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The Association of Ozone and Fine Particulate Matter with Mortality and Hospital Admissions in 12 Canadian Cities

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The Association of Ozone and Fine Particulate Matter with Mortality and Hospital Admissions in 12 Canadian Cities

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ABSTRACT

Many recent epidemiological studies have linked health effects with short-term exposure to air pollution levels commonly found in North America. The association of ozone and fine particulate matter with mortality and hospital admissions in 12 Canadian cities was explored in a time-series study. City-specific estimates were obtained by Poisson regression models adjusting for the confounding effects of seasonality and temperature. Estimates were then pooled across cities using the inverse variance method. Results suggest significant associations across all outcomes except cardiovascular hospital admissions. Generally, stronger associations were found among the elderly. Effect estimates were robust to adjustment for seasonality confounding but were sensitive to lag structures. Considering the large population exposed to air pollution, reductions in ozone and particulate matter would lead to considerable health benefits.

To my parents...

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ACRONYMS/ ABBREVIATIONS

ACS	American Cancer Society
APHEA	Air Pollution and Health: a European Approach
APHENA	Air Pollution and Health: a European and North American Approach
CAA	Clean Air Act
CAC	Criteria Air Contaminants
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CI	Confidence Interval
CIHI	Canadian Institute for Health Information
CMA	Canadian Medical Association
CVD	Cardiovascular
CWS	Canada Wide Standards
df	Degrees of freedom
dist	distributed (models)
EPA	Environmental Protection Agency
FEM	Fixed Effects Model
GAM	Generalized Additive Models
GLM	Generalized Linear Models
HA	Hospital Admissions
HEI	Health Effects Institute
hr	Hour
ICD	International Statistical Classification of Diseases
max	Maximum
MCMC	Monte Carlo Markov Chains
min	Minimum
mort	Mortality
MLE	Maximum Likelihood Estimation
NAAQO	National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
NMMAPS	National Morbidity, Mortality and Air Pollution Study
NS	Natural Splines
O_3	Ozone
PM	Particulate Matter
PM_{10}	Particulate matter with an aerodynamic diameter $\leq$ 10 μm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter $\leq$ 2.5 μm
ppb	parts per billion
PS	Penalized Splines
REM	Random Effects Model
Resp	Respiratory
RR	Relative Risk
Temp	Temperature
VOC	Volatile Organic Compounds
WHO	World Health Organization

Chapter 1

INTRODUCTION

Effects of air pollution have become a major concern for public health in North America, Europe and other developed regions in the past several years. The World Health Organization estimates ambient air pollution leads to approximately 800,000 premature deaths annually (1). In Canada, the Canadian Medical Association (CMA) released the report *No Breathing Room – National Illness Costs of Air Pollution* earlier this year, stating that air pollution results in considerable health and economic damages that will only increase over time. It was estimated that 21,000 deaths and 92,000 emergency department visits in Canada could be attributed to short- and long-term exposure to air pollution in year 2008. Associated economic costs for the year, including worker absenteeism, higher health care costs, loss of life, and other factors were expected to exceed 10 billion dollars (2).

Acknowledging the negative effects of air pollution on human health, governments around the world have set air quality standards in part to protect the public. Thus, understanding the effects of individual air pollutants is crucial for developing effective policies and regulations. Epidemiological research, in particular time-series studies involving multi-cities, has been critical in providing quantitative estimates of the short-term effects of air pollution and has had a major role in policy decisions for setting regulatory standards.

In Canada, air quality is good compared to other countries. However, the literature on air pollution is expanding with striking evidence linking health effects to pollution levels that were previously believed to be safe for the public and are currently experienced in many developed countries. Two ambient air pollutants, ozone (O_3) and particulate matter (PM), are major components of smog in Canada and have both been linked to various health effects that range from sub-clinical functional changes to impaired activities (school/work absenteeism), emergency room visits, hospitalizations and premature death.

1.1 Background

It is well established that extreme levels of air pollution can lead to considerable increases in mortality and morbidity. Several episodes of high air pollution levels and the subsequent increases in deaths and hospital admissions (HA) that occurred in the 20^{th} century are documented. Three well-known episodes were in Meuse Valley, Belgium (1930), Donora, Pennsylvania (1948), and London, England (1952). The famous London Smog in 1952 resulted in more than 4000 deaths during the episode (Figure 1) and a further 8000 deaths in the following months (3;4). The link observed between mortality and air pollution during these events was based on a simple methodology, where death counts were compared before, during, and after elevations in air pollution levels.

Examples of these early studies have led to the common opinion that only extreme levels of air pollution result in appreciable health effects (5). Current emission controls and regulations ensure that extreme levels of air pollution are rarely observed nowadays. Nevertheless, air pollution remains a big health concern and recent research has focused on assessing the impact of air pollution at far lower levels than those observed in severe episodes. Epidemiological studies have shown that long-term and short-term exposure to currently observed air pollution levels are associated with increased mortality and hospital admissions (6-26).

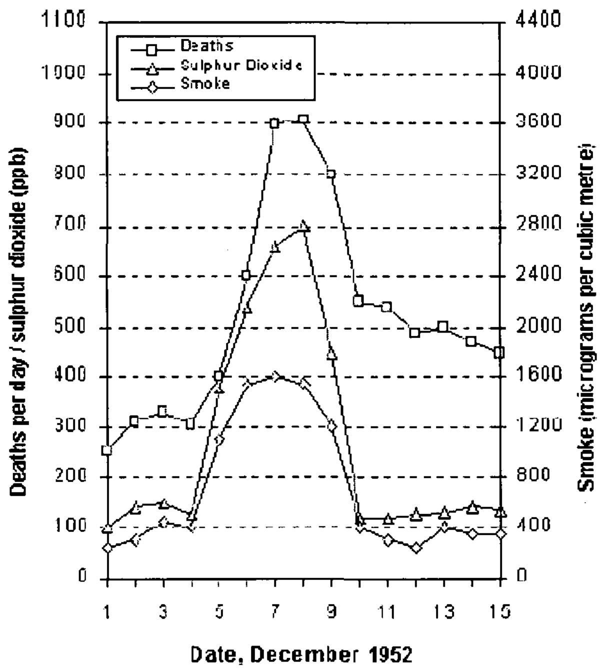

Figure 1 Air pollution and mortality during the 1952 London Smog. *Source: Air pollution: Fact sheet series for key stage 4 and A-level. Figure: Deaths from the great London Smog, p17.* (27).

The literature on short-term effects of air pollution and health contains single- and multi-city studies as well as meta-analyses. Recognizing the importance of multi-city studies in setting air quality standards due to their generalizability (8), a master's research project examining the short-term effects of ozone and $PM_{2.5}$ across 12 Canadian cities was undertaken.

1.2 Objectives

The primary objective of this study was to quantitatively assess the impact of $PM_{2.5}$ and ozone on mortality (total, cardiovascular and respiratory) and hospital admissions (cardiovascular and respiratory).

Secondary objectives of the proposed research were:

- To determine the impact of ozone and $PM_{2.5}$ on mortality and hospital admissions in different age groups
- To examine the sensitivity of results to the confounding adjustment of seasonality (long-term trends) and various lag periods (time between exposure and event)
- To explain between city heterogeneity by examining the effect of ecologic covariates

1.3 Air pollutants

1.3.1 Ozone

Found in the stratosphere, ozone is a colorless and odorless gas that has a critical role in protecting life on earth from harmful ultraviolet radiation. Ozone at the ground level, however, is a common urban air pollutant. It is a major component of smog (28) and is considered as one of the most toxic component of the photochemical air pollution mixture (29). Ozone is a secondary pollutant because it is not emitted directly from natural or human sources. Rather, it is formed through a set of complex reactions of primary pollutants, nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight (3).

The term *ozone* will be used throughout this study to refer to ground-level ozone.

Formation of ozone depends on meteorological conditions. Changes in weather patterns result in short-term and yearly differences in ozone concentrations. In general, higher concentrations are found in the afternoons of hot summer days. Higher levels are also found in suburbs relative to busy urban centers because of the scavenging effect of nitrogen oxides that originate from traffic (30).

1.3.2 Particulate matter

Particulate matter refers to a mixture of solid particles and liquid droplets suspended in the air. The composition of PM varies with geographic location, season, and weather conditions and includes aerosols, smoke, fumes, dust, ash, and pollen (31). The chemical composition of PM includes nitrates, sulfates, organic chemicals and metals (see Table 1) (32).

Particulate matter can be classified according to its source and size. Primary particles are emitted directly from fuel combustion (motor vehicles, power generation, industrial facilities and residential fireplaces) or forest fires (31). Secondary particles, on the other hand, are formed through atmospheric reactions of chemicals such as sulfur dioxides, nitrogen oxides and other organic compounds emitted from power plants, industries and automobiles (3;32).

Table 1 Composition of $PM_{2.5}$.

Component	Fraction (%)
Elemental and Organic Carbon (combustion related)	30 - 50
Sulfates	30 - 40
Nitrates	10 - 20
Soil	3-10

The size of the particles is critical because it is the main determinant of how deep into the respiratory tract inhaled particles will travel. Although not a strict boundary between respirable and non-respirable particles, the 10 µm diameter size of particles is used for monitoring of airborne PM by many regulatory agencies (33). The classification based on size can be seen in Table 2. Thoracic particles (PM_{10}), particles with an aerodynamic diameter equal to or less than 10 µm, can settle in the bronchi and lungs. $PM_{2.5}$, also called fine particulate matter, refers to particles with an aerodynamic diameter equal to or less than 2.5 µm and can penetrate deeper into the gas exchange regions of the lungs. Recent research suggests health effects from particulate matter are mainly due to $PM_{2.5}$ and hence it may be a better indicator than PM_{10} for health effects (3).

Regular monitoring of $PM_{2.5}$ is recent relative to ozone and PM_{10} monitoring. In Canada, daily monitoring of ambient $PM_{2.5}$ levels nationwide was initiated in the late 1990's (34). Similarly, in the United States (US), a nationwide monitoring system of this pollutant was implemented in 1999 (35) whereas PM_{10} data has been collected regularly since 1987 (36).

Table 2 Classification of PM based on size (37).

Fraction	Size Range
PM_{10} (thoracic)	≤ 10 μm
$PM_{2.5}$ (respirable, fine)	≤ 2.5 μm
PM_{10}-$PM_{2.5}$ (coarse)	2.5 μm - 10 μm
PM_1	≤ 1 μm
Ultrafine Particles (UFP)	≤ 0.1 μm

1.3.3 Regulation in Canada

Environmental contaminants are regulated at the federal level under the Canadian Environmental Protection Act (CEPA). Under this act, the federal government can "assess air pollutants and control their impact through the setting of National Ambient Air Quality Objectives (NAAQOs) and Canada Wide Standards (CWS)". Air pollutants that need to be managed are targeted for CWS or NAAQO development, and not both (38). Ozone and $PM_{2.5}$ are included in the Criteria Air Contaminants (CACs) in Canada, where information on CAC emissions has been collected every year within the National Pollutant Release Inventory since 2002 (39).

National Ambient Air Quality Objectives

The National Ambient Air Quality Objectives (NAAQO) are long-term national goals for outdoor air quality and are intended to protect public health and the environment (38). They are used to guide the federal, provincial, territorial and regional governments in making risk management decisions by identifying benchmark levels that protect the public and the environment. Currently, NAAQOs are available for ozone, sulfur dioxide, total suspended particulates (TSP), carbon monoxide and nitrogen dioxide. For ozone, the 1 hour maximum desirable level and the maximum acceptable level are 51 parts per billion (ppb) and 82 ppb, respectively (40).

Canada Wide Standards

Because of demonstrated adverse effects of ozone and PM on human health and the environment, the Canadian Council of Ministers of the Environment (CCME) developed the Canada Wide Standards (CWS) in 2000 (41). The CWSs act as an alternative tool for the management of environmental issues that are of national interest. The goal of these standards is to set achievable targets to reduce health and environmental risks within a specific time frame.

The 2006 CWS for ozone, 8-hour running average time, based on the fourth highest annual ambient measurement averaged three consecutive years, is 65 ppb. For $PM_{2.5}$, the CWS is 30 $\mu g/m^3$, 24-hour averaging time, based on the 98^{th} percentile annual ambient measurement averaged over three consecutive years (28;41). These standards are required to be met by jurisdictions by 2010 (41).

Although many regions across Canada are approaching the CWSs for $PM_{2.5}$ and ozone, there remain communities with pollutant levels higher than the standards. Environment Canada (42) reported that between 2003 and 2005, at least 30% of Canadians lived in communities with $PM_{2.5}$ levels above the corresponding ambient CWS. For ozone, it was at least 40% of Canadians. Locations where PM or ozone levels were above the standards were mainly in Quebec and Ontario, with a few communities in the Atlantic Provinces and British Columbia.

1.3.4 Health effects of ozone and $PM_{2.5}$

Epidemiological studies have looked at both the short-term and long-term effects of ozone and PM. Findings indicate positive and significant associations between short-term exposure and various health effects including premature mortality, deaths related to cardiovascular or respiratory diseases, as well as hospital admissions due to respiratory or cardiovascular diseases. Other effects reported include decreases in lung function and the exacerbation of existing chronic respiratory and cardiovascular diseases. Postulated mechanisms by which ozone and $PM_{2.5}$ lead to adverse effects include oxidative stress and inflammation in the lung tissue.

It has also been reported that among the subpopulations that are most vulnerable to the effects of air pollution are the elderly (10;20;43) and children (44-48). The elderly usually have reduced defense mechanisms in the lungs or pre-existing diseases that are exacerbated by air pollution. On the other hand, children are more susceptible because they are in critical stages of growth and development (49), breathe more per unit body weight than adults, and have smaller airways and lungs. Exposure to high levels during pregnancy has also been linked to low birth weights in Canada and other countries (49).

Figure 2 provides a summary of the health effects that have been linked to air pollution exposure. As can be seen, the proportion of the population affected by the adverse effects diminishes as the severity of the health outcomes increases.

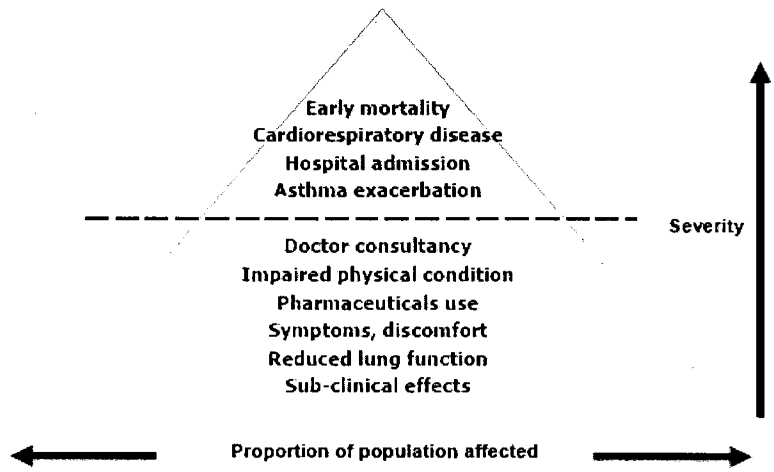

Figure 2 Pyramid of adverse effects on health attributable to air pollution. *Source: Health impact of PM_{10} and Ozone in 13 Italian Cities (50).*

Chapter 2

LITERATURE REVIEW

A literature review of the study designs used to investigate the short-term effects of air pollution as well as the findings of recent multi-city studies is provided below.

2.1 Study designs

Several study designs are used to study the effects of air pollution. The various approaches differ in the methods applied to estimate the health effects linked to variations in exposure across spatial and temporal gradients and the use of individual or aggregate level data on the exposure, outcome and potential confounding factors. The majority of contemporary epidemiologic studies on air pollution health effects have used either cohort or time-series approaches (8).

2.1.1 Cohort studies

Cohort studies generally relate long-term average pollution levels (years) and adjusted mortality rates across geographical locations, after controlling for individual risk factors for death. Exposure to pollution is usually estimated by referring to the place of residence of individuals (8). The design of cohort studies makes it possible to adjust for confounders at the individual level (smoking, body mass index, occupation, etc.) and assess individual risk factors that affect susceptibility. Cohort studies, however, are limited by the adequacy of data on the confounders, the appropriateness of the models used for confounder adjustment, and the exposure measure used to reflect personal exposure (8;51).

