehicles in Quebec has grown spectacularly. At that same time, we have observed a fragmentation of the territory, which has led to an increase in the distances that must be travelled to go to work, to school, to shop and to gain access to services.

Over the century of its existence, the automobile has become a cult object and, occasionally, a genuine necessity when neighbourhoods are lacking in local services and public transportation services are inadequate, not to mention its obvious symbolic value. In a society largely dominated by the automobile and organized accordingly, the development of mass transit and the establishment of infrastructure that promotes active transportation rank second in the order of priorities. The result has been an array of environmental and health problems, described in the preceding chapters. Furthermore, transportation problems are an additional obstacle to

social participation among individuals contending with social handicaps,³⁷ which marginalize them in relation to the workplace, educational institutions, leisure activities and culture. An under-privileged environment with respect to transportation poses the following dilemma: either individuals must devote an inordinate proportion of income to the purchase and operation of an automobile (at the expense of other budget items that would be more useful in the long run), or they must make do with less practical, slower, more complicated modes of transportation, or simply forego certain activities. What is certain is that transportation puts a severe strain on a significant portion of the family budget that varies inversely to income: in the United States in 2003, households in the lowest income quintile spent 34.9% of their pre-tax income on transportation, compared with 11.4% for households in the highest income quintile.

Consequently, the dispersal of services, combined with inadequate public transportation services, can lead to an accessibility deficit that threatens equal opportunities and restricts the range of individual choices, especially for individuals who do not own a car. The solution to this deficit does not lie in the generalization of private motor vehicles but in the integration of transportation and urban planning

37. It should be emphasized that physical disabilities, age, ethnic origin, and so on often result in social handicaps.

The dispersal of services, combined with inadequate public transportation services, can lead, in particular for individuals who do not own a car, to an accessibility deficit that threatens equal opportunities and the range of individual choices.

policies that emphasize multimodal approaches where public transportation covers the entire city.

A definition of social exclusion

In the absence of a consensus on a definition of social exclusion, the SEU adopted a working definition: “Social exclusion reflects the existence of barriers which make it difficult or impossible for people to participate fully in society.”³⁸ The concept is not confined to poverty (it is a multifaceted phenomenon) although material deprivation is an important facet of it. Individuals and groups that are “socially excluded” usually display a series of interrelated traits, which are often linked to poverty: high levels of prolonged unemployment, limited education, low income, precarious health, high rate of fragmented families, deficient housing conditions, high-crime environments, and so on. The notion of social exclusion is not entirely separate from that of poverty. However, it does cast a different light on it by highlighting the relationship between the individual and society

and the dynamics of this relationship rather than an individual's vulnerability factors.³⁹ This explains the interest in concrete, systemic mechanisms (“barriers”) that contribute to cut off disadvantaged individuals and groups from the usual channels of social, economic and political participation.

Transportation and exclusion: a well-documented hypothesis

The report entitled *A New Deal for Transport* acknowledged for the first time that transportation policy can contribute to the exclusion of certain groups and communities. Supported by inquiries, the SEU made the following observations in its final report in 2003.

- Transportation is a significant barrier for two individuals out of five seeking employment.
- Transportation costs put considerable pressure on the budgets of nearly half of students 16 to 18 years of age.
- Reliance on public transportation is a barrier to the use of health services.



38. Several authors accept this definition although, depending on the studies and the countries, what differs are the spheres of participation considered. As one researcher has noted, while research conducted in the United Kingdom is helping to emphasize participation in a varied range of activities such as work, education, social and cultural activities, and so on, concern in the United States is more extensively or solely focused on participation in work. Thus, studies devoted to spatial mismatch between places of residence and workplaces have largely dominated research. The spatial mismatch hypothesis has also been explored in Quebec in research on the access to employment for women.

39. The Scottish Office's definition is more explicit: the process through which individuals are deprived of opportunities to participate in society, whether by means of employment, education, family and social networks, community and leisure activities, and to live without fear of threats to their personal safety [translation].

- The accelerated exodus of businesses such as food stores to outlying areas poses a problem of access for individuals who do not have a car.
- Individuals who do not have a car experience greater difficulty in travelling to visit family and friends, a recreational centre or a library.
- There is a very clear link between social class and traffic accidents, exposure to pollution and noise caused by road traffic (25% of child pedestrian casualties happen in the most deprived 10% of wards).
- Factors related to the individual: income, age, sex, ethnic origin, disabilities, type of household (married couple, single-parent family), occupation (type of job and work schedule⁴⁰), and mobility skills.⁴¹
- Transportation-related factors as such:
 - › the availability of public transportation services within reasonable walking distance from the home, its frequency and reliability, and the transportation network's connectivity; and ownership of an automobile;
 - › affordability: the cost of public transportation services in relation to income, and the proportion of income devoted to travel (it is compromised if households must spend more than 20% of their income on transportation);
 - › accessibility: the ability of transportation systems to satisfy the special needs of individuals with reduced mobility, a parent travelling with children, and so on;
 - › safety: the risk of transportation-related accidents, real or perceived risks of aggression on public thoroughfares or in the public transportation network.

Facets of the accessibility deficit

Problems of accessibility are the key mechanism linking transportation and social exclusion. They stem from interaction among three types of factors at the individual or neighbourhood level:

- Environmental factors: the availability and quality of essential services found in a given neighbourhood (businesses, especially grocery stores, health services, schools, banks, and so on); organizational accessibility (opening days and hours of services); and the quality of infrastructure (pedestrian walkways, bicycle paths, and so on).



40. Atypical jobs, e.g. part-time work, staggered working hours and night work, impose dispersed, desynchronized mobility. These forms of work concern, mostly individuals with limited qualifications. According to one researcher, it is here that the problem takes shape since it is the least qualified individuals who must be the most mobile and they are also the ones who have the most limited means of mobility.

41. For example, the ability to read a map and to interpret instructions.

The decline of local services combined with the inadequacy of public transportation services contributes to the creation of vulnerable, isolated zones, which bodes poorly for a city's future.

The consequences of an accessibility deficit

An accessibility deficit causes an array of problems. Among individuals, unequal access can help to reproduce social inequalities by reducing opportunities to develop individual potential. For communities, the decline of local services combined with the inadequacy of public transportation services contributes to the creation of vulnerable, isolated zones, which bodes poorly for a city's future.

All of these data can be converted into indicators that make it possible to examine systematically disparities in accessibility and, in particular, transportation problems likely to exacerbate social inequalities, which vary in time and space.

The situation in Montréal

Montréal's transportation system has not, until now, been studied systematically from the standpoint of social exclusion. However, the data below suggest the relevance of such an analysis.

- At the outset, in 1980, the cost of the Carte Autobus-Métro (monthly pass) was equivalent to 12.5% of one week (35 hours) of earned income at the minimum wage; in January 2006, it was equivalent to 24%.
- In Montréal, the motorization rate (the proportion of households that own at least one car) is 71.5%.

However, the difference in the rate is more than double between residents of the wealthiest sectors and residents of the poorest. The latter are relatively more reliant on public transportation services and are thus more heavily penalized if the service is inadequate, deteriorates or becomes more expensive for the user.

- Some 45% of women living in urban areas say they do not feel safe when they walk alone in their neighbourhood in the evening, or completely avoid doing so. Among individuals who use public transportation services after nightfall, nearly half of them say that they feel anxious, women (69%) more so than men (29%).
- Statistics Canada's Participation and Activity Limitation Survey (PALS) (2001) reveals the problems that the disabled encounter in gaining access to public transportation services. Over 4% of disabled individuals 15 years of age or over are totally unable to use public transportation. Among those who use the services, 17% say they experience problems to different degrees, and this proportion rises to 35% in the case of more acute disabilities.
- According to a report from the Comité d'accessibilité du métro de Montréal (2003), the metro is one of the last in the world to be entirely



The Montréal metro is one of the last in the world to be entirely inaccessible to individuals in wheelchairs. The ageing of the population highlights more acutely than ever the need to make the metro accessible to individuals with functional limitations.

inaccessible to individuals in wheelchairs. Moreover, the ageing of the population highlights more acutely than ever the need to make the metro accessible to individuals with functional limitations, in keeping with the recommendations of the European Conference of Transport Ministers (2001).

- Inasmuch as motorists do not assume all of the costs stemming from the use of a car, part of this burden is transferred to non-motorists, who are over-represented in low-income groups. The result is a regressive redistribution from wealthier to poorer individuals.
- The negative impacts of automobile traffic are concentrated among certain groups:
 - › In the under-14 age group, accidents are not randomly distributed among socioeconomic groups: in Montréal, twice as many young cyclists were subject to intervention by Urgences-santé in the poorest sectors (lowest decile) than in the wealthiest sectors (4.4% as against 2.1%). Almost four times as many young pedestrians in the poorest sectors were subject to such intervention than in the wealthiest sectors (5.2% compared with 1.4%) (Montréal, 1999-2003).

