

## Traffic-related air pollution and health in Canada

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Canadian cities generally have good air quality; however, exposure to outdoor air pollution continues to elicit considerable negative health effects. Estimates suggest that there are 21 000 premature deaths attributable to air pollution in Canada each year,<sup>1</sup> nearly 9 times higher than the number of deaths due to motor vehicle collisions.

Emerging evidence specifically links the traffic-related component of air pollution to negative effects on health. A comprehensive critical review of the epidemiologic and toxicologic literature published in 2010 concluded that exposure to traffic-related air pollution was causally linked to worsening asthma.<sup>2</sup> The evidence was characterized as bordering on sufficient for a causal link with incident childhood asthma,<sup>2</sup> whereas associations with adult-onset asthma, deteriorating lung function, cardiovascular death, myocardial infarction and the progression of atherosclerosis were deemed suggestive but insufficient to infer causality. Subsequent evidence shows a strengthened case for causal relationships between exposure to traffic-related air pollution and incident asthma, as summarized in a meta-analysis,<sup>3</sup> and with lung cancer, as stated by the International Agency for Research on Cancer's classification of diesel engine exhaust as carcinogenic to humans.<sup>4</sup> Increasing support for the role of traffic-related air pollution in cardiovascular morbidity and mortality is summarized in a recent scientific statement from the American Heart Association, which concluded that "traffic-related pollution as a whole appears to be a specific source associated with cardiovascular risk."<sup>5</sup> This conclusion is supported by experimental and epidemiologic evidence that suggests that air pollution leads to systemic inflammation, oxidative stress and imbalance in the autonomic nervous system.<sup>5</sup>

### Exposure to traffic-related air pollution in Canada

Based on available data on census block points and the National Road Network,<sup>2,6</sup> about 10 million people — 32% of the Canadian population — live in areas where they are exposed to traffic-related air pollution (exposure zones). These ele-

mented exposure zones are defined as the 500 m on either side of highways (average daily traffic  $\geq 18\,000$  vehicles) or the 100 m on either side of major urban roads (average daily traffic  $\geq 15\,000$  vehicles,  $\geq 2$  lanes spanning several kilometres, speed limit  $> 50$  km/h).<sup>6</sup> Using alternative metrics gives a lower-bound estimate of 4.1 million people (people living within 100 m of a major road or highway;  $\sim 13\%$  of the Canadian population) and an upper-bound estimate of 16.9 million people (people living within 500 m of a major road or highway;  $\sim 54\%$  of the Canadian population) living in areas of high exposure. This high prevalence of exposure, in addition to evidence of associated health problems, suggests that traffic-related air pollution is a substantial public health concern in Canada and points to the need for policies to reduce population exposure.

### Mitigating exposure and risks

Reducing exposure to a hazard that is deeply integrated within modern society is difficult and must be addressed with diverse, coordinated policies. In a review of the published and grey literature,<sup>6</sup> we identified 4 broad and potentially overlapping mitigation strategies: reducing vehicle emissions; modifying existing infrastructure; land-use planning and transportation management; and encouraging behavioural change (Box 1). In the short term, policies and regulations that target existing infrastructure and vehicles are likely to be most effective in reducing exposure because they operate at the population level. In the long term, land-use planning that incorporates health impact assessments can

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#### KEY POINTS

- Epidemiologic studies suggest causal links between exposure to traffic-related air pollution and negative effects on health.
- One-third of Canadians live in areas with high exposure to traffic-related air pollution.
- Exposure to traffic-related air pollution can be reduced by targeting vehicle emissions, modifying structures, land-use planning, transportation management and changing behaviour.
- Policies to reduce Canadians' exposure to traffic-related air pollution should be aligned with efforts to increase physical activity and decrease emissions related to climate change.

influence the siting of new buildings or roads such that exposure is minimized.

Although studies directly measuring health benefits related to mitigating traffic emissions are limited, a recent review concluded that there is consistent evidence that interventions targeting air pollution in general lead to a reduction in adverse health effects.<sup>7</sup> For example, a scheme in London, United Kingdom, in which drivers of vehicles operating within a “congestion charge zone” were charged a fee, reduced traffic volume and congestion, resulting in an estimated gain of 183 years of life per 100 000 residents within the zone over a 10-year period.<sup>8</sup> Similarly, the establishment of low-emission zones and the consequent decrease in pollution in Rome, Italy, was estimated to have resulted in 921 years of life gained per 100 000 residents living near major roads over 10 years.<sup>9</sup>

Although these interventions alone benefit health,<sup>7</sup> combining strategies can result in more

cost-effective policies and greater improvements to population health. In particular, policies that encourage integrated land-use planning or that increase active transportation would lead to decreases in air pollutants and greenhouse gas emissions, and increases in physical activity. In the Midwestern United States, replacing short car trips ( $\leq 1.6$  km) with active commuting had an estimated net health benefit of \$4.94 billion per year from reduced air pollution and \$8 billion per year from the combined benefits of improved air quality and physical fitness.<sup>10</sup>

### Box 1: Summary of potential policy options for reducing exposure to traffic-related air pollution

#### Population-level targets

##### Short-term options:

- Implement inspection or maintenance programs to remove or retrofit “super emitters” responsible for disproportionate pollution.\*
- Implement policies to reduce traffic congestion.†

##### Long-term options:

- Implement integrated land-use planning that incorporates health impact assessments.
- Maintain low emission standards for new vehicles.\*
- Expand infrastructure for electric vehicles (e.g., charging stations).

#### Geographic targets

##### Short-term options:

- Limit heavy truck traffic to specific routes away from areas with high population density and at times when areas may be less heavily populated to avoid high exposures in vulnerable populations.
- Implement policies to reduce traffic congestion targeted to specific areas.
- Install air filter systems in buildings that house vulnerable populations within 150 m of busy roads.‡
- Separate active commuting from busy roads (e.g., create bicycle routes on minor roads).
- Implement anti-idling and low-emission zones.

##### Long-term options:

- Site new buildings that will house vulnerable populations (e.g., schools, daycares, retirement homes) at least 150 m from busy roads.‡
- Implement land-use planning that incorporates local health impact assessments.

\*Inspection and maintenance programs exist in many parts of Canada, and increasingly stringent vehicle emissions standards have been implemented nationally.

†Policies to improve vehicle flow; for example, modifying speed limits, altering traffic patterns to reduce stop-and-go traffic and policies to reduce overall traffic levels, such as high-occupancy vehicle lanes, transit improvements or road pricing.

‡Defined as average daily traffic > 15 000 vehicles.

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