Two well-known prospective cohort studies are the Harvard Six Cities Study and the American Cancer Society (ACS) Study. Both were conducted in the United States and demonstrated that the annual average of all cause mortality increased in association with an increase in fine particles ($PM_{2.5}$).

The Harvard Six Cities study followed more than 8000 adults in six cities for 14-16 years. It found an adjusted relative risk ratio of 1.26 (95% CI 1.08-1.47) in all cause mortality for an increase of 18.6 $\mu g/m^3$ increase in particulate matter averaged over 9 years (52). On the other hand, the ACS study followed approximately 800,000 adults in 151 US metropolitan areas. The adjusted relative risk ratio for total mortality was 1.17 (95% CI 1.09-1.26) for an increase of 24.5 $\mu g/m^3$ in PM averaged over 5 years (53).

2.1.2 Time-series studies

Time-series studies on air pollution examine the effects of short-term changes in air pollution. The advanced statistical methods used in time-series analyses have become one of the most important tools in the area of air pollution research. In this approach, associations between daily variations in air pollution levels and daily counts of deaths or hospital admissions in a given area are estimated by Poisson regression models. Data needed for time-series analysis in a given area includes daily counts of health outcomes (deaths or hospital admissions), individual pollutant levels and weather variables (temperature) (8).

One of the central issues in statistical modeling of time-series studies is adequate control for confounding. Confounders typically controlled for are those that change over relatively short periods such as seasonality, day of the week, and weather variables that are associated with both pollution levels and health outcomes. Many studies also control for other variables such as relative humidity and influenza epidemics (54).

Risk factors for the health outcome being assessed that are either constant or slowly changing over time (8;55) such as diet, smoking and exercise habits, are not treated as potential confounders in time-series studies on effects of short-term exposure. Although they may act as effect modifiers, it is not necessary to control for potential confounding when determining city-specific estimates. This is a major advantage of time-series studies (54) because a factor may only act as a confounder if it is correlated with the exposure of interest and the health outcome on a temporal basis (4). For example, smoking is not likely to act as a confounder when determining city-specific estimates because community-average smoking rates do not vary on short timescales and daily smoking rates are not likely associated with air pollution levels.

2.2 Statistical methods in times-series

In time-series studies, complex statistical methods are used to estimate the relationship between air pollution and mortality or morbidity. Because the effects estimated can be small relative to the combined effect of other time varying covariates (ex. weather and seasonal fluctuations in health outcomes and to other unmeasured factors), the methods used must be sensitive to detect these weak effects.

There have been many advances in the models since they were first used to study short-term effects of exposure to air pollution in the 1980's (56). Early statistical approaches included standard regression models, which have now been replaced by semi-parametric models. In the semi-parametric approach, the percent increase in daily mortality or morbidity associated with elevations in the pollutant is typically the outcome. The two main statistical models currently used are based on Generalized Linear Models (GLM) with parametric splines or Generalized Additive Models (GAM) with non-parametric splines.

GAMs offer increased flexibility in estimating the smooth component of the model relative to GLMs. They had been preferred over GLMs until 2002 when it was discovered that these methods were not adequate to give optimal effect estimates and could introduce upward bias (51). Specifically, it was found that the *gam* function in the S-plus software underestimated the standard errors of linear terms in the model (the air pollution regression coefficients) (57) and overestimated the effect of air pollution on health outcomes (58;59).

The discovery of these methodological and computational issues in 2002 came about at the time when the Environmental Protection Agency (EPA) was finalizing its most recent review of the epidemiologic evidence on particulate matter air pollution. Consequently, the review for particulate matter was delayed because the time-series findings were crucial in the regulatory process. As a result, all of the findings from time-series studies that had been based on GAMs were re-evaluated using alternative methods. Approximately 40 original studies from the US, Canada and Europe were reanalyzed and then peer reviewed by a panel appointed by the Health Effects Institute (HEI) (60).

A summary of the statistical methods used for city-specific and combined effect estimates in recent multi-city time-series studies and meta-analyses is presented in Table 3. The review was limited to studies that have looked at the effects of either ozone or $PM_{2.5}$. The major challenge previously mentioned is to adequately control for the time varying factors (mainly for seasonality and temperature) that may confound the association between air pollution and health outcomes. This is usually achieved by smooth functions for time and temperature variables in the Poisson regression models (55). For calendar time, penalized splines (PS) or natural cubic splines (NS) are commonly used as the smoothing functions. Splines divide a continuous variable into a set of discrete ranges, where each range is fit with a separate regression polynomial. The degree of smoothing is determined by the degrees of freedom (df) allowed in the smoothing functions (51). This must be selected carefully to ensure that there is neither over-fitting (too many df) which would fit the "noise" nor under-fitting (too little df) which would not remove confounding effects of potential confounders in order avoid bias in the effect estimate. Allowing 7 df per year is believed to yield conservative air pollution effects, with this value being relatively large to ensure adequate control for seasonal and long-term trends (61). Typically, values allowed in previous studies have been in the range 3-12 df per year. Within this range, national average effects estimates have been found to be relatively robust.

Another important consideration in time-series models is the lag structure which generally refers to the period (number of days) between exposure to the pollutant and the event (health outcome). For example, a lag of 0 days (referred to as "lag0" in this study) corresponds to the association between pollution levels on a given day and the risk of death or hospital admission on that same day. A 2-day lag (lag2) represents the association between pollution levels on a given day and the risk of adverse health effects observed 2 days later. These models are referred to as single-day lag models. In combined lag models, the exposure levels of pollution are the averages of multiple single-day lags. For example, for an average lag period of 0-1 days (lag01), the level of pollutant used in the models would be the average of the current day and the previous day's levels. Further, distributed lag models look at the effect of cumulative exposure to pollution during several days, thus allowing each day to have an effect. The studies reviewed in Table 3 have considered single day lag models up to 3 days as well as combined lags involving mean concentrations of various combinations of 2-3 days.

Although the studies reviewed in Table 3 display a wide range of specifications used in each study for the time-series models, the HEI re-analysis report in 2003 stated that no optimal analytic method could be recommended to estimate the air pollution health effects (62). Studies that have compared different approaches have found that although there may be some sensitivity in the results, the effects remain statistically significant with the common approaches used (11).

One of the main objectives of multi-city or meta-analyses is to provide a pooled quantitative summary of all the individual city-specific estimates. Combining (or pooling) estimates is usually the second stage of analysis in multi-city study and is typically performed by using one of two main statistical approaches: a) random effects models fitted by maximizing the likelihood function (MLE-Berkey) (63) or b) hierarchical regression models fitted by Monte Carlo Markov Chain (MCMC). Both approaches have been reported to provide similar results (64).

Effect modification of the exposure-outcome association can also be explored in the second stage to explain any observed heterogeneity between cities. Several studies of those reviewed did not discuss heterogeneity in the results or did not explore it beyond applying a random effects model (19;22;65-67). However, a number of potential effect modifiers have been reported in prior studies that include socio-demographic variables and characteristics of the pollution mixture.

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies.

Study	**Location/time-series**	**Pollutants studied**	**Outcomes**	**City-specific model**	**Pooling method**	**df for time (/yr)**	**Covariates**	**Lag (days)**
Katsouyanni et al, 2007 (14)- APHENA	• 12 Canadian cities: 1987-1996 (mort.); 1993-1996 (hospital admissions). • 90 US cities: 1987-1996 (mort.); 1987-1994 (hospital admissions). • 32 European cities: at least 3 years between 1990-1997 (mort.).	• PM_{10} • O_3 (1 hr max)	For all ages, over 75 and under 75: • total mort • resp. mort • CVD mort For over 65: • resp. HA • cardiac hospital admissions	• GLMs with PS or NS	Berkey-MLE	• 3 • 8 • 12	•time •temp •holidays • weekday	O_3: •lag1 •lag01 •dist lag02
Gryparis *et al.*, 2004 (11) – APHEA 2	• 23 European cities (exposed population over 50 million) • At least 3 years data for each city since 1990	• O_3 (1hr and 8 hr)	• total mort. • CVD mort. • resp. mort.	• GAM with LOESS smoothers	Berkey MLE, fixed effects and random effects , IV weights.		• time • temp • holidays • weekday • relative humidity • resp. epidemics • heat waves	• lag01

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies. *(cont'd)*

Study	Location/time-series	Pollutants studied	Outcomes	City-specific model	Pooling method	df for time (per year)	Covariates	Lag (days)
Simpson *et al.*, 2003 (24)	• 4 Australian cities: 1996-1999	• O_3 (1 hr and 4 hr max) • $PM_{2.5}$ • NO_2 • bsp • PM_{10}	• Total mort. (all ages) • resp. mort. (all ages); • CVD mort. (all ages and 65+)	3 approaches: • GAM with nonparametric smoothers for time and NS for other variables; • GLM with NS for all variables; • GAM with PS	Fixed and random effects, IV weights		• time • temp • relative humidity • pressure • day of week • holiday • influenza epidemics	• lag0 • lag1 • lag2 • lag3 • lag01
Ostro *et al.*, 2006 (19)	• 9 California counties (two thirds of California's population): 1999-2002	• $PM_{2.5}$	For all ages: • total mort. • resp. disease, • CVD disease, • ischemic heart disease • diabetes. For over 65: • total mort	• GAM with PS	Random effects meta analysis	•7	• temp • humidity • day of the week	• lag2 • lag01

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies. *(cont'd)*

Study	**Location/time-series**	**Pollutants studied**	**Outcomes**	**City-specific model**	**Pooling method**	**df for time (per year)**	**Covariates**	**Lag (days)**
Schwartz *et al.*, 2003 (22)	• 6 US cities: 1979-late 1980s	• $PM_{2.5}$ • PM_{10}	• daily deaths	GAM (strict convergence criteria); various regressions splines: • NS • B-splines, • PS • thin plate splines.		• 4	• temp • dew point • day of week	• lag01
Bell *et al.*, 2004; Bell and Dominici, 2008 (9;64) – *Extension of NMMAPS*	• 95 US communities (~40% of US population).: 1987-2000	• O_3	• total mort • resp. mort • CVD mort	• GLM with NS	Bayesian hierarchal models (MCMC) and mixed effects meta regression (Bell2008)	• 7-21	• temp • dew point • day of week • influenza epidemics • age group variables	• lag0 • lag1 • lag2 • lag3 • dist lag up to one week

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies. *(cont'd)*

Study	**Location/time-series**	**Pollutants studied**	**Outcomes**	**City-specific model**	**Pooling method**	**df for time (per year)**	**Covariates**	**Lag (days)**
Klemm and Mason, 2003 (15)	• Harvard Six cities: 1979-late 1980s	• $PM_{2.5}$	• Total mort. • COPD mort. • IHD mortality • Pneumonia mort.	• GAM with LOESS smoothers (strict criteria); • GLM with NS	IV weighted method	• GAM-strict: 6.4 per year; • GLM: 4.75 per year	• temp • day of week • dew point	
Dominici *et al.*, 2006 (35)	• 202 urban US counties : 1999-2002	• $PM_{2.5}$	• CVD HA • resp. HA	GLM with NS	Bayesian hierarchical models (MCMC)	• 8	• temp • humidity • day of week • dew point	• lag0 • lag1 • lag2 • dist lag02
Ballester *et al.*, 2006 (65)	• 13 Spanish cities: 1995-1999	• O_3 (8 hr) • SO_2 • NO_2 • CO	• CVD HA • heart diseases HA	GAM with LOESS smoothers (stringent criteria)	Random and fixed effects, IV weights	• 8	• temp • humidity • pressure • influenza epidemics • day of week • holidays • unusual events	• lag0 • lag1 • lag2 • lag3 • lag01 • lag23.

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies. *(cont'd)*

Study	**Location/time-series**	**Pollutants studied**	**Outcomes**	**City-specific model**	**Pooling method**	**Time df/year**	**Covariates**	**Lag (days)**
Host *et al.*, 2008 (67)	• 6 French cities (approx. 10 million population): 2000-2003	• $PM_{2.5}$ • $PM_{10-2.5}$	• CVD HA (all ages and over 65); • resp. HA (0–14 years, 15–64 years and 65 years)	PS for time	IV weights, random effects		• temp • day of the week • holidays • influenza epidemics • pollen counts	• lag01
Burnett *et al.*, 1997 (66)	• 16 Canadian cities: 1981-1991	• O_3 (1 hr max)	• resp HA	Random effects relative risk regression model	Random effects pooling		• temp • dew point • day of week • other pollutants	• lag0 • lag1 • lag2 • lag01 • lag012 • lag12.

Table 3 Summary of the methods used in recent multi-city and meta-analyses of time-series studies. *(cont'd)*

Study	**Location/time-series**	**Pollutants studied**	**Outcomes**	**City-specific model**	**Pooling method**	**Time df/year**	**Covariates**	**Lag (days)**
Anderson *et al.*, 2004 (68)	• European studies	• O_3 (8 hr) • $PM_{2.5}$ • PM_{10}	• mort (total, resp. and CVD) for all ages; • resp. HA (3 age groups); • CVD HA (65+)		Pooled estimates when more than 4 studies for an outcome were available.			•various
Stieb *et al.*, 2002; Stieb *et al.*, 2003 (69;70)	• 121 studies included in meta analysis	• O_3 • PM_{10} • CO • NO_2 • SO_2	• mort (total, resp. and CVD) for all ages and elderly	various models used for individual studies	Fixed and random effects, IV weights		• various, but temp or humidity at least in each study	•various
Bellini *et al.*, 2007 (54)	• 15 Italian cities (9 million exposed pop): 1996-2002	• O_3 (summer) • PM_{10} • CO • NO_2 • SO_2	• mort (all, resp, CVD); • HA (resp, heart, cerebro-vascular)	GLM	Bayesian random-effects model (MCMC)		• age • day of the week • holidays • influenza epidemics • meteo-rological variables	• lag01 • lag03

2.3 Findings of time-series studies

Findings from the majority of time-series studies in various locations indicate that there is a significant association between ozone or $PM_{2.5}$ and mortality/morbidity. Recent large-scale time-series studies include Air Pollution and Health: a European and North American Approach (APHENA), Air Pollution and Health: a European Approach 1 and 2 (APHEA), and National Morbidity, Mortality and Air Pollution Study (NMMAPS).

2.3.1 Major Multi-city Studies

APHENA

The APHENA study brought together investigators from Canada, the US and Europe, all of which had previously conducted studies on air pollution and health (NMMAPS, APHEA and other Canadian studies) (14;71). The project involved the development of a common analytic approach used in both, the first stage (to obtain city-specific estimates) and the second stage of the analysis (combined estimates). The data analysis in this study covered 90 US cities, 32 European cities and 12 Canadian cities. The study looked at the effects of ozone and PM_{10} using GLMs with both penalized and natural splines as smoothing functions to adjust for seasonality, with 3, 8 or 12 df per year. Estimates were combined to arrive at regional and overall estimates using meta-regression approaches while looking at the effect of potential effect modifiers such as percent of unemployment in each city (14).

Effects estimated for ozone and mortality were stronger in Canada than in the US and Europe for reasons that could not be identified. As a result, combined results included Europe and the US, but not Canada (72). Results of this study can be seen in Table 4.

APHEA

The APHEA project was first initiated in 1993. It looked at the short-term effects of various air pollutants including ozone and PM_{10} on mortality and hospital admissions in 15 European cities. The total exposed population was over 25 million people (13). Results of the study support the hypothesis of a causal relation between ozone and all-cause daily mortality, where an increase of 50 $\mu g/m^3$ in the 1-hr maximum levels of ozone was associated with a 2.9% increase (CI 1.0- 4.9) in daily mortality (29). For respiratory hospital admissions and ozone, associations were significant and homogenous across cities. Estimates were stronger in the elderly and in the summer months, where an increase of 1.04% (95% CI 1.02%-1.05%) in hospital admissions was found among those 65 and older associated with an increase of $50 \mu g/m^3$ in ozone concentrations. These results were based on data from four European cities only (73). The APHEA project was later extended to APHEA-2 to cover 30 European cities and applied improved statistical approaches (61).