› The proportion of low-income households (according to the average assessed value of dwellings) is higher along heavily used axial highways ⁴² (more than 7 700 vehicles per hour during morning rush hour), which, because of their broader exposure to air pollution, makes them more vulnerable to certain health problems. Residents over 60 years of age living along these axial highways are more likely to be hospitalized for respiratory problems than those living in quieter sectors.

› Moreover, it was the residents of disadvantaged neighbourhoods who were disturbed and displaced the most by major highway projects in the 1960s and 1970s, in Montréal and all over North America.

Policies and measures governing the organization of urban transportation appear to result in costs and benefits that are unevenly distributed among socioeconomic groups. Low-income earners, children, the elderly and individuals with functional limitations seem especially heavily penalized. There is thus a need to ascertain systematically whether the organization of transportation and policies contribute to ensuring more equal



42. With the exception of the West Island, which has fewer residents and one-third the population density, that is, 1 436 inhabitants/km² compared with 4 848 inhabitants/km² in the truly urban sector of Montréal, which accounts for roughly 80% of the population of the Island of Montréal.

Policies and measures governing the organization of urban transportation appear to result in costs and benefits that are unevenly distributed among socioeconomic groups.

opportunities—or if, to the contrary, they hamper the attainment of this goal—and if they adequately and fairly satisfy the mobility needs of all residents.

Questions to be explored

The available data do not allow us to assess the nature and scope of the mobility problems that residents of different Montréal neighbourhoods encounter, nor to gauge the relative contribution of these problems to the social exclusion process. It therefore seems very germane to have available a profile of mobility and accessibility problems related to exclusion and social inequalities that can be monitored over time.

Examining these questions first compels us to ask ourselves what the most adequate measurement of social exclusion would be, bearing in mind different focal points of social participation, and to focus on the choice of the most appropriate indicators to account for problems of accessibility. This undertaking implies employing different types of data (social, demographic, economic, health, and so on) that vary in nature (quantitative and qualitative, objective and subjective), and are drawn from various sources (censuses, administrative records,

survey data, discussion groups, and so on), and relying on an array of analytical techniques that build on, in particular, the potential of geographic information systems.⁴³

We could thus obtain a picture of accessibility problems and the health impacts of transportation as they affect different groups. Recourse to such data would enable us to go beyond abstract generalities to examine empirically the hypothesis of a relationship between transportation and exclusion and, if need be, to pinpoint its mechanisms.

Thus armed with the relevant information, we can all strive to enhance the mobility of individuals, which, since it is decisive for the organization of all facets of urban life, would no longer elude the question of social exclusion.

43. Geographic information systems (GIS) compare in a neighbourhood or on a smaller scale information on individual factors (income and education) and contextual factors (housing conditions, the location of community services and facilities, road transportation, main roads and public transportation services, pedestrian facilities, cycling and crime) that affect accessibility, and examine their variation in space.

REFERENCES

- Blumenberg, E. and Waller, M. 2003. *The Long Journey to Work: A Federal Transportation Policy for Working Families*. Washington, DC, The Brookings Institution Series on Transportation Reform.
- Bureau of Labor Statistics. 2005. Consumers Expenditures 2003 (www.bls.gov/cex/csxann03.pdf).
- Comité sur l'accessibilité du métro de Montréal 2003. *Rapport du Comité sur l'accessibilité du métro de Montréal*, présenté au ministre des Transports.
- Conférence européenne des ministres des transports 2001. *Conclusions et recommandations sur le transport et le vieillissement de la population*, Lisbonne, CEMT.
- DETR. 1998. *A New Deal for Transport: Better for Everyone*, The Government's White Paper on the future of transport, London, HMSO.
- Graffon, P., Hine, J. P., Mitchell, F. 2001. *The Role of Transport in Social Exclusion in Urban Scotland. Literature Review*, Edinburgh, Scottish Executive Central Unit.
- Hine, J. and Mitchell, F. 2003. *Transport Disadvantage and Social Exclusion. Exclusionary Mechanisms in Transport in Urban Scotland*, Burlington, ASHGATE.
- Hine, J. and Mitchell, F. 2001. *The Role of Transport in Social Exclusion in Urban Scotland*, Edinburgh, Scottish Executive Central Unit.
- Laroche, D. 2001. *La victimisation. Portrait social du Québec : données et analyses*, Montréal, Institut de la statistique du Québec.
- Le Breton, E. 2005a. *Bouger pour s'en sortir. Mobilité quotidienne et intégration sociale*, Paris, Armand Colin.
- Le Breton, E. 2005b. Communication présentée au Forum "Mobilités pour l'insertion", Saint-Nazaire, 6-7 octobre 2005.
- Lessoif, C. and Jowee, R. 2000. *Measuring social exclusion*. Centre for Research into Elections and Social Trends. National Centre for social research and Department of Sociology, University of Oxford. Working paper 84, 2000.
- Litman, T. 2002. *Social Inclusion As A Transport Planning Goal in Canada. Contribution To The FIA Foundation G7 COMPARISON*. Victoria, Victoria Transport Policy Institute.
- Litman, T. 2006. *Evaluating Transportation Equity. Guidance For Incorporating Distributional Impacts in Transportation Planning*, Victoria, Victoria Transport Policy Institute.
- Lucas, K. 2003a. *Transport and Social Exclusion. A survey of the Group of Seven Nations. Summary Report*. London, FIA Foundation.
- Lucas, K. 2003b. *Transport and Social Exclusion: A G7 Comparison. An Overview of the UK Position*. London, FIA Foundation.
- Lucas, K., Grosvenor, T., Simpson, R. 2001. *Transport, the environment and social exclusion*. York, Joseph Rowntree Foundation, London, FIA Foundation.

L.R.Q., Chapitre L-7. *Loi visant à lutter contre la pauvreté et l'exclusion sociale.*

Ministère de l'Emploi et de la Solidarité sociale. 2005. *Plan d'action gouvernemental en matière de lutte contre la pauvreté et l'exclusion sociale. Bilan de la première année.* Québec, MESS.

Ministère de l'Emploi et de la Solidarité sociale. 2004. *Concilier liberté et justice sociale : un défi pour l'avenir. Plan d'action gouvernemental en matière de lutte contre la pauvreté et l'exclusion sociale.* Québec, MESS.

Ministère de l'Emploi et de la Solidarité sociale. 2002. *La volonté d'agir, la force de réussir. Stratégie nationale de lutte contre la pauvreté et l'exclusion sociale.* Québec, MESS.

Schönfelder, S. et Axhausen, K. W. 2003. "Activity spaces: measures of social exclusion?", Working Paper, Swiss Federal Institute of Technology, Zurich.

Smargiassi, A. 2005. "Est-ce que les personnes âgées de 60 ans et plus qui vivent sur des rues achalandées à Montréal sont plus à risque d'être hospitalisées pour des problèmes respiratoires ?", rapport synthèse, vol. 8, n° 1, DSP Montréal.

Social Exclusion Unit. 1998. *Bringing Britain Together.* London, Social Exclusion Unit.

Social Exclusion Unit. 2003. *Making the Connection: Final Report on Transport and Social Exclusion,* London, Social Exclusion Unit.

Statistics Canada. 2001. *Participation and Activity Limitation Survey, 2001. Disability Supports in Canada, 2001.* Catalogue n° 89-580-XIE.

TRaC. 2000. *Social exclusion and the provision of public transport. Main report.* University of North London.

Vandersmissen, M.-H. 2003. "Mobilité, accessibilité et cohésion sociale", *Cahiers de Géographie du Québec*, vol. 47, p. 201-222.

6

Shift

Urban Transportation

Urban Transportation

Initiate a **Genuinely Sustainable Shift**



Urban Transportation

Sustainable



CHAPTER 6

Initiate a **Genuinely Sustainable Shift**

In a society in which the automobile dominates, urban transportation imposes, as the data in this report reveal, a heavy toll in terms of mortality, morbidity and quality of life, not to mention the economic costs stemming from health problems and congested thoroughfares. However, this situation is not inevitable and if, as a society, we are determined to achieve sustainable development, it is up to us to resolutely initiate the necessary shift in an innovative manner.

Reduce the pressure that automobiles exercise

In light of the foregoing comments, it is clear that transportation in Montréal is associated with five key effects on health:

- hospitalizations and deaths attributable to cardiorespiratory diseases related to polluting emissions, especially asthma among children and premature mortality due to smog among the elderly;
- the road accident toll (injury victims and deaths) and, more generally, the decline in road safety, especially among pedestrians and cyclists;
- obesity in children and adults;
- the aggravation of chronic diseases, respiratory allergies, and so on, caused by heat waves related to climate change stemming from more abundant GHG;
- social exclusion resulting from the current state of urban transportation and reduced access to the labour force, education, leisure activities and culture.



To curb health problems and the deterioration of the environment engendered by current modes of transportation, we must strive to implement an integrated plan to reduce the number of automobile trips.

