

The logo features a stylized graphic of a city skyline with three buildings of varying heights to the left of the text. The word "TORONTO" is in a large, bold, black, sans-serif font. To its right, the words "STAFF REPORT" are in a smaller, bold, black, sans-serif font. A horizontal line is positioned below the text.

# TORONTO STAFF REPORT

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June 2, 2003

To: Board of Health

From: Dr. Sheela V. Basrur, Medical Officer of Health

Subject: Air Pollution and Physical Activity

Purpose:

To provide information on a new study by Toronto Public Health staff that examines the relationship between air pollution and physical activity.

Financial Implications and Impact Statement:

There are no financial impacts to the City arising from this report.

Recommendations:

It is recommended that:

- (1) the Board of Health request that the Federal Minister of Health, in consultation with Toronto Public Health, the Federal Minister of Environment, the Ontario Minister of the Environment and the Ontario Minister of Health and Long Term Care:
  - (a) conduct or fund research on the health benefits and risks associated with urban air quality in relation to physical activity outdoors;
  - (b) conduct or fund research on whether modifications in outdoor physical activity patterns, such as substituting less strenuous exercise, reducing the duration of exercise, or introducing more rest periods, can mitigate adverse health effects, especially when pollution levels approach or exceed smog-alert conditions; and
  - (c) provide guidance on the promotion of physical activity to health units that includes consideration of the appropriate times, locations and intensity of physical

activity by children and adults, including those with heart and breathing problems, when outdoor air pollution levels are elevated;

- (2) the Board of Health request that the Ontario Minister of Environment issue a smog alert whenever the Air Quality Index (AQI) is forecast to or unexpectedly reaches a value of 50 or greater;
- (3) the Board of Health forward this report to all Ontario health units, the Ontario Medical Association, the Canadian Lung Association, Ontario Lung Association, New Brunswick Lung Association, Canadian Society for Exercise Physiology, Commissioner of Economic Development, Culture and Tourism, Ontario Public Health Association and Association of Local Public Health Authorities for their information and follow-up action as appropriate; and
- (4) appropriate City Officials be authorized and directed to take the necessary action to give effect thereto.

#### Background:

Encouraging sufficient physical activity to ensure good health is an important health promotion goal. However, there is concern that sensitive groups, including those with cardiac and respiratory conditions, are vulnerable to adverse health effects from air pollution, especially during smog alerts when air pollution levels are particularly high. Given the importance of physical activity to well-being, Toronto Public Health seeks to promote routine physical activity year-round, while alerting the public to ways of moderating strenuous physical activity outdoors on those days when Toronto experiences smog alerts. Toronto Public Health and other divisions across the corporation engage in many actions to improve air quality in the City. This is of critical importance in reducing the adverse health effects of poor air quality.

With the large number of smog alert days (also known as ‘Air Quality Advisories’ or ‘Smog Advisories’) in Toronto during the last two years, there has been an increased need to advise the public to moderate their outdoor physical activity on days of poor air quality.

In August 2002, the Ontario Minister of Environment improved the Air Quality Index (AQI) by including respirable particles (PM<sub>2.5</sub>) in the index. This action was consistent with the request of the Board of Health at its meeting of November 26, 2001 when it discussed the staff report “Condition Critical: Fixing the Smog Warning System”. It is possible that the number of smog alert days may increase in the future, due to global warming effects and the improved AQI reporting system. Toronto Public Health undertook an analysis of existing air pollution data, on which the AQI is based, to better understand how pollution levels vary in the City. It was hoped that by determining when and where pollution levels tend to be lowest, it would be possible to better advise those engaged in regular strenuous activity outdoors, on ways of reducing their exposure to air pollutants while ensuring that the benefits of physical activity are maintained.