NMMAPS

The National Morbidity, Mortality, and Air Pollution Study looked at the health effects of PM_{10}. Analyses included effects on mortality associated with PM_{10} in the 90 largest US cities from 1987-1994 and on emergency hospital admissions in 14 US cities. This study is of particular interest in that no other study had looked at this many cities in a consistent manner (74). Upon reanalysis in 2003, the updated NMMAPS database included data from 1987 to 2000, covered 95 urban centers and extended its analyses to include effects of exposure to ozone. Researches used a two-stage approach to reach a national effect estimate. First, a time-series analysis was applied within each city to obtain a city-specific estimate. In the second stage, all estimates were combined across communities to arrive at a national average estimate that takes into account the within community uncertainty and any heterogeneity observed between communities (9).

For ozone, it was found that a 10 ppb increase in the previous week's ozone levels was associated with a 0.52% increase in daily mortality (95% CI 0.27%-0.77%) and a 0.64% increase in cardiovascular and respiratory mortality (95% CI 0.31%-0.98%). Results were robust to the degree of confounding adjustment for seasonality, temperature, and long-term trends (9).

2.3.2 *Other recent studies*

A search in *PubMed* for the key-words *time-series* and *ozone* or *$PM_{2.5}$* returned approximately 1300 results (search performed on August 15, 2008). Because a complete review of all relevant study findings is beyond the scope of this thesis, main findings of recent multi-city time-series studies and meta-analyses that have examined the health effects of either $PM_{2.5}$ or ozone were reviewed and are presented in Table 4. These studies correspond to the same studies that were reviewed for statistical methods in Table 3.

The majority of studies are generally in agreement in that relatively weak but significant associations have been detected across a wide range of outcomes. However, there are inconsistencies when considering whether or not heterogeneity was present between city specific estimates, effect modification patterns and the presence of a delayed (or lagged) effect between exposure and outcome.

Meta-analyses

Several meta-analyses of time-series studies (Table 4) have examined the health effects of ozone and particulate matter (54;68-70;75). The World Health Organization published a meta-analysis in 2004 that reviewed 286 time-series studies. Statistically significant relationships between ambient ozone with mortality, as well as cause specific mortality and respiratory/cardiovascular hospital admissions were observed (68). In a meta-analysis on ozone by Bell *et al.* (75), estimates from 39 time-series studies were pooled and found a 10 ppb increase in daily ozone was associated with a 0.83 % increase in total mortality (95% CI, 0.53%-1.12%), comparable to the estimate of approximately 0.5% increase found by Stieb *et al.* (69) in a meta-analysis that included 121 studies.

The meta-analyses reviewed looked at various pollutants including ozone. However, because the focus on $PM_{2.5}$ is relatively recent, only the WHO meta-analysis examined its effect. Positive but nonsignificant effects were calculated for $PM_{2.5}$ based on pooling of five studies.

Certainly, approaches involving multiple cities and meta-analyses offer advantages over single city studies due to the increased statistical power and generalizability. Meta-analyses of time-series studies, however, have been criticized due to the wide variety of statistical methods used in each of the single city studies making it difficult to pool across cities. The issue of publication bias has also been examined by Bell *et al.* (75), where it was found that estimates from the meta-analyses were consistently larger than the estimates from the NMMAPS. As a result, the authors recommended using caution when interpreting results from single-city studies, which are prone to overestimation.

Table 4 Summary of the main findings in recent multi-city and meta-analyses of time-series studies.

Study	**Significant effect estimates**	**Main findings relevant to O_3 or $PM_{2.5}$**	**Effect modification**
Katsouyanni et al, 2007 (14)- APHENA	Significant Canadian effects for 10 µg/m^3 increase in O_3 with NS, 8df per year : • 0.52% (lag1) and 0.81% (lag01) increase total mort. (all ages); • 0.54% (lag1) and 0.9% (lag01) increase total mort. (over 75); • 0.51% (lag1) and 0.73% (lag01) increase total mort (under 75) • 0.70% (lag1) and 1% (lag01) increase in CVD mort. (over 75) • 1% (lag01) increase in resp HA (over 65)	• This study developed a common approach to analysis of multi city time-series data. • Effect estimates from previous studies (APHEA and NMMAPS) were reproduced • Consistent evidence of an association between O_3 and mort. • Estimates for Canadian cities were generally higher than US and Europe. • Results were not highly sensitive to degree of controlling for confounders and details of model specifications. • lag01 results were higher than lag1 • Data was not collected using uniform protocol. • Effect modification analyses were limited due to lack of common variables across cities.	• Little evidence of consistent effect modification across cities • Canadian estimates did not show any heterogeneity for any of the models. • Some positive correlation between percent unemployed and effects.
Gryparis *et al.*, 2004 (11) –APHEA 2	For a 10µg/m^3 increase in 1hr max O_3 (warm season only): • 0.33% total mort • 0.45% CVD mort • 1.13% resp. mort	• O_3 effects were mainly seen during warm months. • Resp mort more strongly associated with O_3 than CVD or total mort. • Effects on total mort remained statistically significant when other pollutants were adjusted for in 2 pollutant models.	• City estimates were heterogeneous for total mort and CVD mort. • Standardized mort rate explained 16% of heterogeneity (total mort.) • Presence of geographic differences (CVD mort.).

Table 4. Summary of the main findings in recent multi-city and meta-analyses of time-series studies. (cont'd)

Study	**Significant effect estimates**	**Main findings relevant to O_3 or $PM_{2.5}$**	**Effect modification**
Simpson *et al.*, 2003 (24)	• RR 1.0022 for resp mort all ages for 1 ppb increase in O_3 (lag01, 1hr max); • no significant estimates for $PM_{2.5}$	• Similar results for all three approaches applied. • Number of cities too low to detect heterogeneity in estimates	• No significant heterogeneity found although resp mort estimates were most variable.
Ostro *et al.*, 2006 (19)	For a 10μg/m^3 increase in $PM_{2.5}$ (lag0): • 0.6% increase in mort. • 0.6% increase CVD mort • 2.2% increase resp mort • 0.7% increase in mort over 65	• Significant association between $PM_{2.5}$ and mort. • Results were generally insensitive to model specification and the type of splines used, although NS results were slightly lower than PS • Results are likely to have been biased downward due to likely exposure measurement error (1-3 monitors in some counties). • Lag2 results not significant	

Table 4. Summary of the main findings in recent multi-city and meta-analyses of time-series studies. (cont'd)

Study	**Significant effect estimates**	**Main findings relevant to O_3 or $PM_{2.5}$**	**Effect modification**
Schwartz *et al.*, 2003 (22)	For a 10µg/m^3 increase in $PM_{2.5}$ • 0.129% (NS) • 0.113% (PS)	• Initial message (before reanalysis) remained unchanged after reanalysis. • Results were in general comparable using different statistical methods. • Slightly lower estimates for the splines models compared with the GAM using stricter convergence criteria.	not discussed
Bell *et al.*, 2004; Bell and Dominici, 2008 (9;64) – Extension of NMMAPS	A 10-ppb increase in the previous week's O_3 were significant: • 0.52% (total mort.) • 0.64% increase (CVD and resp. mort)	• Results indicate a statistically significant association between short-term changes in O_3 and mort. • National average estimated of distributed lag model was robust to df for time. • Results were robust to adjustment for particulate matter, weather, seasonality, and long-term trends. • Effect estimates for aggregate O_3 during the previous week were larger than for single lag models; • Second stage approaches both gave similar results for national average.	• Looked at 22 community level potential effect modifiers. • Higher estimates were associated with higher unemployment, fraction of African American populations, public transportation use, lower temperature prevalence or percent of central air conditioning.

Table 4. Summary of the main findings in recent multi-city and meta-analyses of time-series studies. (cont'd)

Study	Significant effect estimates	Main findings relevant to O_3 or $PM_{2.5}$	Effect modification
Klemm and Mason, 2003 (15)	A 10 μg/m^3 increase in $PM_{2.5}$ was associated with a significant increase in mort: • 1.2% increase (GAM strict) - all ages • 0.8% increase (GLM) -all ages • 1.4% increase (GAM strict) - over 65 • 1% increase (GLM) -over 65	• Estimates from GLM were generally lower but comparable to those from GAM-strict. • Estimates differed by df used for smoothing time trends. • Effects generally were reduced with increasing df for GAM, but not always for GLMs.	• Estimates differed by study location.
Dominici *et al.*, 2006 (35)	• Largest significant effect was 1.28% increase in heart failure for 10 μg/m^3 increase in $PM_{2.5}$ (lag0).	• Positive associations for all outcomes, except injuries, for at least 1 exposure lag. • The largest effect was found at lag 0 for all of the CVD outcomes except ischemic heart disease. • Largest effects for resp. outcomes occurred at lags 0 and 1 for COPD and at lag 2 for resp. tract infections. • Distributed lag estimates were statistically significant for heart failure. • The national average RR estimates were larger for the oldest group for some outcomes including ischemic heart disease, heart rhythm disturbances, heart failure, and COPD	• Strong evidence for spatial heterogeneity in the effect of $PM_{2.5}$ on HA was found. • CVD risks were higher in eastern US. • The pattern and degree of heterogeneity tended to vary by outcome measure.
Ballester *et al.*, 2006 (65)	For a 10μg/m^3 increase in O_3 (8hr and average lag2-3) : • 0.69% increase all CVD diseases • 0.66% increase heart diseases	• O_3 presented a more delayed effect on hospital admissions with effect of lag2 and lag3 the highest. • O_3 estimates were robust after controlling the potential for confounding attributable to other pollutants. • The effect of O_3 on CVD admissions seems to be independent of the other pollutants.	• Used random effects when present

Table 4. Summary of the main findings in recent multi-city and meta-analyses of time-series studies. (cont'd)

Study	**Significant effect estimates**	**Main findings relevant to O_3 or $PM_{2.5}$**	**Effect modification**
Host *et al.*, 2008 (67)	• Positive associations between $PM_{2.5}$ and resp. infections: 2.5% (95% CI 0.1 to 4.8)	• no association with resp. diseases was observed with $PM_{2.5}$ • Positive associations were observed between CVD diseases and $PM_{2.5}$ levels, although some did not reach significance	
Burnett *et al.*, 1997 (66)	• RR 1.042 in resp. HA for 30 ppb increase in O_3, after adjusting for covariates	• Associations were stronger with lag1 models. • Effects stronger in summer months. • Estimates were same for all ages and when restricted for over 65;	

Table 4. Summary of the main findings in recent multi-city and meta-analyses of time-series studies. (cont'd)

Study	**Significant effect estimates**	**Main findings relevant to O_3 or $PM_{2.5}$**	**Effect modification**
Anderson *et al.*, 2004 (68)	For an increase of 10 μg/m^3 in O_3:: • RR 1.003 for total mort. (15 studies) • 1.004 for CVD mort. (12 studies) • Positive but nonsignificant effects for HA	• $PM_{2.5}$ effects were positive but nonsignificant (Note: only 5 estimates for $PM_{2.5}$ were available for pooling) • Evidence for publication bias for studies on O_3.	Study did not attempt to explore heterogeneity
Stieb *et al.*, 2002; Stieb *et al.*, 2003 (69;70)	For an increase of 31.2 ppb O_3 an increase in total mort: • 1.4% increase (Non-GAM models; 10 studies) • 1.7% increase (GAM, 15 studies) in total	• Strong association for O_3, consistent with those reported in other studies. • Effect sizes were reduced in multi-pollutant models, but remained positive and significant.	• No consistent geographic pattern on effects size
Bellini *et al.*, 2007 (54)	• nonsignificant	• Positive nonsignificant estimates for O_3 • Some heterogeneity was accounted for by differences in variability of pollutant concentrations.	

Chapter 3

MATERIALS AND METHODS

3.1 Study locations

Air pollution and mortality/morbidity data for the following 12 Canadian cities was analyzed: Calgary, Edmonton, Halifax, Hamilton, Montreal, Ottawa, Toronto, Quebec City, St John, Vancouver, Windsor and Winnipeg. Cities were selected based on the availability of air pollution monitoring data. The number of PM monitors varied between cities from 1-5 monitors, whereas the number of O_3 monitors varied between 2 and 23 monitors. The census division or combinations of census subdivisions were used to define each community study area.

3.2 Description of databases

3.2.1 *Exposure data*

Air pollution data was obtained through the National Air Pollution Surveillance (NAPS) program administered by Environment Canada. This program has provided accurate and long-term air quality data of uniform standard throughout Canada since 1970. Data from NAPS is subject to an extensive quality assurance program and are included in the Canada-wide Air Quality

Database. It is published in annual air quality reports and can be found at http://www.etc-cte.ec.gc.ca/publications/napsreports_e.htm

A single daily measurement for each pollutant was obtained for each city by averaging the measurements of all monitors in that city. The number of monitors in each city did not change throughout the study period. On days when one or more monitors were not functioning, daily measurements were derived from the remaining monitors.

Daily ozone concentrations collected include the 1-hour (1-hr) and the 8-hour (8-hr) maximum concentrations. The 1-hr maximum, available on a daily basis from 1980-2001, was used in the analyses to facilitate comparison of results with previous findings. Particulate matter data analyzed represents the 24-hour average cumulative mass measurements from all the monitors in one city. $PM_{2.5}$ was measured once every six days. However, the data had occasional random periods with missing data in many of the cities. In general, the time period with data available for each city varied between 6-16 years since 1984. Records of the daily mean temperature for the time-series were also available.

3.2.2 Mortality and hospitalization data

A computerized database for mortality has been available in Canada since 1959 with information on the demographics and major cause of death of the decedent. Outcome data for this study was obtained through the Canadian Institute for Health Information (CIHI). Hospital admissions data was obtained from the Discharge Abstract Database through CIHI, which contains data on discharges, deaths, sign-outs and transfers. To ensure the quality of data collected, CIHI regularly performs quality checking of its databases.

Deaths and hospital admissions were classified using the ICD-9 (International Statistical Classification of Diseases) codes. Records that had been classified using the ICD-10-CA scheme were converted to the ICD-9 classification scheme by CIHI and were then subject to a quality assurance program. Mortality data for the 12 Canadian cities was available for a 20-year period 1981-2001, while hospital admissions data was available from 1993 to 2001. The databases included information on the residence (city), age, date of death, and single underlying cause.

3.2.3 Ecologic covariates

Data on 29 ecologic covariates representing city-level demographic, socioeconomic, health care and lifestyle determinants was used to explore effect modification. The data was initially compiled to be used in APHENA but was of limited use due to the lack of uniform data of variables in the US and Europe. A list of these variables is provided in Table 11.

3.3 Statistical analyses

Statistical methods used in time-series studies have varied considerably and there is no consensus among experts on what constitutes the ideal model for time-series analyses. The various model specifications used in the studies reviewed in Chapter 2 are believed to yield comparable risk estimates.

3.3.1 City-specific estimates

In this study, Poisson regression models allowing for overdispersion were used to estimate the associations of ozone and PM with mortality and hospital admissions. The city-specific models used in this study were of the form:

$$\log E(\mu_t) = s_1(time, df) + s_2(temp_t, 3df) + \beta P_t + (DOW) + (holiday)$$

(Equation 1)

where $E(\mu_t)$ is the expected value of the Poisson distributed variable μ_t, which represents the daily counts of events (deaths or hospital admissions) on day *t*. The term $s_1(time, df)$ controls for seasonality where s_1 is a smooth function with natural cubic splines as basis functions for the *time* variable and *df* is the degrees of freedom that allows s_1 to take various functional forms. The function s_1 models the non-linear association between time-varying covariates, calendar time, and daily mortality. To control for weather, the term $s_2(temp, 3)$ was included where s_2 is a smoothing function of temperature on day *t* with 3 df allowed. *P* is the pollutant concentration (ozone in ppb or $PM_{2.5}$ in $\mu g/m^3$) on day *t*; *DOW* and *holiday* are dummy variables included in the model for the day of week and holidays. The regression coefficient β represents the log relative increase (if β is positive) in the number of events in the target population per unit increase in pollutant concentration. Time-series studies usually report results as percent change in mortality or hospital admission per 10 units change in pollutant. This value is simply obtained by multiplying the regression coefficient β by a factor of *1000*.