To reduce these effects implies, among other things, the organization of transportation according to the basic principle of sustainable development, that is, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs,” as defined by the World Commission on Environment and Development. Our current travel methods, which are obviously characterized by extensive reliance on the automobile, are incompatible with this perspective and call for a major shift. This observation is widely shared at the international level, as European officials responsible for transportation, the environment and health have emphasized.

In the Montréal area, a number of planning documents have recently underlined the need to reduce the number of automobile trips by fostering alternative transportation (public transportation and active transportation) and to reduce motor vehicle emissions. Some examples are:

- the *Premier plan stratégique de développement durable de la collectivité montréalaise*, April 2005;
- the *Plan d’urbanisme de la Ville de Montréal*, 2005;
- the *Projet de schéma métropolitain d’aménagement et de développement*, Communauté métropolitaine de Montréal (working paper), March 2005;

- the *Plan de transport de la Ville de Montréal* (working paper), March 2005.

To curb health problems and the deterioration of the environment caused by current travel methods, we believe it is necessary to elaborate and implement an integrated plan to reduce the number of automobile trips in the territory of the City of Montréal and in the metropolitan area. To this end, two key measures should be emphasized: maximize the availability of public transportation and active transportation and dissuade residents from using private automobiles, especially to go to work or school. We must at the same time ensure that polluting emissions from automobiles are substantially reduced.

Public transportation and active transportation should account for 50% of travel by 2020

According to the 2003 O-D study, the modal share of public transportation in the metropolitan area during morning rush hour is 22%, and that of active transportation (walking and cycling), 10%. The solution to the problems we have described relies on a substantial adjustment in the modal share of these two modes of transportation and therefore a reduction in the number of automobile trips. This adjustment can only be achieved over a number



To ensure that residents rely less extensively on the automobile, we must first perceptibly enhance the competitiveness of public transportation in terms of its cost to the user and quality of service (speed, comfort, safety, convenience and reliability).

of years. However, as the successful initiatives of big cities such as Portland, Copenhagen and Amsterdam reveal, we can achieve this objective provided, of course, that we adopt the necessary means, as these other cities have done: clearly display a strong political will supported by public opinion and define a measurable objective that rallies all stakeholders in the sectors concerned.

We are proposing that the modal share of public transportation and active transportation be increased to 50% by 2020. We acknowledge that the target is a demanding one, but the experience of other big cities leads us to believe that a target that is much easier to achieve would not likely lead to the necessary public mobilization and shift. Indeed, to attain this objective, we will have to make choices other than those we have made in recent decades, where all options appeared to be open simultaneously, and to give priority to the mobilization of the resources necessary to give public transportation and active transportation a comparative advantage that the public can clearly perceive in relation to recourse to private automobiles in dense urban environments.

Increased funding for public transportation

The competitive position of public transportation in the Montréal area has deteriorated considerably since

1987. Its modal share has fallen from 28% to 22%, a downturn that coincided above all with the 1992 Ryan reform, which terminated the provincial government's contribution to the operations of mass transit companies, and the increase in the proportion of costs that users assume, i.e. 31.3% in 1991, compared with 40% in 2005. While Montréal established itself as a major modern city with the opening of the metro in 1966, the four subsequent decades have, instead, witnessed stagnation and, indeed, the deterioration of public transportation services and infrastructure.

To ensure that the residents of Montréal and the metropolitan area rely less extensively on the automobile and turn to other modes of transportation, we must first perceptibly enhance the competitiveness of public transportation in terms of cost to the user and quality of service (speed, comfort, safety, convenience and reliability). This will require substantial additional funding to slow down fare increases or even reduce fares and, in some instances, to develop new infrastructure, especially in the east end of Montréal, which overall will otherwise remain poorly served despite planned train service to Terrebonne and Mascouche, or to update infrastructure that has been neglected for too long. Once we have agreed on the need to increase public transportation funding, we must then resolve the thorny question of



the means to achieve this end. First, given the crucial role that public transportation plays in the metropolitan area's economic vitality and the desire to achieve sustainable development, top levels of government have a major responsibility to make sustainable transportation a genuine priority: on the one hand, the federal government, which, until very recently, earmarked for road transportation in Quebec roughly one-quarter of the revenues that such transportation generates and, on the other hand, the Quebec government, which has always hesitated to firmly opt for public transportation in the metropolitan area.

During the 1960s, the unprecedented investment made by the population in the Montréal metro was offset by equally substantial investment in the development of highway systems. The little-known net result was that the number of public transportation passengers in no way increased during those years, if only temporarily during the six months of Expo '67. It was not until several years, with the introduction of the Carte Autobus-Métro (CAM, or monthly pass), that public transportation passenger figures really began to soar. It is clear that by blowing hot and cold, wanting to make several choices simultaneously, and encouraging reliance on public transportation but equally or even more so reliance on private automobiles, we incur considerable expense without obtaining

the desired effect. Will the state of public finances allow us much longer to act without choosing? We doubt it.

The Communauté métropolitaine de Montréal (CMM) recently estimated at \$7.2 billion the total investment needed to improve public transportation; \$3.1 billion to maintain existing public transportation infrastructure

Contradictory incentives

The Quebec Premier made an anticipated announcement last March concerning the commuter train project in the east end of Montréal. However, it followed an expression by the government of its intention to proceed with the extension of autoroute 25, which will add a 15th bridge to the Island of Montréal. The project, which the Direction de santé publique de Montréal opposed during the BAPE hearings, will inevitably ultimately create traffic jams for motorists who attempt to go downtown at the same time as a new public transportation service is being offered. During the hearings, representatives of the MTQ (Ministère des Transports du Québec) acknowledged that the extension of autoroute 25 would lead to a reduction in the number of public transportation users.

The desire of suburbanites to use the quickest, most comfortable means of reaching their destination is quite understandable. What is debatable, however, is the absence of clear, non-contradictory incentives in favour of public transportation in such a situation. Indeed, the decongestion of the network would be more effective and durable if, in densely populated urban environments, it focused first and foremost on the development of public transportation infrastructure instead of the development of road and autoroute networks.



Annual funding needs for public transportation are on the order of \$480 million. Existing programs to support capital expenditure funding total only \$170 million a year.



and \$4.1 billion to develop four priority projects that have a strong potential to curb the number of automobiles entering and travelling in Montréal, i.e. the Terrebonne-Mascouche-Repentigny-Montréal train, the rail shuttle service to Montréal-Trudeau Airport, the extension of the metro to Anjou, and the light rail transit line between Brossard and Montréal along autoroute 10.

Annual funding needs for public transportation are on the order of \$480 million. Existing programs to support capital expenditure funding total only \$170 million a year, including assistance from Quebec covering expenditures and the very recent federal government contribution stipulated in the agreement⁴⁴ on the partial transfer of the excise tax on gasoline (\$443 million for the period 2006-2010, or \$88.6 million per year, on average). The shortfall thus stands at \$310 million per year. The outlays required may at first glance seem considerable, but they must be examined in terms of the returns they engender. From a strictly economic standpoint, a Secor study conducted in collaboration with the Board of Trade of Metropolitan Montreal estimated at \$15 million the benefits stemming from a 2% gain in public transportation's modal share in the metropolitan area.

There are several ways to equitably increase public transportation funding that draws on all beneficiaries and not just users. The Bernard report, commissioned in 2002 by the Quebec government to review the financial framework for metropolitan public transportation, proposed several solutions that would allow for a net capital intake of roughly \$100 million per year. Financial needs for the next 15 years will demand even more extensive funds. Among the possibilities to be considered aside from an increase in the direct contribution made by governments and the municipalities in the metropolitan area, e.g. an increase of up to \$0.03 per \$100 of standardized real estate value would generate an additional \$60 million per year, one or a combination of the following measures applying to motorists, as direct beneficiaries of an increase in public transportation's modal share, should be contemplated.

- The regional surtax on gasoline, now \$0.015/L, could be increased and would generate \$30 million per year per \$0.01/L increment. This measure has the advantage of prorating motorists' contribution to their use of roads and the GHG emissions that they generate.

44. Under the agreement, Ottawa will transfer \$1.36 billion to Quebec, which will assign management of the funds to the recently established Société de financement des infrastructures locales (SOFIL). Quebec will also contribute funds to the corporation. All told, 50% of funding for SOFIL projects will come from the federal government, 25% from the provincial government, and 25% from municipal governments. Funds earmarked for public transportation will be given to transportation agencies according to the number of users served.



In London, where the toll was introduced in 2003, a 15% drop has been noted in the number of cars entering the designated zone during applicable hours. The resulting decongestion is estimated at 30%.

- The metropolitan supplement on registration fees, now \$30, would generate \$15 million per year for each \$5 increase per vehicle.