Comments:

The attached report, "Air Pollution and Physical Activity: Examination of Toronto Air Data to Guide Public Advice on Smog and Exercise" (Appendix 1), summarizes the health benefits of physical activity as well as health concerns with existing air pollution levels in the City. This study on air pollution and physical activity was made possible through collaboration with Environment Canada. Toronto Public Health and Environment Canada are currently undertaking a major two-year study funded by Health Canada on the synergistic impacts of weather and air pollution. As a result, Toronto Public Health had access to air pollution data in an easy-to-analyze format that made the current investigation feasible.

The attached report summarizes the health benefits of exercise and outlines concerns with the potential increase in exposures to pollutants when undertaking vigorous activity. It compares indoor and outdoor pollution levels, and notes how some key pollutants vary with traffic density. The report provides an analysis of hourly pollution levels of five key smog-related pollutants in Toronto for all days during 1997 through 2000. In a previous staff study, these five common pollutants (ozone, carbon monoxide, nitrogen dioxide, inhalable particles and sulphur dioxide) have been estimated to contribute to about 1,000 premature deaths and 5,500 hospitalizations each year among Toronto residents.

Benefits of Exercise:

Regular physical activity has a profound and positive influence on the health of people at all stages of their life, spanning from childhood to the senior years. Sufficient physical activity is important for health and well-being including the prevention of disease, yet more than two-thirds of Canadians are insufficiently active for good health. The absence of regular physical activity is associated with increased risk of cardiovascular disease, diabetes, osteoporosis, obesity and mental health. Researchers estimate that in 1999, physical inactivity contributed to about 21,000 premature deaths in Canada.

Regular physical activity that results in cardiorespiratory fitness, decreases the risk of coronary heart disease, including heart attacks; health effects that increase with the level of air pollution. Exercise also increases respiratory efficiency so that a fit person actually inhales less air than an unfit person undergoing the same level of physical activity. A fit individual will therefore breathe in a smaller amount of pollutant than a less fit person.

Health Concerns About Air Pollution:

Over the last decade, a large body of scientific evidence has accumulated that confirms that air pollution, even at the levels experienced in major urban centres such as Toronto, adversely affects the health of children and adults. Effects are wide ranging, and include reduced lung function, acute and chronic bronchitis, asthma attacks, strokes, high blood pressure and congenital heart defects. These studies identify asthmatics, diabetics and those with congestive heart failure as being at especially elevated risk from air pollution. Respirable particulate matter (PM<sub>2.5</sub>) is emerging as a pollutant for which the demonstrated health risk is significant. The recent inclusion of PM<sub>2.5</sub> into the Ministry of Environment's smog alert system provides an

important opportunity to notify the public of when air pollution levels, including those for PM<sub>2.5</sub>, are so high that special precautions should be undertaken.

#### Highlights of Analysis of Toronto Air Quality Data:

The key air pollutants analyzed in this study varied in their temporal distribution, with some pollutants (such as PM<sub>2.5</sub> and sulphur dioxide) highest during mid-day. Ozone was highest in mid-afternoon, and carbon monoxide and nitrogen dioxide were highest during morning rush hour. In Toronto, pollution levels tend to be lowest overall in low-traffic areas (such as along residential streets rather than main arterial roads), and before 7 a.m. in the morning and after 8 p.m. in the evening. These are the conditions under which exposure to both long-range pollutants (such as ozone and PM<sub>2.5</sub>) and locally-derived pollutants (such as nitrogen dioxide and carbon monoxide) can be minimized.

The analysis also indicated that applying the Ontario Ministry of Environment's new AQI classification scheme (which includes PM<sub>2.5</sub>) to the data for previous years would have resulted in the identification of more days of "poor" air quality than using the old AQI system. The Ministry designates air quality as "poor" when the AQI is 50 or greater. Using the old AQI classification scheme resulted in 28 days of "poor" air quality for 1997 through 2000. However, with the addition of PM<sub>2.5</sub> into the new AQI classification scheme, there would have been 48 days of "poor" air quality during this same four-year period. The analysis also revealed that the addition of PM<sub>2.5</sub> results in poor air quality days occurring most of the year, not only during the summer months as with the previous classification system. However, the summer months do continue to be the period of most frequent smog alert days.