Previous studies have controlled for influenza epidemics in the time-series models (9;11;24;54;64;65;67). However, other published results have indicated that the association between air pollution and health outcomes is not affected by controlling for these epidemics (76;77). The models used in this study did not control for influenza epidemics.

Two pollutant models that explored potential confounding of the ozone effect by $PM_{2.5}$, and vice versa, were applied by adding linear terms for ozone and $PM_{2.5}$ simultaneously in the model.

Seasonal confounding control

The effect of degrees of freedom allowed for seasonality control in the smooth function of calendar time was investigated in the first part of analyses. Effect estimates of ozone on all outcomes (all ages) were determined with models each allowing 1-20 df for the time variable per year of data available. For temperature, 3 degrees of freedom were allowed in all the analyses, based on previous findings that indicate that results are robust to varying degrees different approaches used for the temperature variable. Results of this stage were examined in order to select three values for the degrees of freedom to use in the remaining analyses.

A sensitivity analyses comparing the effect of natural splines and penalized splines on the effect estimates was also carried out on the Toronto data set.

Lag structure

To determine the effect of lag period on health outcomes, several lag periods were examined for all health outcomes (all ages) for increases in 1hr ozone with models containing degrees of freedom chosen from the first stage of analyses. The following is a list of the lag structures examined along with the effect that each model estimates:

- 0-day lag (lag0): effect of same day pollution concentrations.
- 1-day lag (lag1): effect of previous day's pollution concentrations.
- 2-day lag (lag2): effect of the pollution concentrations 2 days prior.
- Combined lag01: average of lag0 and lag1 ozone concentrations
- Combined lag02: average of lag0, lag1 and lag2 ozone concentrations
- Distributed lag (lag02): cumulative effect of the same-day effect, the 1-day lag effects and the 2-day lag effects (sum of regression coefficients).

All models included the same lagged term for the temperature variable as for the exposure pollutant. For example, in lag01 models, the temperature included in the model was the average temperature of the current day and previous day.

Based on the results of the lagged models analysis for ozone exposure, three lag structures were selected for the remaining ozone models. For $PM_{2.5}$, combined and distributed models were not feasible due to lack of daily data. Thus, single day lag models were applied to PM data: 0-day lag, 1-day lag and 2-day lag.

Outcomes

For mortality outcomes, health effects were assessed for three age groups (all ages, ≥75, <75). ICD codes used to classify deaths were ICD-9<800 for total mortality corresponding to all non-accidental causes of death; ICD-9 390-459 for cardiovascular causes of death; and ICD-9 460-519 respiratory causes of death.

For hospital admissions, effects were assessed for two age groups (all ages and ≥65). ICD codes used were ICD-9 390-429 for cardiovascular admissions and ICD-9 460-519 for respiratory admissions.

3.3.2 Combined estimates

City-specific estimates were combined using by applying fixed effects (FEM) and random effects (REM) regression models. In the fixed effects approach, effect estimates *(βs)* were assumed to be normally distributed around an overall estimate and were pooled using inverse variance weighting, with weights proportional to the inverse variance of each city's *β*. In the random effects regression approach, the city-specific *β*s were assumed to be from a sample of independent observations from a normal distribution with the same mean and with variance equal to the sum of the between-city variance and the squared standard error of *β*. The between-city variance is added to the city-specific variance and is estimated using the maximum likelihood estimation (MLE) method (63).

3.3.3 Effect modification

To explore effect modification, four outcomes that displayed heterogeneity between city-specific *βs* were selected in order to test whether the variability in the regression coefficients could be explained by city level variables. Heterogeneity was assessed by the I^2 index, which is a measure of the total variability among effect sizes that can be attributed to true heterogeneity (between-city variability) (78). In general, an I^2 less than 25% indicates that there is low heterogeneity between cities.

Weighted linear regression of the city-specific estimates was performed onto each ecologic covariate to test for effect modification. Weights were inversely proportion to the variance of each city specific risk estimate *(β)*. Models where the data showed a significant linear association at the 95% confidence level between the potential effect modifier and the risk estimates were assumed to potentially modify the pollutant exposure – health outcome relationship.

All analyses were completed using R statistical software (79) for Windows version 2.6.1.

Chapter 4

RESULTS

4.1 Summary statistics

4.1.1 Health outcomes

Descriptive statistics of the databases are provided in Table 5-Table 7. The total number of deaths for all ages across the 12 Canadian cities were approximately 1.6 million from 1981-2000. The total exposed population varied between 9.1 million (mortality database) to 10 million (hospital admissions database). Individual city population ranged between 100,000 in St John and approximately 2.3 million in Toronto, based on the 1991 Census. Mean daily counts of deaths and hospitalizations were generally lower for respiratory outcomes compared to cardiovascular outcomes across all age groups.

Table 5 Total number of outcome counts in the 12 Canadian cities for mortality (1981-2000) and hospital admissions (1993-2000).

Outcome/ Age group	Total counts
All cause mortality	
all ages	1,564,583
75 and over	748,498
under 75	271,855
Cardiovascular mortality	
all ages	641,072
75 and over	815,978
under 75	85,971
Respiratory mortality	
all ages	134,663
75 and over	369,177
under 75	48,683
Cardiovascular hospital admissions	
all ages	917,646
65 and over	610,463
Respiratory hospital admissions	
all ages	541,523
65 and over	244,769

Table 6 Summary of the population size and mean number of daily mortality counts by cause and age group in the 12 Canadian cities

City	Population (x1000)	All cause mortality			Cardiovascular mortality			Respiratory mortality		
		All ages	*75 and over*	*Under 75*	*All ages*	*75 and over*	*Under 75*	*All ages*	*75 and over*	*Under 75*
Calgary	711	10	5	5	4	2	2	1	1	0
Edmonton	617	11	5	6	5	3	2	1	1	0
Halifax	231	6	3	3	2	1	1	1	0	0
Hamilton	319	10	4	5	4	2	2	1	0	0
Montreal	1,776	48	22	26	19	10	9	4	2	2
Ottawa	880	15	7	8	6	4	3	1	1	0
Quebec City	540	17	8	9	7	4	3	1	1	1
St John	103	3	1	1	1	1	1	0	0	0
Toronto	2,276	47	22	24	18	11	8	4	3	1
Vancouver	1,832	29	15	14	12	8	4	3	2	1
Windsor	191	6	3	3	3	2	1	0	0	0
Winnipeg	615	14	7	7	6	4	2	1	1	0

Table 7 Summary of the population size and mean number of daily hospital admissions (HA) in the 12 Canadian cities.

City	Population (x1000)	Cardiovascular HA		Respiratory HA	
		All ages	*65 and over*	*All ages*	*65 and over*
Calgary	768	18	11	12	5
Edmonton	616	13	9	10	4
Halifax	233	8	5	5	2
Hamilton	322	15	10	7	4
Montreal	1,776	63	38	38	16
Ottawa	939	19	12	10	5
Quebec City	556	23	13	12	5
St John	102	7	5	5	2
Toronto	1,385	71	50	40	19
Vancouver	1,603	51	36	30	14
Windsor	198	10	7	5	2
Winnipeg	619	17	12	10	5

4.1.2 *Air pollution and weather*

Mean annual temperatures for the 12 cities were in the range of 2.4°C (Edmonton) and 10.6°C (Vancouver). Ozone measurements were available on a daily basis from 1981-2000 with minor missing data (except for Halifax). The time periods of available $PM_{2.5}$ data were not uniform across cites. In general, $PM_{2.5}$ was measured every sixth day for most cities, with occasional intermittent missing data across longer periods.

Ozone and $PM_{2.5}$ levels were not strongly correlated. The highest correlation coefficients were 0.46 and 0.41 for Windsor and St Johns. Correlation coefficients between the two pollutant levels in each city are presented in Table 8 and descriptive statistics of the exposure databases are presented in Table 9 and Table 10.

Table 8 Correlations between 1-hour maximum ozone and 24-hour average $PM_{2.5}$ levels from 1981-2000.

City	Correlation
Calgary	-0.24
Edmonton	-0.23
Halifax	0.17
Hamilton	0.32
Montreal	0.12
Ottawa	0.12
Quebec City	0.04
St Johns	0.41
Toronto	0.36
Vancouver	-0.24
Windsor	0.46
Winnipeg	0.10

Table 9 Descriptive statistics for the study period, air pollutants and temperature data used in the analyses of mortality outcomes.

City	Cal.	Edm.	Hal.	Ham.	Mont.	Ott.	Que.	Stj.	Tor.	Van.	Win.	Wpg.
Temp (˚C)												
Mean	4.5	3.0	6.5	8.0	6.6	6.4	4.4	5.2	8.1	10.5	9.8	3.1
25th centile	-1.9	-5	-0.8	0.1	-2.1	-2.7	-4.6	-1.7	0.2	6.3	1.5	-7.4
Median	5.6	4.7	6.9	8.2	7.6	7.45	5.4	6.1	8.3	10.3	10.2	4.7
75th centile	13	13	14.6	17	16.7	17	14.8	13.7	17.2	15.3	19.1	15.4
Ozone (ppb)												
Time period	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00	01/81-12/00
No. obs.[1]	7305	7302	5945	7290	7304	7303	7208	7144	7305	7292	7225	7159
No. missing[2]	0	3	1360	15	1	2	97	161	2	13	80	146
Mean	33.1	31.2	29.0	34.8	28.7	28.8	28.8	34.5	34.2	27.0	36.9	30.0
Maximum	94	110	100	129	115.7	105	135	160	144.1	104.6	159	99
25th centile	25	22	21	22.3	18.8	20	20	26	22.3	19.1	21	21.5
Median	33	30.5	28	31	26.2	27	28.5	32.3	30.5	26.6	31.5	29
75th centile	41	40	35	44	35.9	35.7	35.0	40.0	42.3	34	49	37.5
$PM_{2.5}$ (µg/m³)												
Time period	12/84-12/00	12/84-12/00	12/84-12/96	01/95-12/00	12/84-12/00	12/84-12/00	12/85 - 12/00	09/92-09/99	12/84-12/00	12/84-12/00	12/87-12/00	09/84-09/00
No. obs.	891	791	657	418	1180	807	524	1125	1537	1082	1031	816
No. missing	6414	6514	6648	6887	6125	6498	6781	6180	5770	6223	6274	6489
Mean	10.2	10.1	11.0	15.3	14.7	10.7	11.3	7.7	14.7	11.8	16.3	9.0
Maximum	66.1	64.0	45.5	74.1	72.0	53.8	50.4	53.2	71.0	67.0	85.6	71.3
25th centile	5.7	5.3	6.1	7.7	7.8	5.1	6.0	3.8	7.3	6.7	8.7	5.2
Median	8.3	8	9.15	12.5	12	8.32	9	6.3	12.34	9.8	13.7	7.3
75th centile	12.1	12	13.5	20.3	18.8	13.8	14.0	9.9	19.5	14.1	20.7	11.0

[1]Total number of observations
[2]Number of missing observations

Table 10 Descriptive statistics for the study period, air pollutants and temperature data used in the analyses of hospital admissions outcomes.

City	Cal.	Edm.	Hal.	Ham.	Mont.	Ott.	Que.	Stj.	Tor.	Van.	Win.	Wpg.
Temp (˚C)												
Mean	4.0	2.4	6.7	7.9	6.8	6.4	4.5	5.2	8.2	10.6	9.8	2.7
25^{th} centile	-2.8	-6.3	-0.2	0.0	-1.8	-2.5	-4.3	-1.3	0.3	6.3	1.5	-7.6
Median	5.5	4.5	7.0	8.4	7.8	7.7	5.5	6.1	8.6	10.3	10.4	4.7
75^{th} centile	12.7	12.7	14.8	17.1	17.3	17.1	15.3	13.7	17.4	15.4	19.1	15.1
Ozone (ppb)												
Time period	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/00
No. obs.	2922	2922	2070	2921	2922	2922	2889	2922	2922	2922	2922	2922
No. missing	0	0	852	1	0	0	33	0	3	0	0	0
Mean	32.7	31.1	31.8	35.3	29.8	31.2	30.0	32.3	36.0	27.0	37.0	29.4
Maximum	76.7	88.5	94.0	103.3	102.9	95.0	96.0	96.0	124.5	76.4	138.0	71.0
25^{th} centile	25.3	22.0	25.0	23.5	20.9	23.3	23.5	26.0	24.3	20.1	21.5	21.5
Median	33.0	30.0	31.0	32.3	27.7	29.7	30.0	31.0	32.8	27.4	33.0	28.0
75^{th} centile	40.7	39.5	37.0	44.5	36.8	38.0	37.0	37.0	44.5	33.7	49.5	36.5
$PM_{2.5}$ (μg/m³)												
Time period	01/93-12/00	01/93-12/00	01/93-12/95	01/93-12/00	01/93-12/00	01/93-12/00	01/94-12/00	01/93-01/99	01/93-12/00	01/93-12/00	01/93-12/00	01/93-12/99
No. obs.[1]	461	412	343	419	769	442	340	1087	1167	522	649	383
No. missing[2]	2461	2510	2579	2503	2153	2480	2582	1835	1758	2400	2273	2539
Mean	9.0	8.8	8.8	16.2	12.3	8.9	8.6	7.7	13.7	8.3	15.3	7.6
Maximum	66.1	64.0	43.4	418.0	67.7	53.8	50.4	53.2	53.9	34.6	85.6	45.5
25^{th} centile	5.0	4.7	5.6	7.8	6.7	4.3	5.8	3.8	6.9	5.2	7.8	4.8
Median	7.4	6.7	7.4	12.6	10.1	6.8	8.6	6.3	11.3	7.5	12.5	6.5
75^{th} centile	11.1	10.5	10.5	20.6	15.2	11.1	14.1	9.9	18.4	10.0	19.4	8.9

[1]Total number of observations
[2]Number of missing observations

4.1.3 Ecologic covariates

Description of the city level variables with summary values is provided in Table 11. These variables were assessed for potential effect modification of the association between pollutants and mortality/hospital admissions. Several of the variables listed were highly correlated, which is expected. Population density was correlated with population size (correlation =0.62). Proportion of the population over 65 and over 75 were highly correlated (correlation =0.99). The unemployment rates among sexes, males only and females only were also high correlated (correlation 0.82-0.97). Unemployment rate was correlated with percentage of population with low education (correlation =0.67). The percentage of smokers and drinkers at the city level were also correlated (0.72). The density of doctors per 100 000 inhabitants was negatively correlated with the proportion of people with unmet health needs (-0.63). Low household income was negatively correlated with low education (-0.62).

Table 11 City-level variables studied for potential effect modification of ozone and PM on health effects.