Dissuade residents from relying on automobiles

The desired modal transfer must also rely on measures aimed at restricting the use of automobiles. We might consider urban tolls, which have produced highly convincing results in the cities that have had the courage to implement them: in London, for example, where the toll was introduced in 2003, a 15% drop has been noted in the number of cars entering the designated zone during applicable hours. The resulting decongestion is estimated at 30%. We might also consider other dissuasive revenue-generating measures, the proceeds from which could be earmarked for public transportation, although this is not the main objective. Public space in the downtown area is in high demand. This resource has an economic value and it is not unreasonable to charge for its use. Moreover, new technologies make possible very efficient collection systems, e.g. by changing fares depending on time of day, as is the case in Stockholm and Singapore.

The same logic applies to parking control. On the one hand, a reduction in the availability of long-term on-street or off-street parking immediately makes reliance on an automobile less

practical and makes a modal transfer to public transportation or active transportation all the more attractive. On the other hand, higher parking metre rates or a tax on private parking fees more accurately reflects the price of a scarce resource, i.e. a square metre of urban space, which could be used otherwise and in a more worthwhile fashion. It is thus logical and legitimate for users of this public asset to assume its true cost.

Fiscal measures to enhance the competitiveness of public transportation

The Bernard report also proposed recourse to relatively minor fiscal adjustments that would, above all, have a neutral overall impact on the public treasury, to encourage modal transfer. Revenue earmarked for the purchase of the monthly pass could be exempt from tax and companies could also pay for their employees' passes without this benefit being taxed. According to the Bernard report, this would represent an estimated expense of \$34 million for the Quebec treasury. The March 2006 Quebec government Budget proposed two measures that are somewhat in keeping with this approach, i.e. the non-taxation of the benefit granted by employers concerning the public transportation pass and an increase from 100% to 200% of the tax deduction for employers who offer their employees passes. The two





The reduction in the number of motor vehicles represent a net gain for society: less pollution, fewer accidents and less congestion.

measures represent a tax expenditure of \$10 million per year. Moreover, this shortfall for tax authorities could be roughly offset by the taxation of the fringe benefit represented by free parking that certain employers offer. In addition, the impact of this tax adjustment could be augmented if the federal government agreed to follow suit. This strategy, without costing the public treasury anything, would engender a net gain for society through the reduction in the number of motor vehicles: less pollution, fewer accidents and less congestion.

Urban planning: intervene upstream

Beyond strategies directly centred on the organization of transportation and the regulation of the number of automobiles, it is clear that the manner in which we occupy the territory and build the city strongly influences the modal distribution of travel. The urban sprawl that has occurred since the end of the Second World War and stemmed from unprecedented prosperity is generating considerable expenditures for all governments. Furthermore, our growing reliance on the automobile, the destruction of natural spaces and the loss of some of Quebec's most fertile farmland are harming our environment and living conditions. However, cities and suburbs have not spread out because of a natural need for expansion. The urban and suburban environment

results from a series of public and private decisions that are sometimes made without careful consideration of their long-term consequences, usually for the benefit of specific interests: it is up to us to do better now.

Urban planning can and must be combined with sustainable development and include transportation as a structuring factor that is inseparable from the whole. Urban space is not free: the omnipresence of the automobile diverts valuable space from potentially more valuable uses and ultimately proves to be counterproductive. Indeed, to move a given number of people from point A to point B, public transportation takes up roughly one-twentieth of the space that automobiles require. Urban planners have elaborated two urban planning concepts to describe a modern, sustainable city.

- 1-Smart growth has five characteristics: the increasing concentration of population in sectors; the growth of communities already served by services and infrastructure; the mixed nature of neighbourhoods (proximity of dwellings, businesses and community facilities); the integration of green spaces and the introduction of alternatives to travel by private automobile.
- 2-Transit-oriented development (TOD) refers to development or redevelopment structured in light of access to the public transportation network.

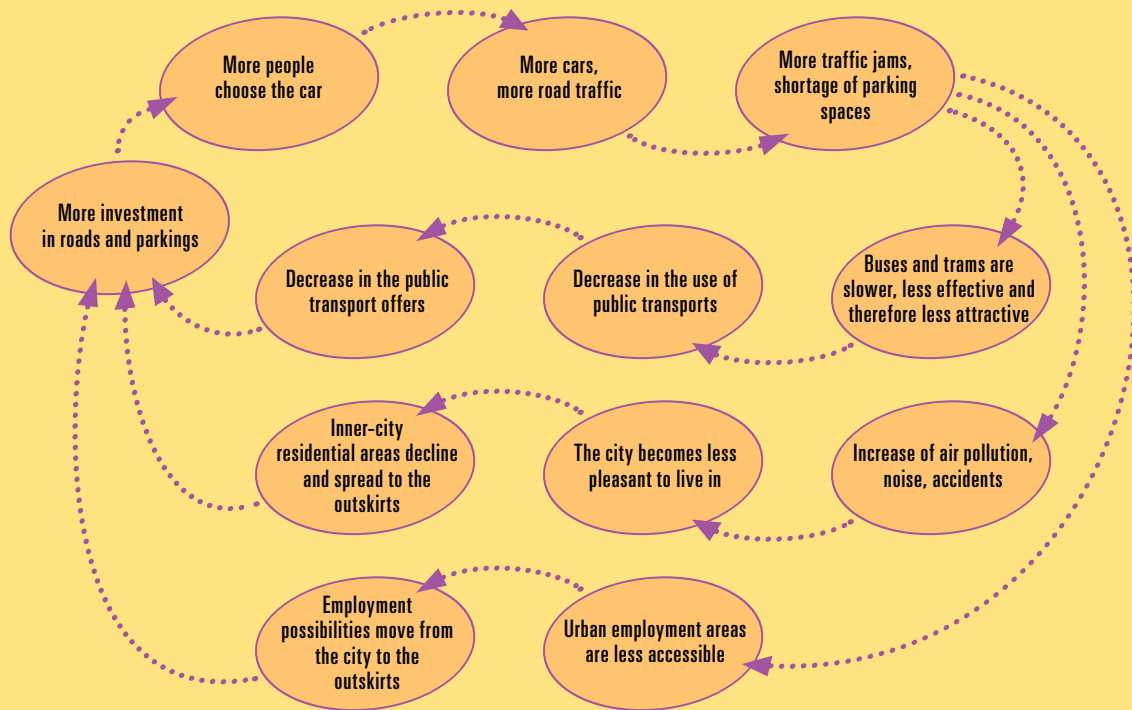


A TOD approach implies dense, mixed urban development that is always close to a public transportation service point. Indeed, the mixed nature of functions in a neighbourhood tends to reduce the number and length of automobile trips. The increasing concentration of population in the territory close to public transportation service makes it possible to increase the number

of users and to make profitable the investments required to achieve a reasonably efficient service. The availability of quality service obviously encourages the modal transfer that we deem necessary, but it will always be difficult and perhaps even illusory to want to establish such a service against a backdrop of urban sprawl and low population density: public

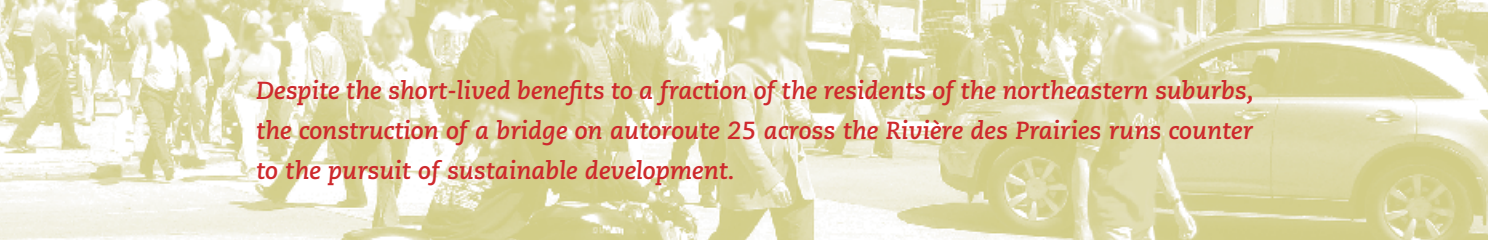
Figure 37

The vicious circle of urban decay



Source: International Union of Public Transport, *Better Mobility in Urban Areas*

Despite the short-lived benefits to a fraction of the residents of the northeastern suburbs, the construction of a bridge on autoroute 25 across the Rivière des Prairies runs counter to the pursuit of sustainable development.



transportation and urban development must be conceived and planned jointly.

In very concrete terms, as crucial decisions concerning transportation are about to be made in our region, we believe that it is important to reiterate a position that stems logically from our examination of health issues in Montréal: we must avoid building any new infrastructure that will lead, in the medium term, to a net increase in the number of vehicles on the roads. Thus, despite the short-lived benefits to a fraction of residents in the northeastern suburbs, we believe that the construction of a bridge on autoroute 25 across the Rivières des Prairies clearly runs counter to the pursuit of sustainable development. Similarly, a decisive criterion to evaluate the project adopted that will be selected for Notre-Dame Street will be to ascertain its net impact on the volume of automobile traffic.