A preliminary examination of the scientific literature suggests that overall, the level of many pollutants of significant health concern in Toronto tend to be lower inside the home (of non-smokers) than outside. It is plausible that on smog alert days when outdoor air quality is poor, the differences are even greater, especially for pollutants such as ozone and PM<sub>2.5</sub> that are particularly high when the AQI exceeds 50. Sulphur dioxide, ozone and PM<sub>2.5</sub> tend to be lower inside the home compared with outside, as do trace metals and benzene. Carbon monoxide and many volatile organic compounds (VOCs) tend to be higher inside the home; however, indoor levels can be minimized through good practices in the home.

#### Guidance to Reduce Exposure to Air Pollutants During Physical Activity:

While there is a need to protect that segment of the population already engaged in routine vigorous activity (such as jogging outdoors) from air pollution during smog alerts, it is critical to recognize the health benefit of more modest measures to increase physical activity in those persons who tend to be sedentary. Introducing light activity (such as slow pace walking, easy gardening, stretching) and moderate activity (such as brisk walking, bicycling, raking leaves) to persons who are generally inactive is very beneficial to improving their health. To date, there appears to be no evidence that light or moderate physical activity during smog alert conditions poses a health risk to people without other underlying medical conditions. However, there is some evidence in the literature that prolonged vigorous activity when air quality is poor can pose

a health risk, especially to those persons with pre-existing respiratory conditions. More research is required in this area.

Most of the key pollutants associated with significant premature mortality and hospitalizations occur at higher levels outdoors than indoors. Therefore one way to reduce exposure to such pollutants is by exercising indoors whenever possible in a smoke-free environment on smog alert days (or when the AQI is 50 or greater). Another way might be to moderate physical activity outdoors by substituting vigorous activity with light or moderate activity, and introducing more rest periods. However, more research is warranted to confirm these strategies.

People could also reduce exposure to pollutants if they can schedule their outdoor exercise activities at times of the day and in locations where pollution levels are lowest, consistent with when and where AQI values would be expected to be lowest. This can be beneficial even at pollution levels below those triggering smog alert conditions. However, given that air pollution levels are highest during the peak daylight hours, this is not possible or reasonable for much of the population, especially children who are active in daytime sports events at schools, day cares, recreational facilities and summer camps. It is recommended that Health Canada conduct further research to guide the development of health protective advice that takes into account the health benefit of regular exercise (even during times of elevated pollution) and identifies possible modifications in activity patterns that can lessen health risk, especially among those most vulnerable to the adverse health impacts of air pollution.

For all people, but especially sensitive populations, it is important that they monitor any symptoms they experience with different activity levels and, if possible, relate these to increases in AQI values. Every person should reduce their activity level outdoors at AQI values or activity levels that trigger their symptoms. Symptoms associated with breathing polluted air include coughing, wheezing, chest tightness, pain with deep breathing and difficulty breathing.

#### Smog Alert Warning System:

Toronto Public Health participated in a survey of 1,000 Toronto residents conducted by the Ontario Clean Air Alliance in December 2001 for the Toronto Atmospheric Fund. The survey yielded information on a wide variety of air quality concerns, including the provincial AQI and smog alert response. About 46% of those interviewed were unaware that the Ministry of Environment makes information on air quality available to the media and public through its AQI notification system. Among those aware of the AQI, 12% paid attention on an almost daily basis and 17% paid attention all the time.

In contrast to the poor awareness of the AQI index and where to find out what the daily AQI values were, more than 90% of Toronto residents interviewed were aware of smog alerts during the previous summer. Of those people aware of smog alerts, 42% said they avoided strenuous physical activity outdoors on almost all smog alerts, 13% did so on at least half the alert days, and 18% avoided strenuous activity on only a few alert days. Of those aware of smog alerts, 26% reported that they never avoided strenuous activity outdoors on smog alert days.