Variable	Description	Mean	Min.	Max.
Area (Km^2)	Area of city	850	120	3096
Population (no.)	Total population (1991 census)	816,820	102,915	2,275,775
Over 65	Proportion of the population ≥ 65 years	0.12	0.08	0.14
Over 75	Proportion of the population ≥ 75 years	0.05	0.03	0.06
Under 16	Proportion of population < 16 years	0.19	0.16	0.22
Unemployment, both sexes (%)	Percentage of those aged ≥15 years who are unemployed	9.9	7.3	13.20
Unemployment, males (%)	Percentage of males aged ≥15 years who are unemployed	10.1	7.2	13.60
Unemployment, females (%)	Percentage of females aged ≥15 years who are unemployed	9.8	7.3	12.70
External migrants, 1 yr (no.)	Number of external migrants, 1 year mobility status	13394	250	54285
External migrants, 5 year (no.)	Number of external migrants, 5 year mobility status	53062	715	260185
Population density (/Km^2)	Population density	1435	231	3612
Manufacture (%)	Percentage of labor force in manufacturing	13.3	5.8	26.41
Primary industry (%)	Percentage of labor force in the primary industry	1.72	0.42	8.07
Low income (%)	Percentage of population with low income	16.3	11.8	23.10
Average income ($)	Average household income	46056	40118	54601
Gini coefficient	A measure of inequality of wealth distribution	0.34	0.31	0.39
Life expectancy (yr)	Life expectancy at birth (2000)	79.5	78.1	81.1
Good self-health (%)	Percentage of population with self-rated health as *good* or *better* (2000/2001)	88.2	84.6	91.6
Smokers (%)	Percentage of population >12 years of age that smokes	23.0	15.5	25.9
Heavy drinkers (%)	Percentage of population > 12 years of age that is heavy drinkers	15.2	10.8	19.9
Inactive (%)	Percentage of population >12 years of age that is physically inactive	47.7	37.7	54.3
Obesity (%)	Percentage of population between 20-24 years with a body mass index >30	14.6	10.1	19.3
High blood pressure (%)	Percentage of population >12 years of age with high blood pressure	12.8	9.9	16.3
Depression (%)	Percentage of population over 12 years of age with depressions	7.6	5.1	9.5
Stress (%)	Percentage of population >12 years of age with life stress	24.4	19.7	33.0
Unmet health needs (%)	Percentage of population >12 years of age with unmet health needs	13.2	7.6	18.7
Doctor density (/100,000)	Density of general practitioners per 100,000	101	61	143
Specialist density (/100,000)	Density of specialists per 100,000	129	73	183
Low education	Proportion of population with low education	0.34	0.27	0.43

4.2 Study results

4.2.1 Degrees of freedom for seasonality control

The effect of seasonality control was explored by varying the degrees of freedom allowed per year of data available between 1 and 20 in the smooth function of time in each model. Effect estimates (city-specific percent changes deaths/hospital admissions) for all ages associated with an increase of 10 ppb in the previous day's ozone concentrations (lag1) are presented in Figure 3-Figure 7. Effect estimates decreased rapidly until about 4-5 df per year, and then stabilized with slight decreases as df increased. The largest cities, Montreal, Toronto and Vancouver, had the highest numbers of mean daily counts and showed the least variation in results whereas smaller cities, like Halifax and St. John showed the most variation (wide confidence intervals (CI)).

Fixed effects and random effects pooled regression coefficients are presented in Figure 8 for mortality outcomes and in Figure 9 for hospital admissions. The same trend observed in the city-specific results was seen here, where estimates stabilized after 4-5 df per year and then slightly decreased with further increases in df. Random effects estimates were similar to the fixed effects models because the statistical methods used did not detect substantial heterogeneity between cities. Estimates were positive and statistically significant across all outcomes except cardiovascular hospital admissions.

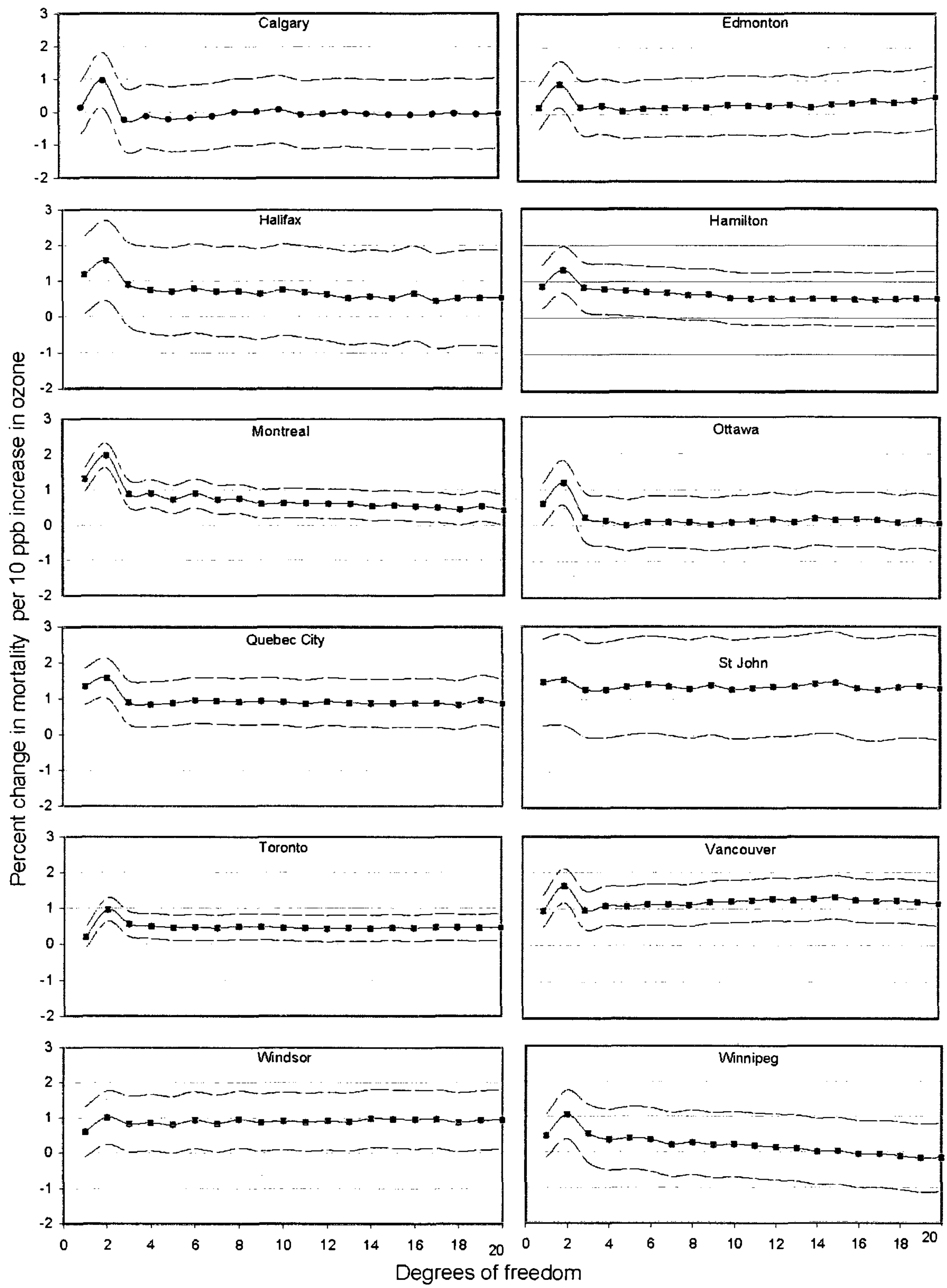

Figure 3 Estimated percent change and 95% confidence intervals in total mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day lag with varying degrees of freedom per year for seasonality control.

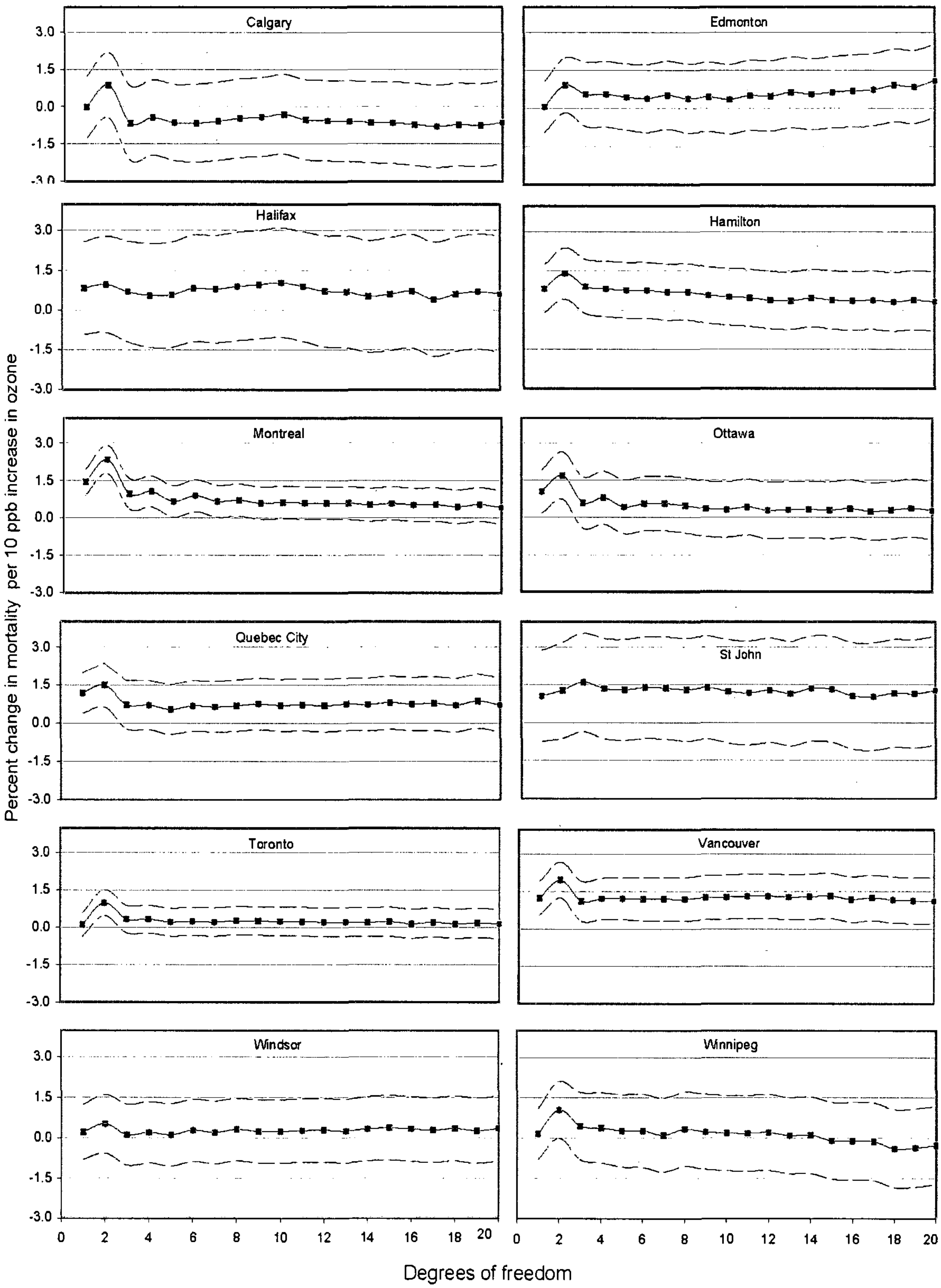

Figure 4 Estimated percent change and 95% confidence intervals in cardiovascular mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day lag with varying degrees of freedom per year for seasonality control.

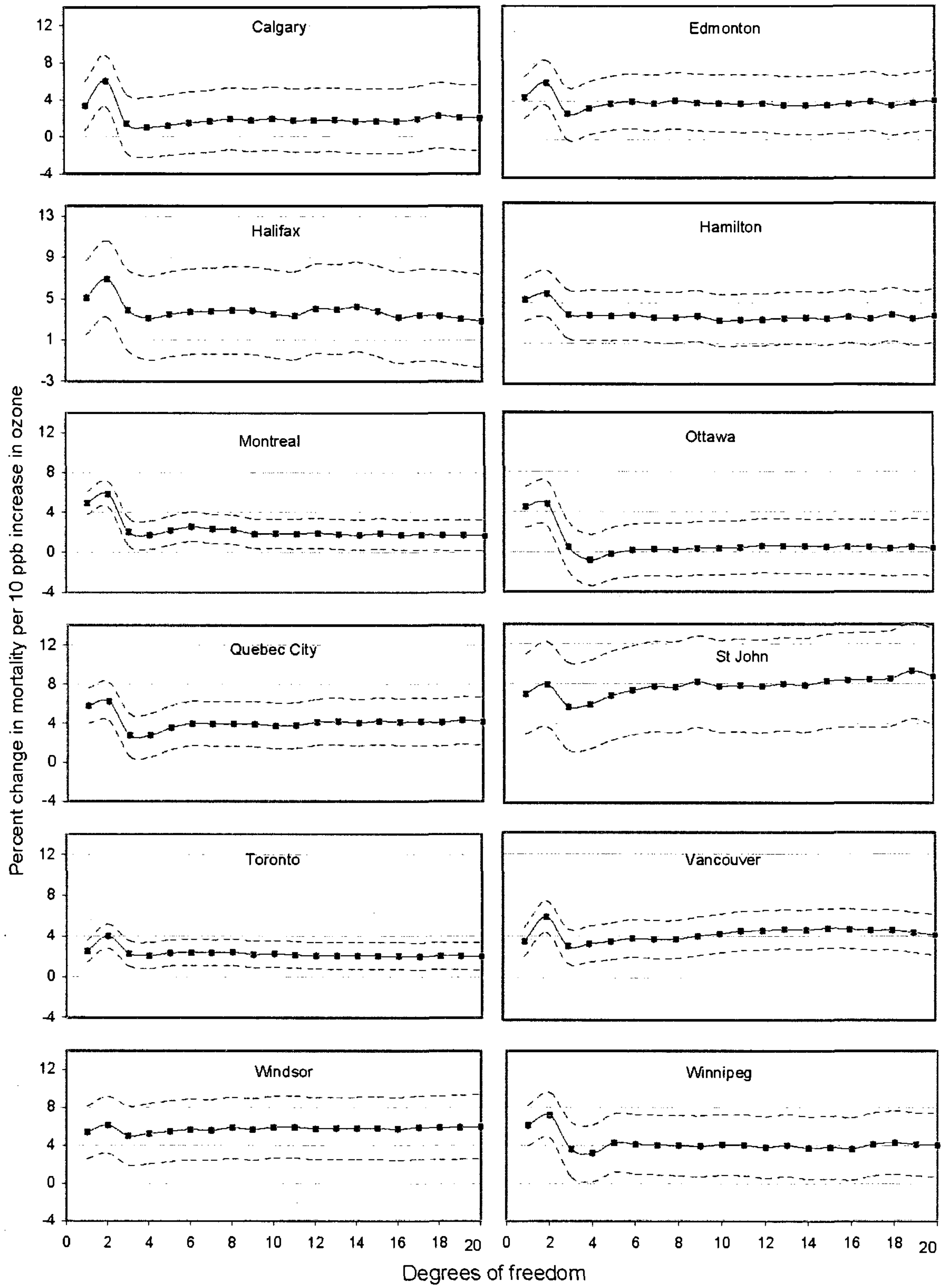

Figure 5 Estimated percent change and 95% confidence intervals in respiratory mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day lag with varying degrees of freedom per year for seasonality control.