Instead of constantly accommodating growth in automobile traffic, we can instead use the enormous power of public investments to organize the transportation sector according to the principles of sustainable development. This assumes that we call into question the hegemonic position that we have *de facto* conceded to the automobile and adapt automobile traffic to existing infrastructure and not the other way round. For example, widespread use of exclusive rights-of-way for buses, taxis

and bicycles along major thoroughfares is a worthwhile, inexpensive solution for Montréal.

Promote cycling and walking in Montréal

Urban planning can serve as a formidable health promotion tool not only by facilitating a modal transfer to public transportation but also by developing an active transportation network that is at once efficient, accessible and safe for all users and fully connected to the public transportation network. Throughout North America, the built environment has developed in a way that has complicated the adoption of an active lifestyle. In light of what has resulted, the time is right to review our urban development plan to make the city better suited to a physically active lifestyle. This approach has been adopted in numerous projects in the United States in conjunction with the Active Living by Design program of the Robert Wood Johnson Foundation.

All too often, cycling and walking are still simply deemed to be pleasant leisure activities instead of genuine modes of transportation that can be used every day for all types of trips, e.g. to go to work or school or for shopping, as is true in big cities that have challenged the automobile's hegemony. While Montréal is very proud of its cycling events, it has fallen behind somewhat with respect to its network of cycle paths. There are over 300 km of



Using Toronto as a model, Montréal would do well to step up efforts to develop a network of cycle paths that promotes much more widespread reliance on bicycles for everyday travel.

cycle paths and lanes on the Island of Montréal, although connectivity leaves a lot to be desired (there are numerous fragments of varying lengths that are not always entirely safe). Using Toronto as a model, Montréal would do well to step up efforts to develop a network of cycle paths that promotes much more widespread reliance on bicycles for everyday travel. Toronto has adopted an action plan now being implemented to create 1 000 km of cycle paths by 2011, including 744 km of paths and lanes on exclusive rights-of-way. Much remains to be done in Montréal to enhance the scope, safety and connectivity of our network of cycle paths, all of which are conditions necessary to increase the modal share of cycling as a “serious” mode of transportation and reduce at the same time sedentariness and the risk of injury. Such an initiative could serve as an opportunity for the City of Montréal, the boroughs and other municipalities on the Island of Montréal to stir people to action, genuinely enhance mobility and encourage an active lifestyle for a fraction of what roads costs on average. The network of cycle paths must no longer be a low-ranking priority of urban and metropolitan transportation infrastructure.

The fate of pedestrians must not be relegated to the background either and the development of the city’s pedestrian potential must satisfy, among other things, the specific needs of

children and individuals with reduced mobility (especially the elderly, who make up a growing segment of the population).

European cities, especially in the Netherlands and Germany, can teach us a great deal about how to develop the city to genuinely make room for pedestrians and cyclists: by organizing safe crossings at intersections and on bridges and overpasses, by paying close attention to lighting and road signs and traffic lights, and by ensuring year-round maintenance of this infrastructure, as is obviously the case with motor transport infrastructure. One key step in this respect that has an immediate impact and offers promise for the future would consist in establishing safe active transportation routes for return trips to schools, thus fostering from a very early age the adoption of active transportation.

Traffic calming

Traffic-calming measures have proven themselves as an effective strategy to reduce injuries and enhance the quality of life in city neighbourhoods. According to the definition that the Institute of Traffic Engineers proposes, this combination of measures reduces the negative effects of motor vehicle use, alters motorists’ behaviour and enhances the lives of non-motorized road users. Moreover, the measures are relatively inexpensive, either to reduce the volume of motor vehicle





A 53% average decrease in injuries was noted in sectors where traffic calming was implemented in Denmark, Great Britain, the Netherlands and Germany, which suggests a noteworthy cost-benefit ratio.

traffic by closing or half-closing streets or narrowing lanes, or to slow down traffic by means of speed humps, the modification of the pavement's texture, and so on.

A European study reveals an average decrease in injuries of 53% in sectors where traffic calming was implemented in Denmark, Great Britain, the Netherlands and Germany. This outcome suggests a noteworthy cost-benefit ratio regarding these measures. Scientific documentation also confirms the effectiveness of implementing 30-km/h zones to significantly reduce the risk of death and serious injury.

The Direction de santé publique de Montréal has undertaken with the Fonds d'action québécois en développement durable to support the Conseil régional de l'environnement de Montréal to carry out a project centred on surveying and implementing traffic-calming measures in central neighbourhoods.

Education and social marketing

Moreover, we must pursue social marketing campaigns such as Car Free Day and Opération Vélo-Boulot, which remind the public of the importance of active transportation. Social marketing and physical developments aimed at facilitating and enhancing the safety of active transportation do not exempt us from striving constantly to improve the behaviour of all users of public thoroughfares: in particular, people

who rely on active transportation would largely benefit from greater civility among motorists, which leads us, among other things, to how new drivers are trained. It is also common knowledge in Montréal that more stringent application of the *Highway Safety Code* has become a necessity. In this regard the decision by the Service de police de Montréal, which, since February 2006, has assigned 133 additional police officers to this task must be commended.

City planners and officials responsible for administering urban plans in each borough should also seek to bolster conditions that facilitate active transportation. This requirement should apply both to sectors under development and older neighbourhoods.

Promote the Allégo program

Aside from the major measures to be adopted to achieve a modal transfer to public transportation and active transportation, there is underdeveloped potential for improvement that can be broached in public enterprises and institutions or employment zones, which are obviously important destinations. Take the example of the Allégo program, through which the Agence métropolitaine de transport (AMT), either directly or through the Centres de gestion des déplacements, offers support and consulting services to workplaces with 50 or more employees to reduce recourse to the single-occupant



automobile. Through a systematic analysis of origins and destinations, the program influences employees' choice of mode of transportation by means of targeted information on options that could be implemented readily and inexpensively (e.g. by publicizing requests for car pooling). If need be, the employer can even obtain financial assistance, for example, to install bicycle racks, showers or lockers. The employer can also reimburse part of the cost of the CAM.

As German researchers have ascertained through several projects carried out in Australia, Europe and the United States, behavioural changes with respect to transportation are not achieved solely by means of coercive measures. They observed, astonishingly, that half of German commuters with ready access to public transportation and who were aware of its existence were misinformed about two key variables, overestimating the cost and duration of the trip. We can probably accomplish a great deal through a simple approach centred on awareness, provided that it is structured and personalized, and, of course, that public transportation is actually available.

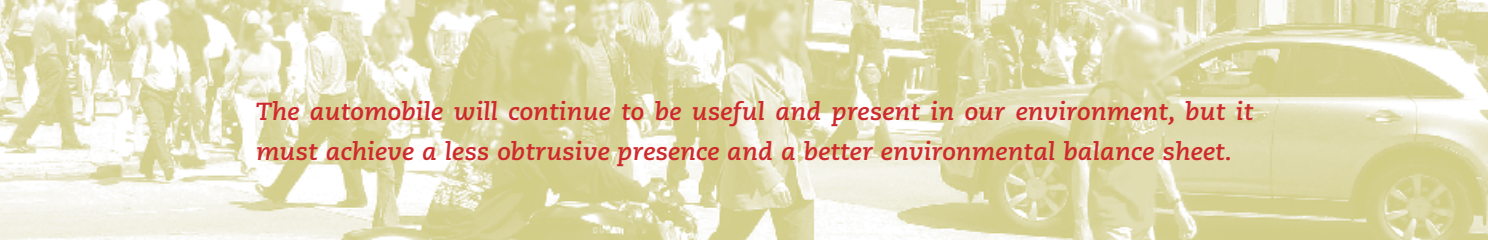
Over the past 15 or so years, a new way of accessing a car has appeared and already has more than 200 000 users in 600 cities around the world, including Montréal since 1995. Communauto maintains a fleet of vehicles in several neighbourhoods that are accessible

to members day and night, without delay, at very reasonable rental rates. Members can use a car as needed and pay only for the time the vehicle is used. The community benefits from all of the advantages stemming from a reduction in the number of vehicles on the roads. Communauto is enjoying growing popularity and now has roughly 6 500 members in Montréal. It is an innovative, intelligent initiative whose contribution to sustainable transportation must be acknowledged and supported.

One employer takes the lead: the Hôpital Maisonneuve-Rosemont

The *Ménagez vos transports* program encourages employees of the Hôpital Maisonneuve-Rosemont to rely on alternative modes of transportation such as public transportation, car pooling, cycling and walking. The hospital offers a 15% discount to employees who request a CAM and sets up car pooling teams, which obtain special parking. Participants in the public transportation or car pooling program enjoy guaranteed return trips to their homes (taxi coupons for emergencies). At present, 529 employees out of 3 000 are registered in the public transportation program (who obtain a CAM occasionally or every month) and 102 are registered in the car pooling program (paired in teams or awaiting pairing), for a total of 631 employees.

The Allégo car pooling services will be available on the Internet to all hospital employees with a computer. To access the program, employees will simply click on the "Allégo car pooling" icon on the desktop.



The automobile will continue to be useful and present in our environment, but it must achieve a less obtrusive presence and a better environmental balance sheet.