The Ontario Ministry of Environment seeks to give Ontario residents as much notice as possible regarding the appearance of a high smog day. The Ministry issues two kinds of smog alerts: (1) a 'Smog Watch', which is called when there is a 50 percent chance of having poor air quality (i.e., the AQI will be 50 or greater); and (2) a 'Smog Advisory', which is called when there is a strong likelihood that a smog day is coming within 24 hours. These alerts are issued when an AQI of 50 or greater is expected to be "widespread and persistent". In addition, the Ministry will issue an advisory on days when poor air quality has not been predicted and "elevated smog is forecast to continue for six hours".

While the overall structure of the smog alert system is very beneficial, it could be further improved. Toronto Public Health has concerns that the current issuance of smog alerts does not provide sufficient warning to the public, and especially sensitive populations, to take health-protective actions when air pollution is forecast to or unexpectedly becomes "poor" when peak pollution levels are short lived. Even though peak pollution levels may occur for less than 6 hours, peak levels are typically accompanied by a significant period of time before and after the peak level when AQI values approach 50, and are likely of similar health risk.

Although it is prudent for everyone to pay attention to up-to-date AQI reporting by media outlets, or to connect directly (via telephone or website) to the Ontario Ministry of Environment's AQI information service, it is unlikely that everyone will do so. Whereas people in Toronto have a high awareness of smog alert days, awareness of the AQI notification system is much poorer and only a small fraction of people pay attention to the AQI values on a daily basis. For this reason, it is recommended that the Ministry of Environment should issue a smog alert whenever the Air Quality Index (AQI) is forecast to or unexpectedly reaches a value of 50 or greater, rather than doing so only when an AQI of 50 or greater is expected to be "persistent".

When the Ministry issues smog alerts, there is prominent amplification of the smog warning messages by all media outlets, resulting in more widespread and extensive message penetration than would occur without issuance of a smog alert. It is common for summertime ozone levels to peak during the six-hour period between 12 noon and 6 p.m. If smog alerts are not called unless AQI values exceed 50 for more than six hours, media-assisted public notification of high smog days will diminish, resulting in reduced public awareness and less adoption of health-protective behaviours.

### Conclusions:

Sufficient physical activity is important for health and well-being including the prevention of disease, yet more than two-thirds of Canadians are insufficiently active for good health. At the same time, outdoor air pollution continues to pose a significant health risk to the Toronto population, especially during periods of peak pollution when smog alerts are issued. Given the importance of physical activity to well-being, Toronto Public Health seeks to promote routine physical activity year-round, while alerting the public to ways of moderating vigorous physical activity outdoors on those days when Toronto experiences smog alerts. All people, but especially sensitive populations, should monitor any symptoms they experience with different activity levels as well as when air pollution levels increase, as indicated by Air Quality Index (AQI)

values. Every person needs to reduce their activity level outdoors whenever air quality could trigger their symptoms.

It is recommended that Health Canada conduct research on the relative risks and benefits of exercising during episodes of poor air quality, and on the extent to which modifications in physical activity patterns (such as reducing exercise intensity and duration, and introducing more rest periods) can mitigate adverse health effects. It is also recommended that the Ministry of Environment issue a smog alert whenever the AQI is forecast to or unexpectedly reaches, a value of 50 or greater. This will increase the likelihood that the public is made aware of high smog days through the media, and that Ontario residents take action to protect their health and reduce household emissions of air pollutants.

In the long term, it is important to ensure that barriers to physical activity, such as limited physical education opportunities in schools, access to recreational or sports facilities, and availability of green space are addressed in a comprehensive way to achieve public health goals. Accelerated action on improving air quality in the City is also of critical importance so that poor air quality does not become a barrier to enhancing physical activity.

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List of Attachments:

Appendix 1: Air Pollution and Physical Activity: Examination of Toronto Air Data  
to Guide Public Advice on Smog and Exercise