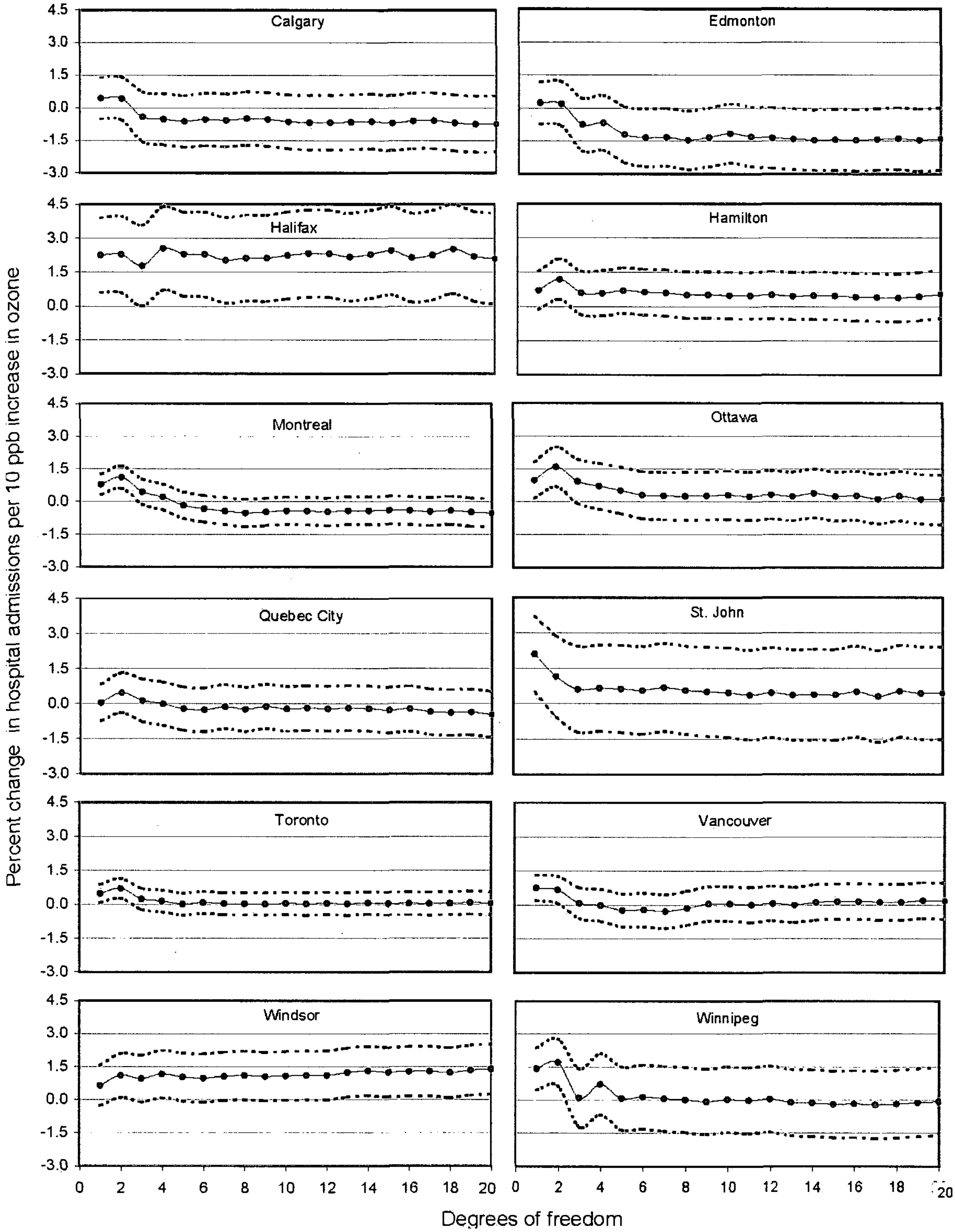

Figure 6 Estimated percent change and 95% confidence intervals in cardiovascular hospital admissions associated with a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day lag with varying degrees of freedom per year for seasonality control.

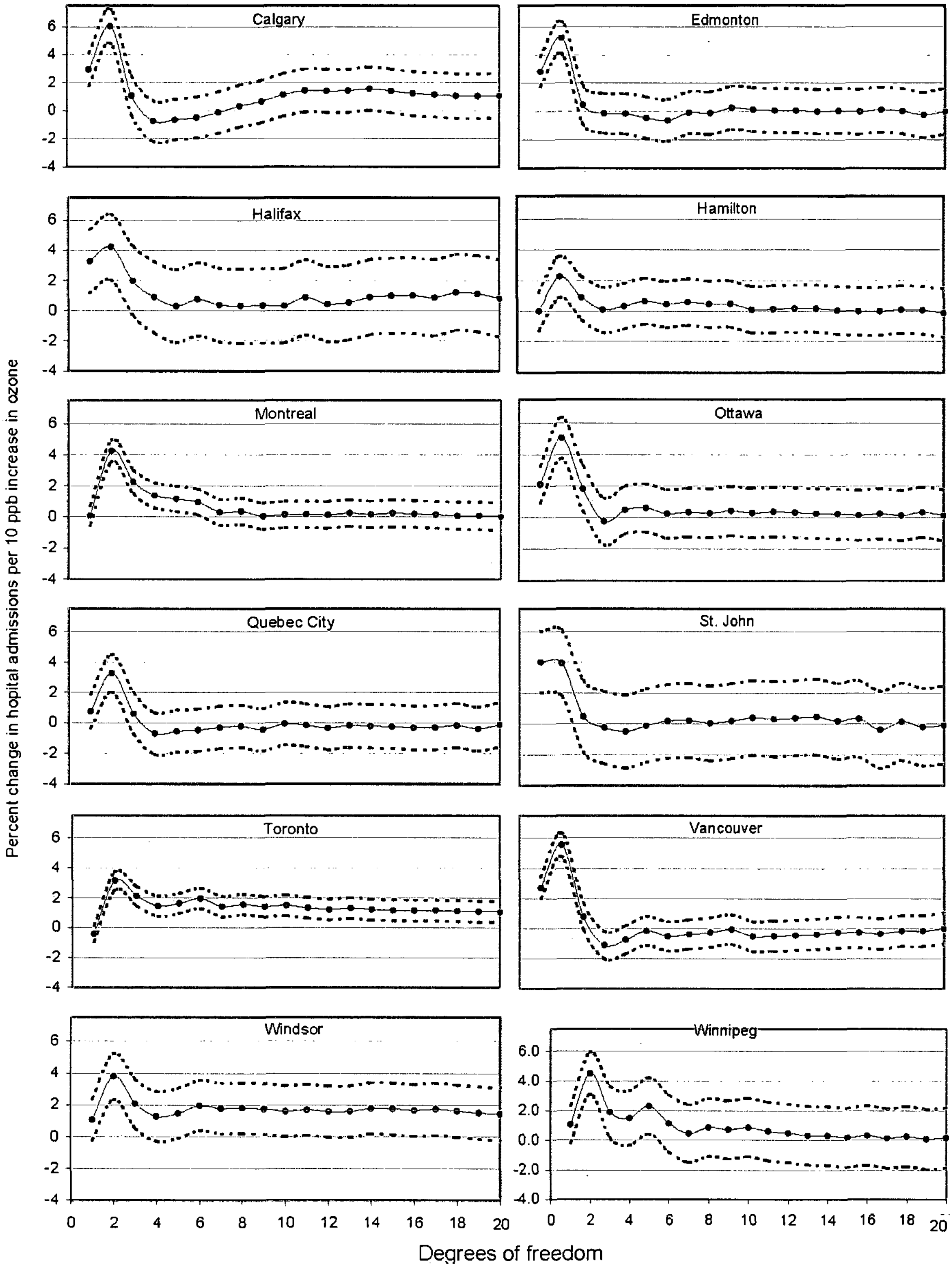

Figure 7. Estimated percent change and 95% confidence intervals in respiratory hospital admissions (all ages) associated with a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day with varying degrees of freedom per year for seasonality control.

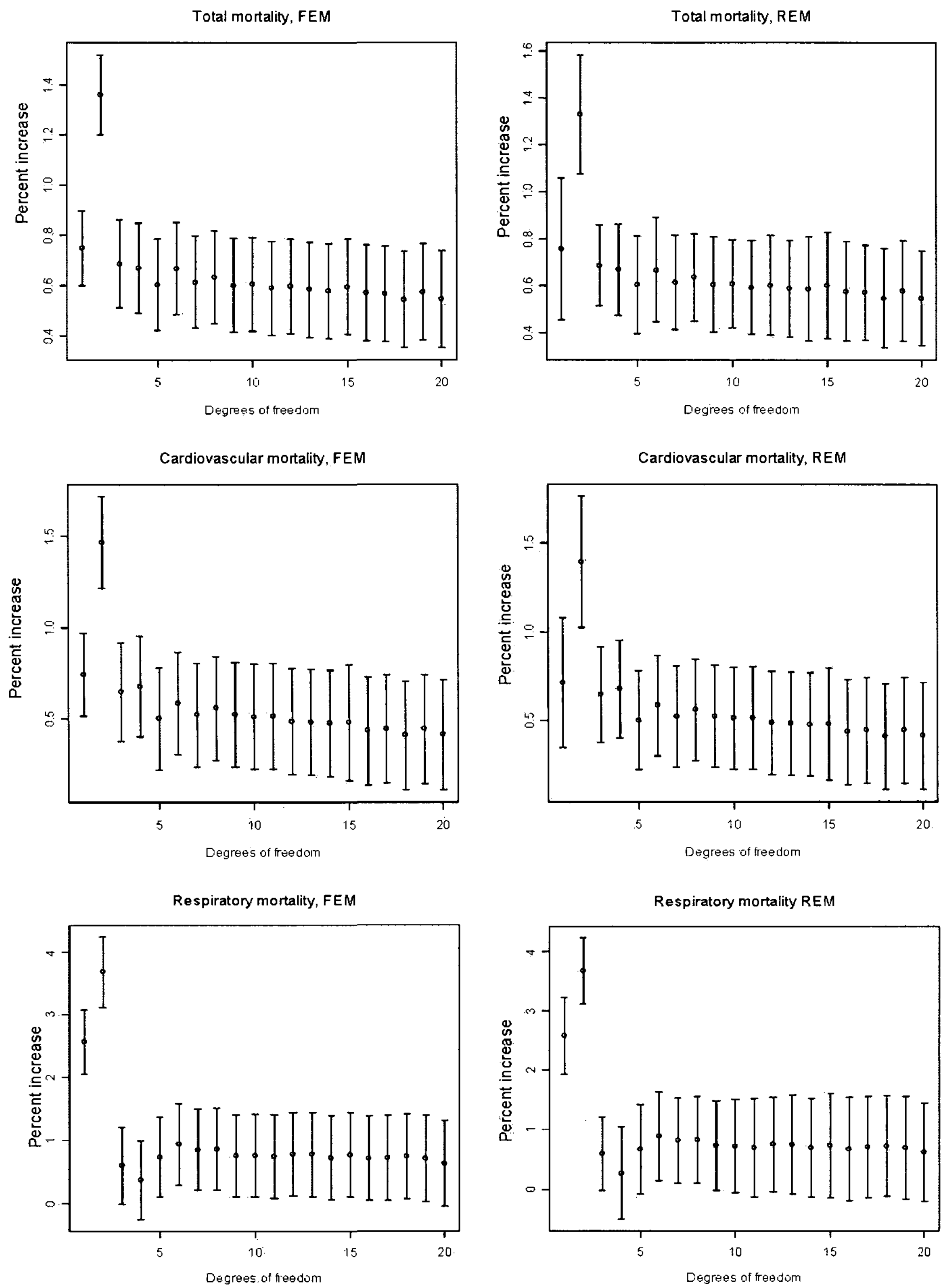

Figure 8 Pooled percent increase and the 95% confidence intervals for mortality outcomes for a 10 ppb increase in the 1-hour maximum ozone levels and a -day lag across the 12 Canadian cities with varying degrees of freedom per year for seasonality control. (FEM: fixed effects model; REM: random effects model).

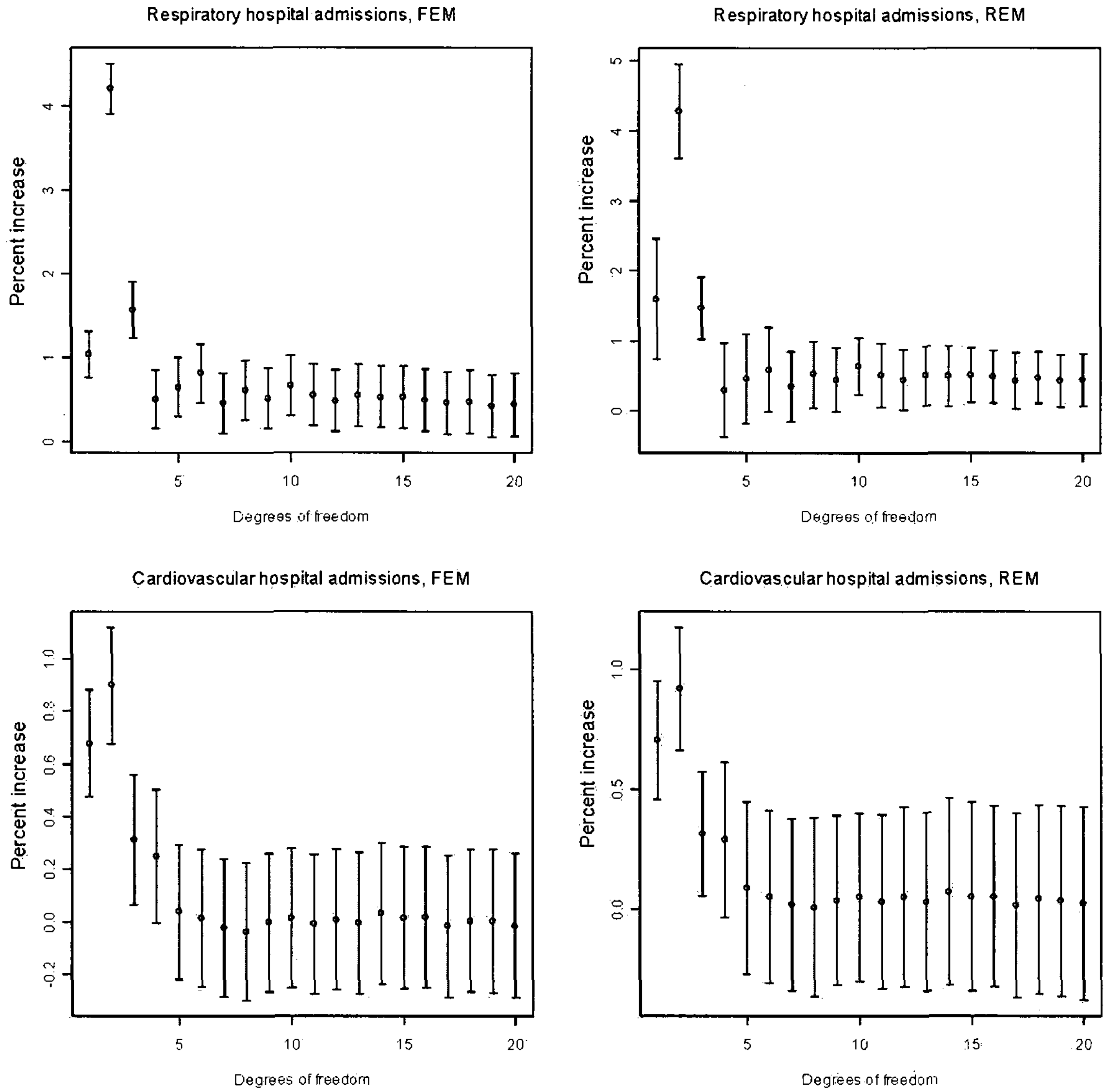

Figure 9 Pooled percent increase and the 95% confidence intervals for hospital admissions for a 10 ppb increase in the 1-hour maximum ozone levels and a 1-day lag across the 12 Canadian cities with varying degrees of freedom per year for seasonality. (FEM: fixed effects model; REM: random effects model).

4.2.2 Lag structures

The effect of changing the lag period between the day of exposure and the day of occurrence of the health outcome was examined by evaluating effects estimates at various lag structures. City-specific results (each evaluated at 4, 8 and 12 df per year) for all outcomes are shown in Figure 10-Figure 14. Results of distributed lag models gave similar point estimates as those from the 3-day average lag (lag02) models.

City-specific results for each outcome and lag structure are presented in Figure 10-Figure 14. Pooled results are provided in Figure 15. For mortality outcomes, higher estimates were observed for combined lag models relative to single day lags. Wider CI for respiratory mortality compared to other mortality outcomes were observed, a result of the low daily counts for this outcome. Respiratory hospital admissions effect estimates were somewhat higher than those for cardiovascular hospitalizations. Associations for cardiovascular hospital admissions were not sensitive to changing lag structures. Across all outcomes, there was low heterogeneity between city-specific results; hence, fixed effects and random effects models gave similar results.