Reduce polluting emissions from motor vehicles

The optimal development of an accessible, affordable and competitive public transportation system and the development of a model active transportation system does not mean the rejection of the automobile, which will continue to be useful and present in the environment. However, it must achieve a less obtrusive presence and a better environmental balance sheet. Since the automobile as we now know it will, for the foreseeable future, continue to be an important or dominant means of travel, we must succeed in easing its adverse effects. In other words, the first objective, that is, to reduce the absolute number of automobile trips, must be complemented by the reduction in polluting emissions from motor vehicles.

Until we achieve the dream of a cleaner, safer car, we can immediately mitigate the harmful effects of motor transport by focusing on consumers' behaviour (less polluting vehicles and fuels are already on the market) and by spurring the pace of research and development.

These two targets are attainable inasmuch as we decide as a society to adopt the necessary tools. This will obviously imply often exacting efforts to alter consumption habits and review our choice of priorities, but we will constantly have to remind ourselves

that the status quo even today is costing us dearly and points to an even bleaker future.

Let us now examine some of the measures that might be implemented or, if need be, intensified, to achieve the two strategic targets proposed. These are concrete measures that have often proved themselves elsewhere.

More fuel-efficient automobiles

After the oil shock of the 1970s, the two subsequent decades witnessed the tremendous proliferation of heavier, more powerful vehicles that necessarily consumed more gasoline. As we saw earlier, the number of light trucks (including SUVs) and heavy trucks on Quebec roads doubled between 1990 and 2002. While Quebec makes a fairly good impression in Canada with respect to the proportion of compact cars among new vehicles sold (46.6% in 2002), the proportion of big four-door sedans has been stable for 10 years and that of SUVs doubled between 1994 and 2002. Consequently, the average consumption of the 70 000 new vehicles sold each year has scarcely changed and stood at 10.5 L/100 km in 2002.

The additional registration duties on vehicles with large-displacement engines levied by the 2004 Audet Budget range from \$30 for 4-L engines to \$150 for 5.2-L and larger engines. The revenues generated by this measure, on the order of \$50 million per year for Quebec as a whole, are transferred to



Consumer interest in compact cars or, generally, in cars with low emissions, such as hybrids, could grow if, through subsidies and taxation, we further widened the price gap with more polluting vehicles.

SOFIL to fund public transportation infrastructure. The amount is nonetheless derisory for the purchaser of an SUV costing \$40 000 or more and we doubt that this measure has any effect whatsoever on purchasing habits. Consumer interest in compact cars or, generally, in cars with low emissions, such as hybrids, could grow if, through subsidies and taxation, we further widened the price gap with more polluting vehicles. Taxation and subsidy rates could be adjusted to neutralize the net tax effect. The Quebec government's March 2006 Budget took a step in this direction by reducing the sales tax on hybrids that consume less than 6 L/100 km. However, it should be noted that since a number of conventional vehicles consume less than 6 L/100 km, there is every reason to encourage consumers to purchase them as well.

Technological progress to reduce automobile pollution

All things being equal, the marketing of more fuel-efficient vehicles will help reduce greenhouse gases, a cause of climate change, and air pollution that causes cardiorespiratory problems. We must encourage the automobile industry to step up research in this realm and to quickly introduce in production models effective devices as they are developed. In the wake of the adoption in California of the Pavley Act in 2002, the California Air Resources Board (CARB) published a regulation that compels manufacturers to offer vehicles

that emit less GHG starting in 2009. The regulation sets specific standards spread over seven years to reduce GHG by 22% (in relation to 2004) by 2009, and by 30% by 2016. The installation of the necessary devices obviously imposes additional costs to the consumer, estimated at \$1 064 by 2016. CARB nonetheless maintains that these costs will be more than offset by the reduction in vehicle operating costs.

In addition to reducing GHG emissions, the California regulation will lower by 6 tonnes/day the volatile organic compound and nitrogen oxide emissions responsible for smog. Several American states, including New York, Washington and Massachusetts, are currently examining the advisability of adopting a similar regulation.

In Canada, the government has opted for a more conciliatory approach. On April 5, 2005, it signed with the automobile industry a voluntary draft agreement under which manufacturers will seek to achieve an overall reduction in GHG of 5.3 million tonnes by 2010, in relation to the situation that would prevail had no specific measures been adopted. However, article 10 of the agreement stipulates that it is not legally binding.

Without wishing to call into question the good faith of the signatories to the agreement, we can nonetheless wonder whether the industry, left to its own devices, will have the necessary





Some 80% of polluting emissions come from 20% of poorly maintained vehicles. British Columbia, Ontario and several American states have established inspection and maintenance programs.

incentive to attain the desired objective. On the one hand, unlike California's approach, the Canadian agreement proposes a comprehensive objective that does not set a specific, reasonable standard for each member of the industry. On the other hand, when manufacturers face competition, it is hard to see how market mechanisms could, without a referee who sets identical rules for all, encourage a manufacturer to impose constraints on itself without the assurance that its competitors will follow suit. We must thus be vigilant and closely monitor the market's development. If, within one or two years, progress in achieving the objective falls short of expectations, the Canadian government would be well advised to review its strategy and to contemplate a more formal framework.

Prior to the advent of new technologies, it would, however, be elementary to ensure that the vehicles on our roads are in good operating order. It is estimated that 80% of polluting emissions come from 20% of poorly maintained vehicles. For this reason, British Columbia, since 1990, and Ontario, since 1998, along with several American states have established inspection and maintenance programs that appear to be producing worthwhile results. For example, an evaluation study of the California *Smog Check* program indicates a 14% reduction (1 360 tonnes/day) in carbon monoxide emissions and a 16% reduction (158 tonnes/day) in nitrogen oxides.

Why should Quebec not draw inspiration from its neighbours' best practices? As the Association québécoise de lutte à la pollution atmosphérique has proposed for several years, we believe that it is advisable to establish such a program that would reinforce among motorists and citizens alike the message that clean air is not a stable, inexhaustible, free resource. Indeed, there is a price to be paid to ensure that human activity has a lesser impact on the air that we breathe, failing which we will have to assume even higher health costs.

We have seen in the preceding chapters that the current problem of transportation in Montréal has five key effects on health: most particularly hospitalizations and deaths stemming from cardiorespiratory diseases linked to polluting emissions; the road accident toll and the decline in road safety; obesity among children and adults; the aggravation of chronic diseases during heat waves; and social exclusion. The problem is attributable, above all, to the automobile's omnipresence and we must significantly reduce the pressure that it exerts. To this end, we must firmly broaden the availability of public transportation and active transportation and dissuade residents from resorting to private automobiles, especially to go to work or to school. Such efforts must lead by 2020 to an increase to 50% in the modal share of public transportation and active transportation and a significant reduction in polluting emissions from automobiles.



REFERENCES

- Bergeron, R. 2003. *L'économie de l'automobile au Québec*, Éditions Hypothèse, Montréal.
- Bernard, L. 2002. *Révision du cadre financier du transport en commun au Québec* (Montréal), ministère des Transports du Québec.
- Board of Trade of Metropolitan Montreal. 2004. *Public transit: a powerful economic-development engine for the metropolitan Montreal region*.
- Brög, W. and Erl, E. 2004. *Just do it! Wegweiser für Verhaltensveränderungen*, Socialdata, Institut für Verkehrs- und Infrastrukturforshung GmbH, Munich.
- California Air Resources Board. 2004. *Fact Sheet: Climate change/Emission control regulations*, (www.arb.ca.gov).
- California Air Resources Board and Department of Consumer Affairs/Bureau of Automotive Repair. 2004. *Evaluation of the California Enhanced Vehicle and Maintenance (Smog Check) Program*, Sacramento.
- Litman, T. 2005. *Induced Travel Impact Evaluation. Evaluating Impacts of Increasing Roadway Capacity to the Island of Montreal*, 13 p.
- Ministère des Transports du Québec. 2000. *Des transports au service du développement du Québec, Une perspective économique, sociale et environnementale*.
- Ministère des Transports du Québec. 2002a. *L'induction des déplacements et le modèle de transport de la région de Montréal*, 27 p.
- Ministère des Transports du Québec. 2002b. *Prolongement de l'autoroute 25 ; Réponses aux questions et commentaires transmis par le ministère de l'Environnement*, 36 p.
- Natural Resources Canada. 2005. *Memorandum of Understanding Between Government of Canada and the Auto Industry on Reducing Greenhouse Gas Emissions by 2010*, Ottawa.
- Preston B. 1995. "Cost-effective ways to make walking safer for children and adolescents" *Injury Prevention*, 1, p. 187-190.
- Regional Office for Europe of the World Health Organization. 1999. *Charter on Transport, Environment and Health*.
- Transport Canada. 2000. *Toward Sustainable Transportation*.