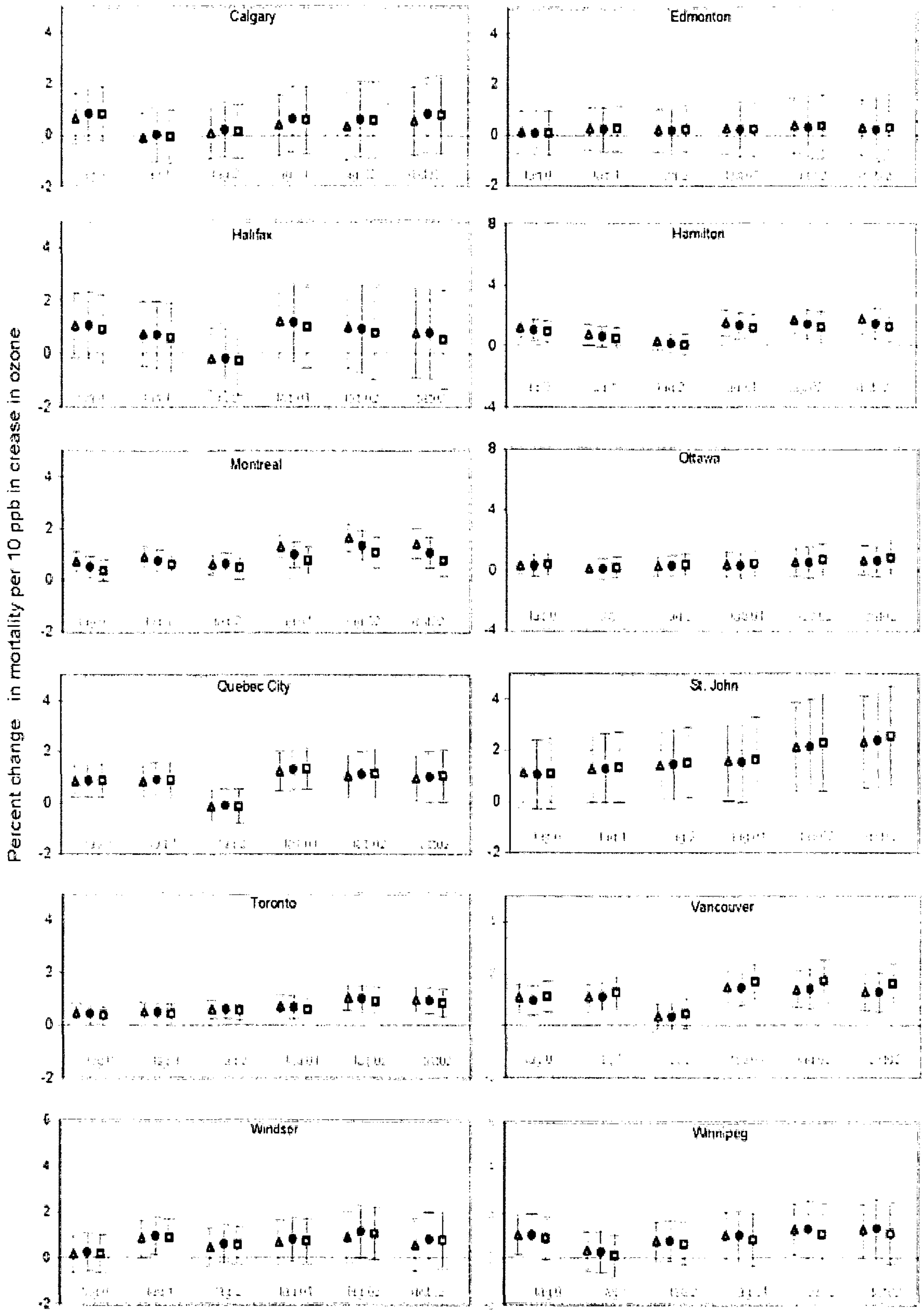

Figure 10 Estimated percent change and the 95% confidence intervals in total mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control (Δ 4 df; • 8 df; □ 12 df).

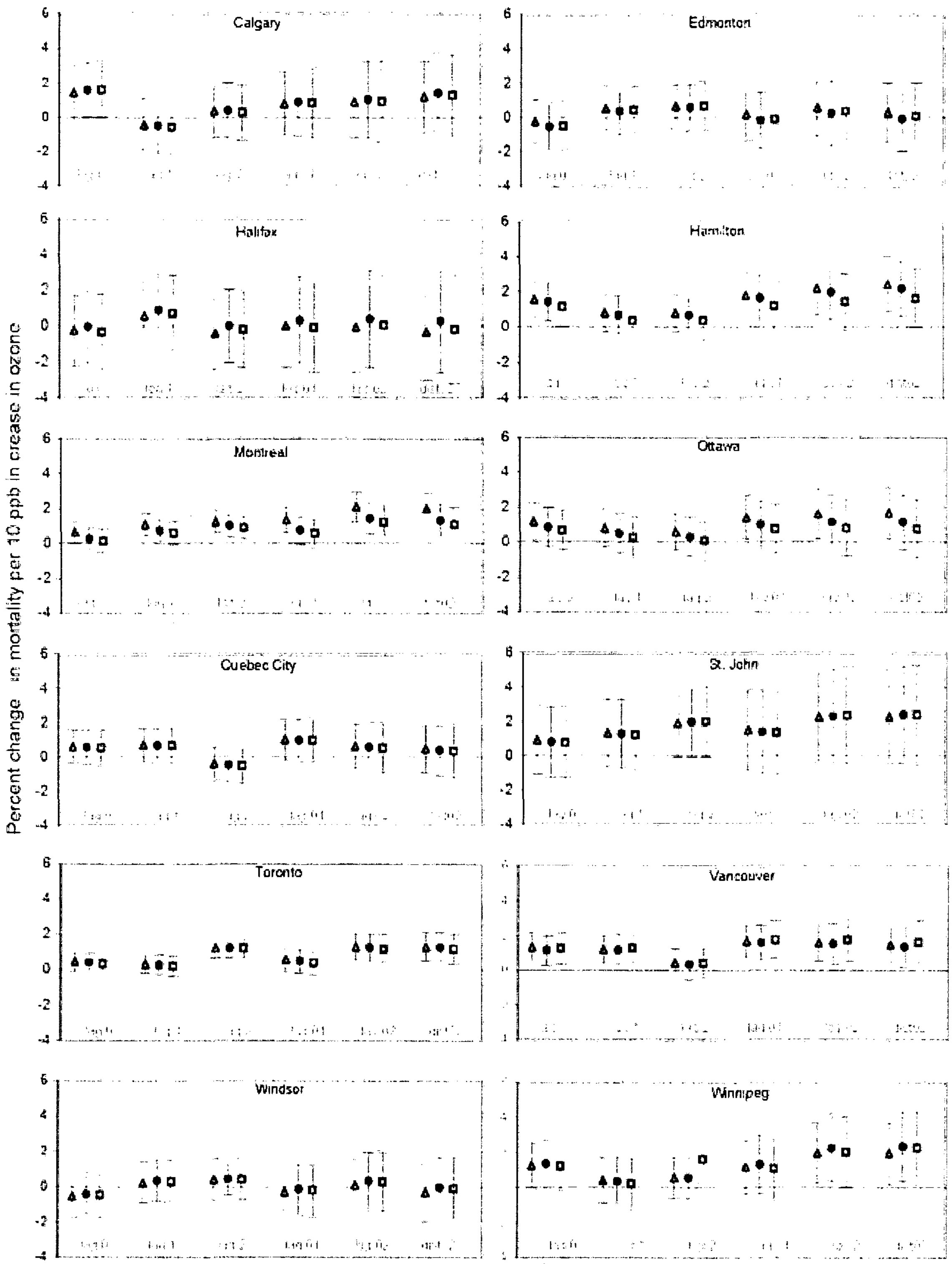

Figure 11 Estimated percent change and the 95% confidence intervals in cardiovascular mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control (Δ 4 df; • 8 df; □ 12 df).

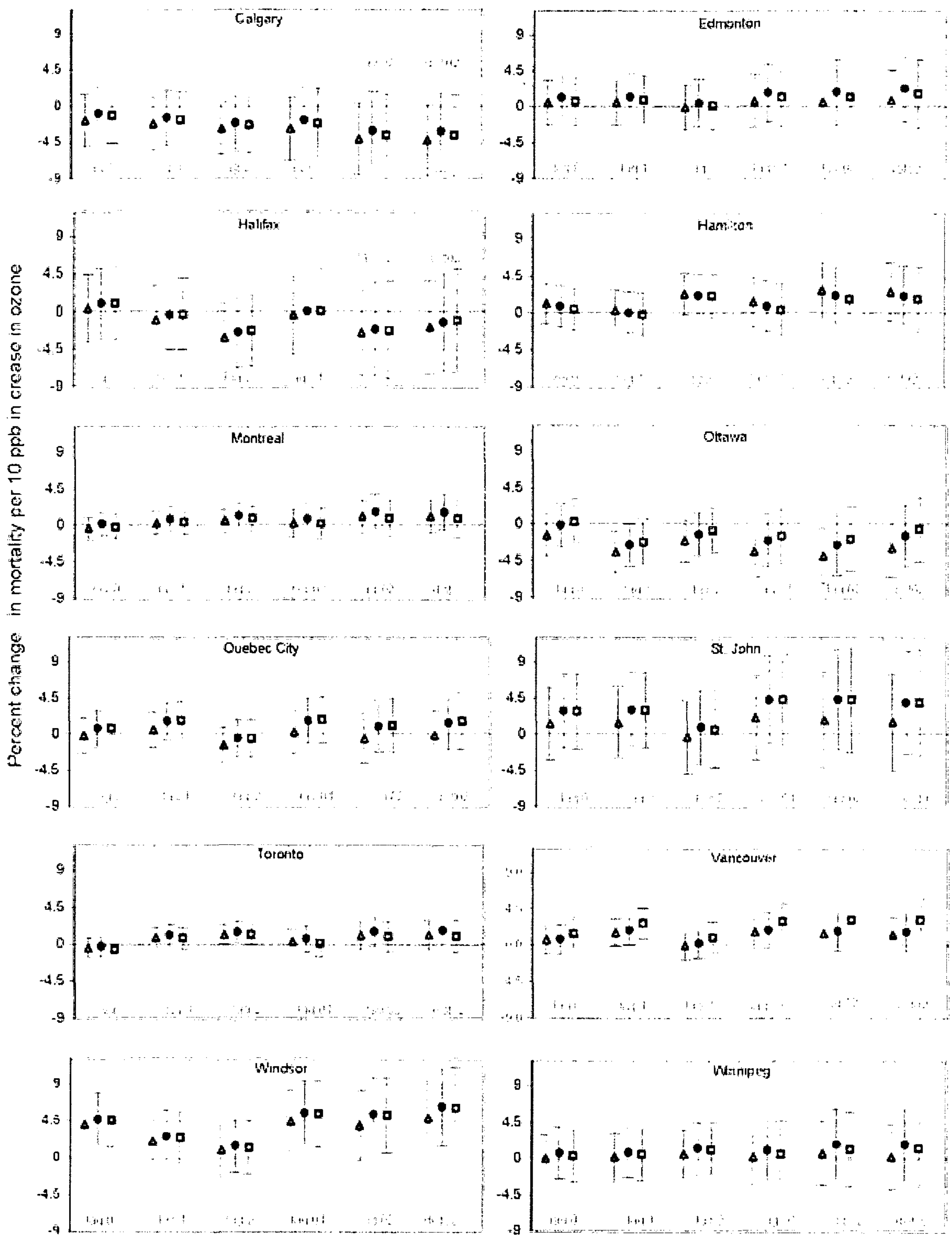

Figure 12 Estimated percent change and the 95% confidence intervals in respiratory mortality associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control (Δ 4 df; • 8 df; □ 12 df).

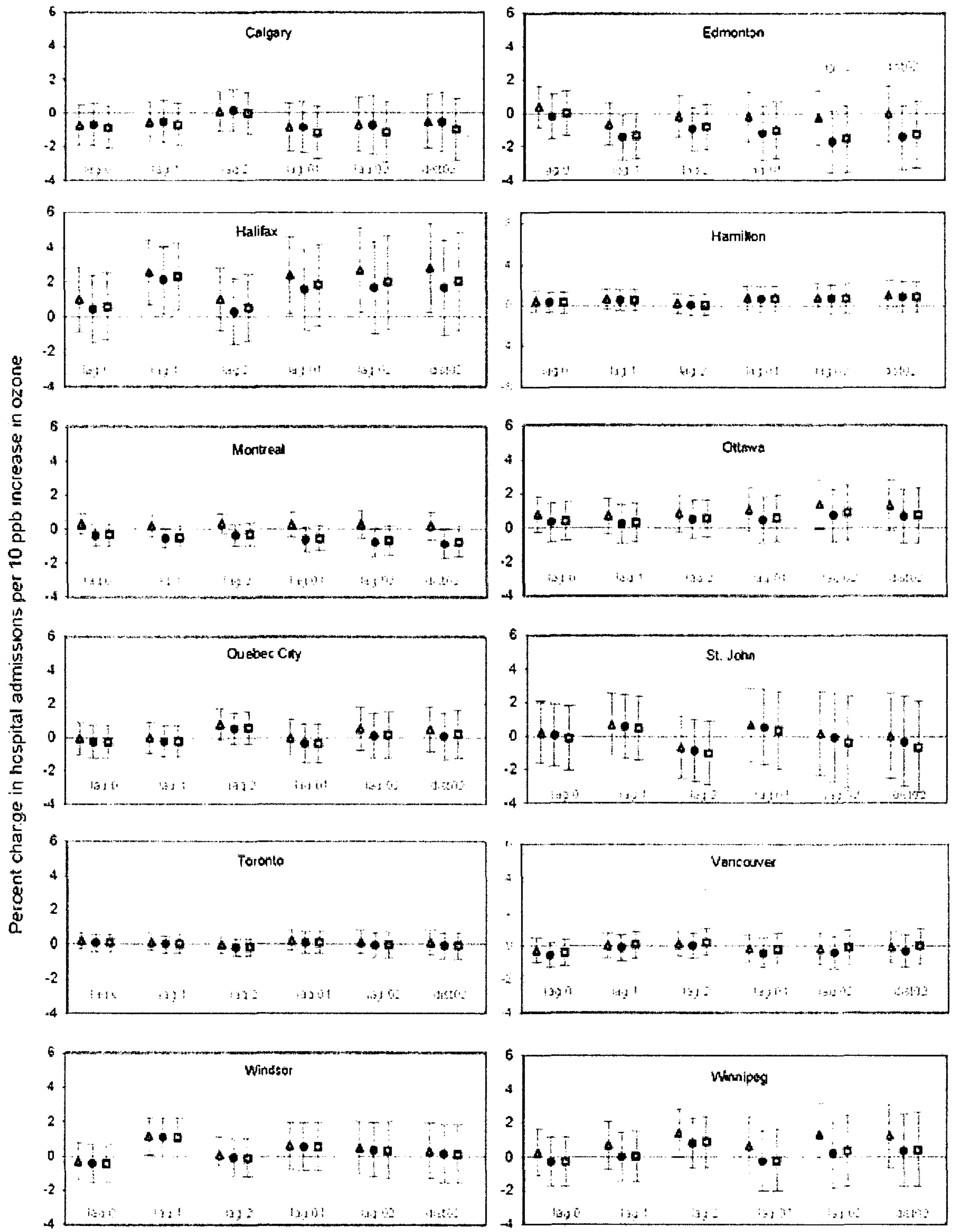

Figure 13 Estimated percent change and the 95% confidence intervals in cardiovascular hospital admissions associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control (Δ 4 df; • 8 df; □ 12 df).