Mobilisation

7

Urban Transportation

Leadership and Mobilization are Conditions for Success

Leadership

Urban Transportation

Health



Urban Transportation

Health

Success



CHAPTER 7

Leadership and Mobilization are Conditions for Success

We have been aware for some time of the problems that the omnipresence of the automobile poses for cities. However, the health perspective that we present in this annual report is perhaps slightly less well known and the data put forward show that the problem is even more serious than is generally believed: urban transportation in its current form is the source of several health and well-being problems and, if the trend persists, the present announces a near future in which we will all be losers. We must act now to change direction. We must urgently reduce the number of automobile trips and the polluting emissions of motor vehicles.

To this end, there are solutions in the realms of engineering, urban planning, taxation and health promotion. We have just mentioned some solutions that several big cities around the world have implemented successfully. Yes, it is possible to reduce the number of vehicles that enter and travel in the city. Yes, it is possible to manage demand for travel, to genuinely enhance the availability of public transportation and to encourage the city and businesses to make active transportation attractive, efficient and safe. All of this can be achieved without increasing existing budgets, which are indeed pharaonic when we add up all public and private expenditures dedicated to transportation each year.

The measures to be implemented are known and can be found in any number of transportation and urban design plans. However, the prioritization of sustainable transportation, frequently and loudly proclaimed, is having difficulty coming to fruition where it counts, in budgetary terms. Our society is, to some extent, unable to act, caught in the rut of the status

The need to rethink urban transportation in Montréal and the area overall is not insoluble if we take as examples certain North American (Vancouver, Seattle and Portland) and European cities (Copenhagen, Stockholm, Paris and Zurich).

quo whose short- and long-term consequences we know perfectly well. We tend to put off making decisions that should have been made long ago, despite the good intentions that are often expressed.

Technical problems usually have technical solutions and even money, the crux of the matter and the classic pretext for inaction, is hardly an object if one calculates the overall costs and benefits stemming from different types of investment in transportation: the difficulty of achieving the shift to sustainable transportation concerns, first and foremost, modes of governance, which seem harder to optimize than engineering or accounting problems.

The need to rethink urban transportation in Montréal and the area overall is not, however, insoluble, if we take as examples certain North American cities (Vancouver, Seattle and Portland) and European cities (Copenhagen, Stockholm, Paris and Zurich). In light of the success achieved by these cities and many others as well, there is no choice but to accept that three factors are always present when a successful shift is made to sustainable transportation, i.e. the mobilization of the entire population and socioeconomic stakeholders in light of a perception of the city of the future and sustainable transportation, measurable objectives and clearly proactive political leadership.

Working towards a consensus in Montréal

The decisions to be made to achieve a shift to sustainable transportation are certainly difficult ones because they risk upsetting at the outset certain firmly rooted habits. Decision-makers would be more inclined to act if the mobilization of individuals and organizations in civil society were more visible, better articulated and more intense, and if they perceived unequivocal support. The social consensus in favour of durable solutions that benefit society as a whole is slowly being elaborated. Its progress will depend, by and large, on the dissemination of accurate, adequate information on the situation.

The problems that we wish to tackle are not confined, indeed, to simple irritants to which each of us is resigned after a fashion, as though it were a question of minor drawbacks inherent in modern life, such as interminable commutes between departure and destination points, deteriorated public transportation services, and a lack of consideration for cyclists and pedestrians. All of this is true, but it must also be remembered that the overall outcome is much more serious: the omnipresence of the automobile, the inadequacy of public transportation and hindrances to active transportation directly and indirectly aggravate morbidity and



A recent survey conducted on behalf of the Centre d'action québécois sur les changements climatiques revealed that nearly 48% of motorists in the area were willing to turn to public transportation or active transportation.

mortality in addition to contributing to marginalizing communities and socioeconomic groups.

We are aware that Quebecers are far from insensitive to problems stemming from dependence on the automobile. A recent CROP survey conducted on behalf of the Centre d'action québécois sur les changements climatiques revealed that nearly 48% of motorists in the area were willing to turn to public transportation or active transportation. The respondents nonetheless expect clear signals from elected representatives and governments concerning their decision to invest in efficient, safe, comfortable, accessible public transportation infrastructure and in active transportation, (bicycle lanes on exclusive rights-of-way, pedestrian malls, neighbourhood traffic-calming measures, and so on).

Unquestionable potential for mobilization already exists, which can only grow stronger as rigorous data are published on the scope of the problems. This potential could now serve as an effective pivot to develop strong, proactive leadership.

Political leadership that is, first and foremost, centred in Montréal

The difficulty encountered in making concrete an urban transportation system that is more efficient, healthier and better geared to social equity probably

stems to a large extent from the fragmentation of decision-making centres. The situation that we are experiencing is the sub-optimal result of vast numbers of decisions made by stakeholders with sectoral missions, concerns and interests and whose power relationships are often very unequal. In the end, decision-making processes seem systematically biased in favour of the automobile, to the detriment of everyone, including, paradoxically, motorists themselves, whose fast lanes virtually turn into linear parking lots as they are built. We know the solutions to break out of the vicious circle but their implementation probably requires the determination of an overseer who can orchestrate all facets of the sustainable transportation project.

The need for an overseer capable of perceiving the situation overall is all the more pressing when we realize that transportation concerns matters other than mobility alone. The sound use of the urban environment should, indeed, lead us to perceive transportation as a component of a policy that organically integrates questions of urban planning, employment and economics, protection of nature, respect for our heritage, social equity and, of course, health.

Other institutions can offer decisive support for the leadership we desire to achieve the shift to sustainable transportation: the CMM, the AMT, the STM and other mass transit companies. The



Several institutions can offer decisive support for the leadership we desire to achieve the shift to sustainable transportation: the CMM, the AMT, the STM and other mass transit companies.

CMM is an important forum and hub for cooperation between the municipalities in the metropolitan area and it can certainly actively promote and facilitate the shift to sustainable transportation. The AMT is responsible for the coordination and development of public transportation and the enhancement of the efficiency of highway corridors. It works, as is normal, in light of mandates and means attributed to it by the government, directly or by delegation. Its technical expertise in the realm of transportation management is valuable and, indeed, indispensable. As for mass transit companies and, first and foremost, the Société de transport de Montréal, they play an essential role in terms of efficiency, safety, reliability and connectivity.

A central role for the Mayor of Montréal and elected municipal representatives

Montréal, in its capacity as the main political entity in the agglomeration and the first among its peers in the CMM, should naturally exercise broader leadership in the realm of urban transportation. Montréal is well equipped to give substance to a vision of urban transportation that takes into account the dimensions of environment, equity, and health that we just mentioned. These dimensions must not be construed as impediments to transportation planning but, to the contrary, as giving meaning and

coherence to such planning. After all, transportation is not an end in itself. We provide it so that all residents have access to the services and activities that they need to live and fully develop, which implies a healthy, economically dynamic living environment that fosters collective memory and culture

To proceed on the course proposed, the Mayor of Montréal and his administration must work jointly with their local and regional partners and with higher levels of government. Montréal is a key stakeholder by virtue of its political and economic weight but must earn its role as an overseer through the strength of society's support and the coherence of the vision that it articulates. On behalf of its residents, it must seek to reach agreement with Quebec authorities on a better defined responsibility to make new decisions concerning the apportionment of transportation budgets between roads and public transportation. Montréal must also obtain from Quebec certain new fields of jurisdiction, for example, the power to tax parking lots.

This marks a radical change in the design and organization of public thoroughfares, one that must make extensive allowance for other modes of transportation such as public transportation, car pooling, taxis, cycling and walking. This change must rely on a perspective that is different from the one that has prevailed in recent decades. The elaboration of the *Plan de*





The elaboration of the Plan de transport montréalais now under way offers an opportunity not to be missed to resolutely initiate the shift to sustainable transportation.

transport montréalais now under way offers an opportunity not to be missed to resolutely initiate this shift. It should be noted that municipal authorities enjoy all of the regulatory powers needed to do so and thus all of the necessary latitude to rethink the use of public thoroughfares in their territory.

Montréal's leadership, if it is based on a knowledge of best practices in urban transportation and is exercised with respect for the city's partners and residents throughout the area, can serve as the powerful impetus for change that has been lacking for several years. Resistance is undoubtedly to be expected, fed by reflexes acquired in past decades, but good sense could ultimately prevail, for it is neither in the interests of Quebec nor the residents of the metropolitan area that Montréal falter and fail.

A renewed partnership with the Quebec government

The Quebec government, through the ministère des Transports (MTQ), is responsible for overall planning but also for the elaboration of transportation policies and programs. It must oversee major choices between regions and modes of transportation in a fair manner that benefits all of Quebec in all respects, both with regard to environmental protection and economic prosperity or social development. To a large extent, it is through the MTQ that decisions that guide our transportation

plans are carried out. It is thus incumbent upon the ministry to support the shift to sustainable transportation. The MTQ must update in its specific field of responsibility the principles of sustainable development that Quebecers share, and also concretely support its municipal partners' determination and initiatives in this respect.

As for densely populated urban areas, especially the Montréal area, the MTQ must develop a strategic approach that firmly prioritizes public transportation, in keeping with government objectives concerning health and the environment. To this end, it can rely on solid consensus reached by international researchers and the recommendations of authoritative organizations such as the International Union of Public Transport and the World Health Organization. In its capacity as the sectoral government department responsible for a territory as big as Europe, the MTQ should acknowledge local expertise and delegate to the political authority responsible to the electorate that is in the best position to contribute to genuinely integrated planning, carried out openly, for the benefit of the public good. We must implement planning that properly incorporates all modes of transportation, bearing in mind the entire range of urban functions and concerns and the needs of all residents, including some 550 000 Montrealers living in households without cars and whose interests have all too often been

The MTQ must update in its specific field of responsibility, the principles of sustainable development that Quebecers share, and also concretely support its municipal partners' determination and initiatives in this respect.

overlooked. The success of transportation planning that complies with best practices depends on a new approach to collaboration between the MTQ and Montréal authorities and adequate increases in the MTQ's budget allocated to public transportation and active transportation. We can no longer continue to develop the metropolitan road network without taking into consideration its impact on health. Section 54 of the *Public Health Act* imposes on the Minister of Health and Social Services the obligation to ensure that sectoral policies are coherent and that all of them seek to enhance the health of the population.

Concrete support from federal authorities

The federal government assumes greater responsibility for other factors. In its dealings with Ottawa, Montréal (ideally within an alliance with Canada's big cities) can emphasize the validity of less timid regulation of the automobile and oil industries to reduce polluting emissions and GHG. Montréal must also be concerned with the question of fiscal imbalance, which is especially striking in the realm of transportation. We must also remind the federal government of the decisive influence that it could exercise on consumers' choices, for example, by adjusting the GST on vehicles in inverse ratio to gas consumption.

We should also emphasize two measures in the budget that the Harper government tabled on May 2, 2006 that are relatively favourable to public transportation. Provision is made for a 15.5% tax credit for users of monthly transit passes and for investments, which are unfortunately still inadequate in light of needs, totalling \$900 million up to 2010 in public transportation infrastructure in big cities.



AFTERWORD

For a **Sustained Commitment** from **Health Professionals**

For regional public health authorities, the shift to sustainable transportation is becoming increasingly necessary and simultaneously responds to a number of economic, environmental and health concerns. It can only be implemented by society as a whole. If the Montréal municipal government, supported by the Quebec government, must assume leadership for the shift, other social stakeholders also have a role to play. The Agence de la santé et des services sociaux de Montréal and its Direction de santé publique and, more broadly speaking, the entire health care network, must work jointly to achieve this renewal.

Since the elaboration and execution of a sustainable transportation plan must rely on research and monitoring, the DSP can contribute to this process in keeping with its expertise in conjunction with its mandate concerning knowledge and monitoring of public health determinants. It will thus step up its recently initiated transportation study program, some findings of which are published in this annual report, notably studies devoted to

respiratory diseases linked to traffic flows and the mapping of ambulance transport for road-accident injuries. These studies have made it possible to better understand and objectify the scope of health problems stemming from road transportation in Montréal and to arouse the interest of decision-makers and Montrealers in research that can usefully guide their decisions in this realm.

In particular, research seeks to monitor changes in trips (the O-D survey) according to socioeconomic status among other things, to document the health impact of the different modes on transportation on which Montrealers rely, and to ascertain the effectiveness of the implementation of various sustainable transportation strategies. Monitoring consists in pinpointing result indicators (process, impact) agreed upon with decision-makers that allow us to follow over time changes in trips, their impact on health and the economy, and the implementation of transportation policies.



We want to support the Mayor of Montréal and the CMM in all concrete efforts to mobilize Montrealers in favour of sustainable transportation.

However, above all, we know that we have a well documented plea to pursue with municipal authorities, the Communauté métropolitaine de Montréal (CMM) and the government in favour of the implementation of sustainable transportation strategies throughout the territory. We intend to do so by relaying the information that our professionals assemble or produce to the Agence de la santé et des services sociaux de Montréal and to the Minister of Health and Social Services to highlight and disseminate health issues in the realm of transportation (injuries, obesity, respiratory and cardiovascular diseases, and so on), and to thus support the elaboration of public policies by the Quebec government that promote health. Moreover, we want to support the Mayor of Montréal and the CMM in all concrete efforts to mobilize Montrealers in favour of sustainable transportation. We can and must make the most of the knowledge acquired through research and monitoring to enlighten decision-making and heighten public awareness.

The Agence de la santé et des services sociaux and its Direction de santé publique will continue to provide support through their expertise and financial assistance for the elaboration of road injury prevention programs and promotion of active transportation. This program is being introduced in collaboration with the 12 new health and

social services centres on the Island of Montréal and non-governmental organizations with whom we work on a regular basis. As a major employer in Montréal, with over 100 000 employees, the health care network has a special responsibility to set an example and undertake to concretely promote the shift to sustainable transportation, for example by facilitating the implementation and evaluation of the Allégo program in its own institutions.

Over the years, if so many European cities, in particular, have become beacons from an urbanistic standpoint, they owe it of course to those visionaries who had a vision of their major thoroughfares, public squares and buildings. They also owe it, perhaps even more markedly, to the decision-makers at the head of these urban centres who, beyond the day-to-day management of their communities and against all odds, have stayed the course over decades to implement demanding choices geared to sustainable development. We constantly marvel at the outcome whenever we visit these cities.

Over the past decade, many European cities contending with the invasion of private automobiles that threatened to asphyxiate them economically and socially, and growing numbers of cities in North America, have sought to preserve their past experience and have initiated a major shift to restore the

As a major employer in Montréal, with over 100 000 employees, the health care network has a special responsibility to set an example and undertake to concretely promote the shift to sustainable transportation.

city to its inhabitants, a demanding shift based on policy directions that they will have to maintain for many years before they benefit fully from it. This is the price to be paid to bequeath to future generations dynamic cities in which it is pleasant to live. Montréal must be one of these cities.





FIGURES

- Figure 1:** Growth in the number of motor vehicles in Quebec between 1987 and 2004
- Figure 2:** Annual population growth on the Island of Montréal and the suburbs
- Figure 3:** Number of automobiles per person and proportion of households with vehicles (2003)
- Figure 4:** Modal share of transportation used during morning rush hour (2003)
- Figure 5:** Breakdown of additional trips during morning rush hour in 2003 in relation to 1998
- Figure 6:** Transportation's contribution to air pollution
- Figure 7:** Air quality in Montréal with regard to ozone
- Figure 8:** Air quality in Montréal with regard to $PM_{2.5}$
- Figure 9:** Cardiac and respiratory effects linked to air pollution
- Figure 10:** Main health impacts of the two key pollutants found in smog
- Figure 11:** Growth in the number of light and heavy trucks operating in Quebec (1990-2003)
- Figure 12:** Problems stemming from road safety
- Figure 13:** Annual number of road deaths, by age and sex (2000-2001)
- Figure 14:** Evolution in the annual number of people injured in road accidents in Quebec and on the Island of Montréal
- Figure 15:** Breakdown in the number of injured persons, hospitalizations and deaths among road users (Montréal, 1999-2001)
- Figure 16:** Breakdown of pedestrians injured, by borough (1999-2003)
- Figure 17:** Proportion of dwellings without a car according to sector
- Figure 18:** Breakdown of pedestrians injured in the borough of Ville-Marie/Centre-Sud (1999-2003)
- Figure 19:** Examples of the factors involved (Haddon's Matrix)
- Figure 20:** Risk of death for pedestrians, by category of vehicle
- Figure 21:** Recent growth in the number of road accident injury victims and the number of motor vehicles (1998-2003)
- Figure 22:** Breakdown of road accident injury victims depending on the time of day (Montréal, 1999-2003)
- Figure 23:** Examples of layouts that reduce neighbourhood traffic problems
- Figure 24:** Evolution in obesity rates in the adult populations of OECD countries



Figure 25: Prevalence of excess weight and obesity in the 2-17 age group (Canada)

Figure 26: Evolution in the level of leisure time physical activity, individuals 18 years of age or over (Quebec, 1994-1995 to 2003)

Figure 27: Walking as a means of travel: weekly duration, individuals 18 years of age or over (Quebec, 1994-1995 to 2003)

Figure 28: Walking as a means of travel: weekly duration, 12 to 17 year-olds (Quebec, 1994-1995 to 2003)

Figure 29: Breakdown of Montrealers, by mode of transportation used to go to work

Figure 30: Proportion of Montrealers who rely on active transportation to go to work, by borough

Figure 31: Modal share of walking and cycling in travel in North America and Europe (1995)

Figure 32: Obesity and modal share of active transportation in various industrialized nations

Figure 33: Preferred destinations of active transportation users

Figure 34: The fused grid and its characteristics

Figure 35: Modes of transportation used to go to school (Quebec, 1999)

Figure 36: The decline of active transportation among school children

Figure 37: The vicious circle of urban decay