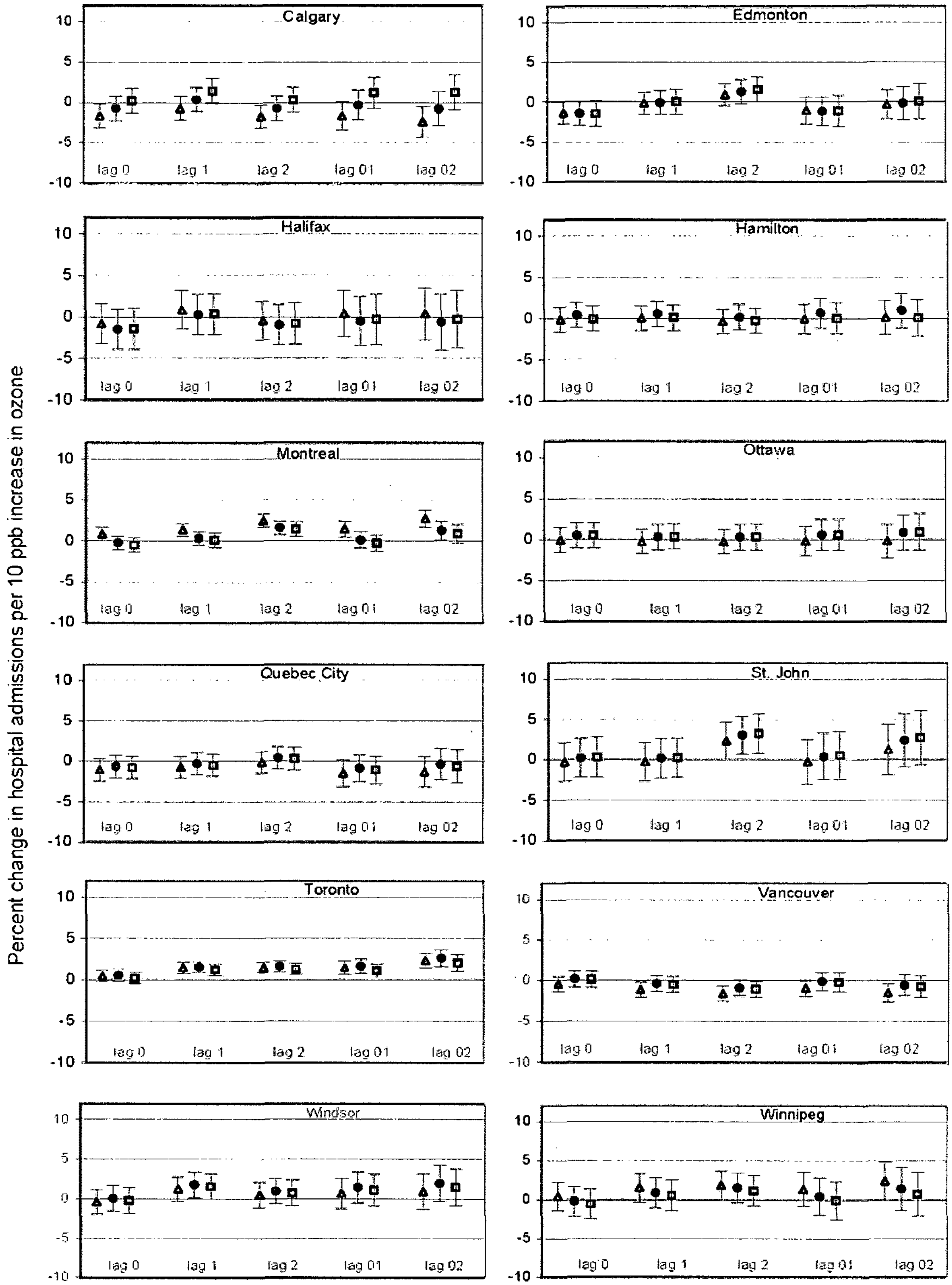

Figure 14 Estimated percent change and the 95% confidence intervals in respiratory hospital admissions associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control (Δ 4 df; • 8 df; □ 12 df).

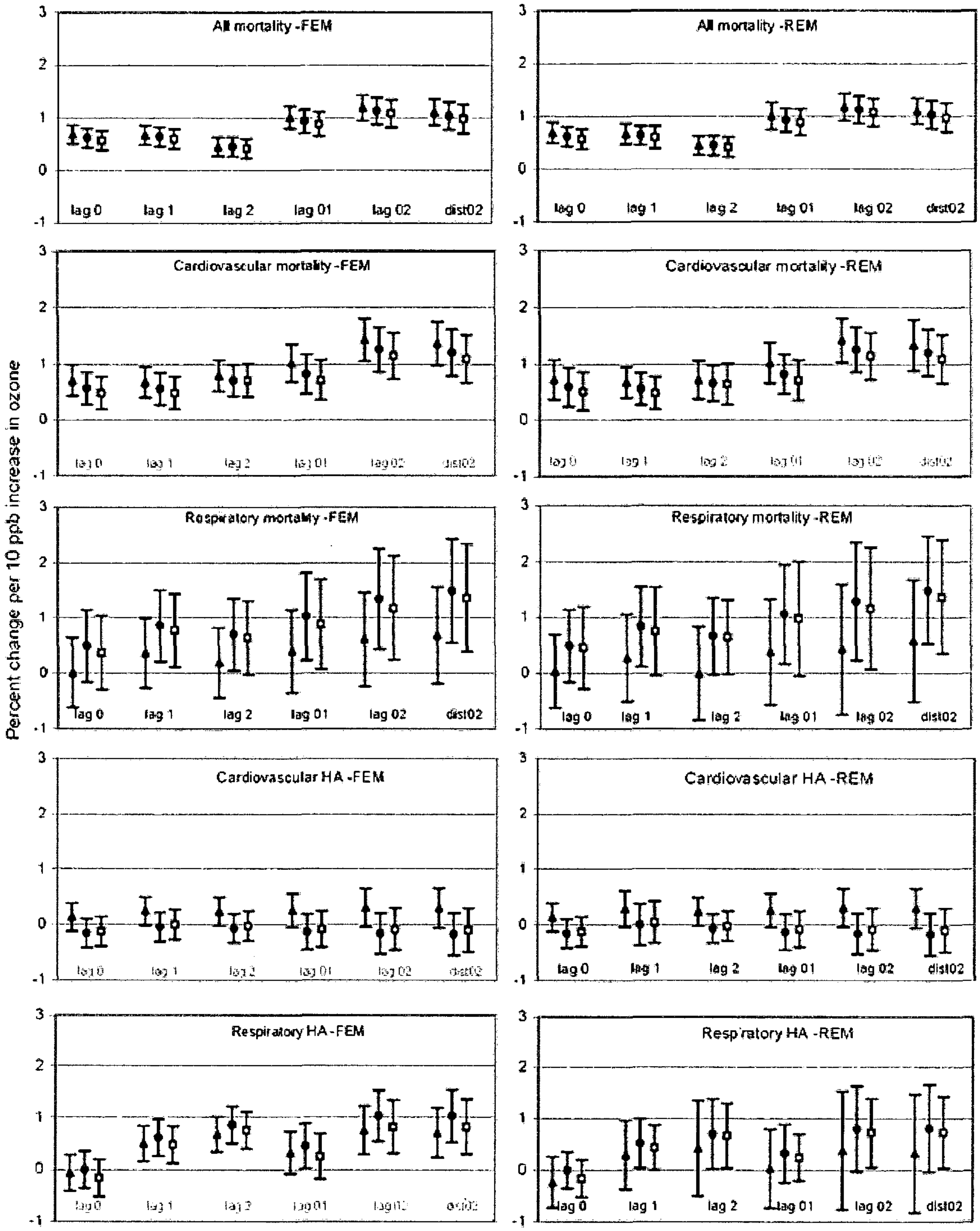

Figure 15 Pooled percent increase and the 95% confidence intervals for mortality and hospital admissions outcomes (all ages) associated with a 10 ppb increase in the 1-hour maximum ozone levels at various lag structures and degrees of freedom per year for seasonality control Δ 4 df; • 8 df; □ 12 df (FEM: fixed effects model; REM random effects model).

4.2.3 Ozone effect estimates

Pooled results for the three mortality outcomes associated with ozone at two lag structures and 3 values of degrees of freedom are provided in Figure 16. Significant effects were estimated for all mortality outcomes at lag02 for all ages (except respiratory mortality for ≥75 years). For total and cardiovascular mortality, positive and significant effects were evaluated across all ages groups (except cardiovascular mortality for <75 years). Effect estimates were generally stronger among the elderly. However, respiratory mortality estimates were stronger for the <75 age compared to the ≥75 group, contrary to what would be expected. In comparison with other outcomes considered, the CIs around the effect estimates for respiratory outcomes were much wider due to the low numbers of daily deaths.

Figure 17 shows the combined results for hospital admissions for ages 65 and over. There does not seem to be an association between cardiovascular hospital admissions and ozone levels. Positive and significant results were obtained for respiratory hospital admissions for lag1 and lag02 models. There was considerable heterogeneity detected between cities for respiratory hospital admissions for lag02, which resulted in wider confidence intervals in the effects estimated by the random effects models.

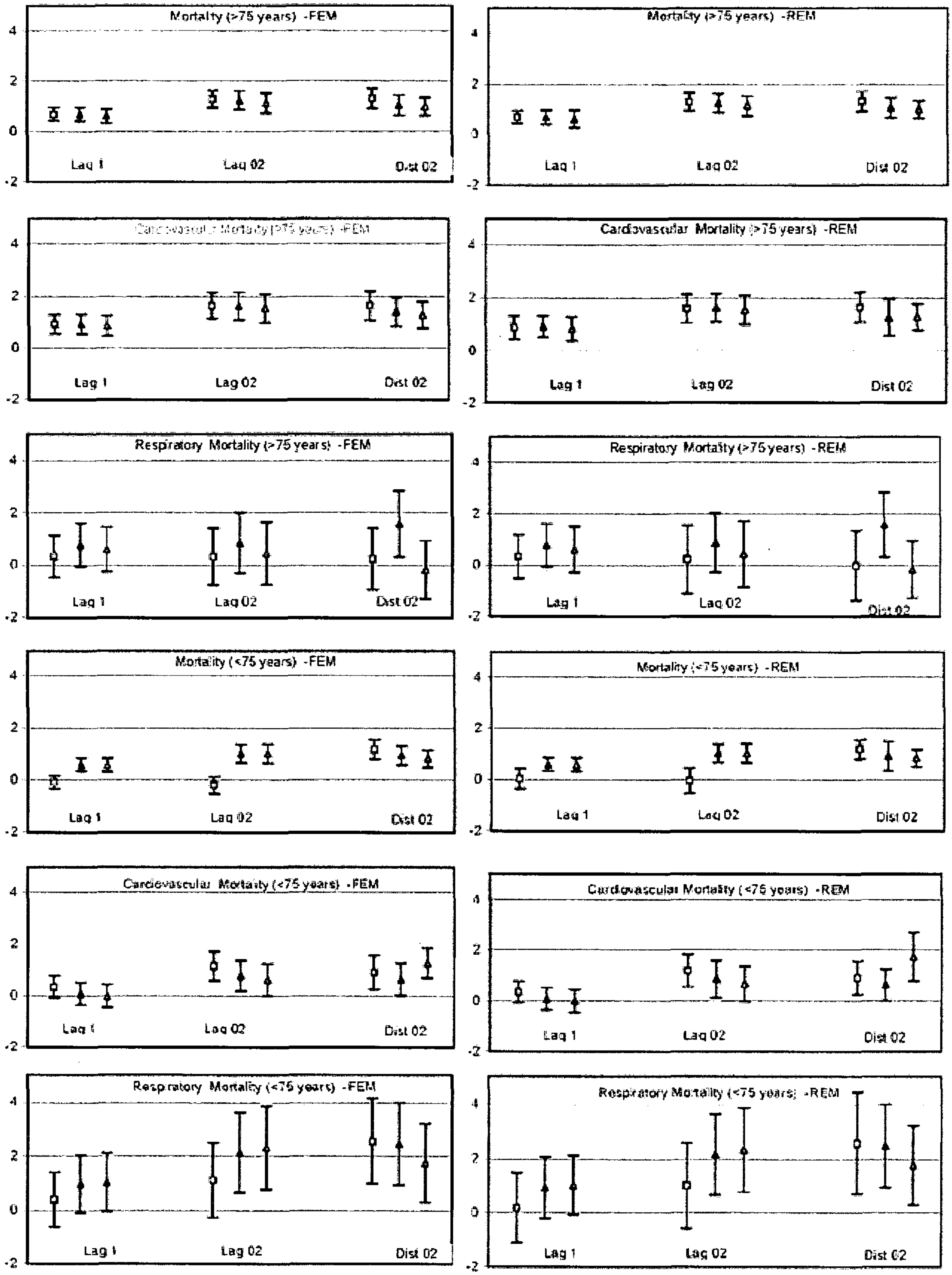

Figure 16 Pooled percent increase and the 95% confidence intervals for mortality outcomes (75 and over, less than 75) associated with a 10 ppb increase in ozone for various lag periods and degrees of freedom per year for seasonality control Δ 4 df; • 8 df; □ 12 df. (FEM: fixed effects model; REM: random effects model).

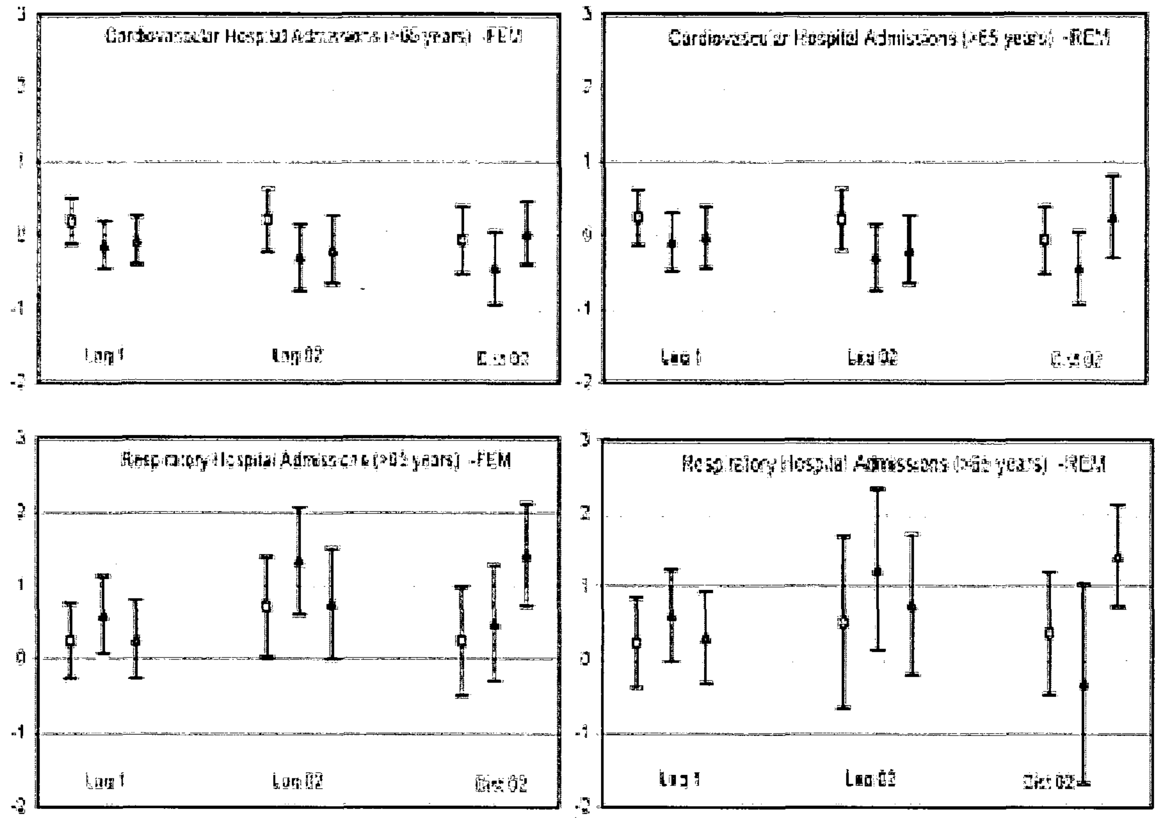

Figure 17 Pooled percent increase and the 95% confidence intervals for hospital admissions (65 and over) associated with a 10 ppb increase in ozone across the 12 Canadian cities at different lag periods and degrees of freedom per year for seasonality control Δ 4 df; • 8 df; □ 12 df. (FEM: fixed effects model; REM: random effects model).

4.2.4 *$PM_{2.5}$ effect estimates*

For $PM_{2.5}$ as an exposure pollutant, three lag structures were evaluated with exposure on the same day (lag0), the previous day (lag1) and 2 days prior (lag2). These lags were selected because average and distributed lags could not be applied to $PM_{2.5}$ due to unavailability of daily data. Pooled results across cities for mortality and hospital admission outcomes evaluated for each age group are presented in Figure 18 and Figure 19. Effects represent the percent increase in the outcome associated with a 10μg/m³ increase in the 24-hour average $PM_{2.5}$ levels.

A common trend observed across all mortality outcomes and two age groups (all ages and over 75) was that the effect of $PM_{2.5}$ seems to have a delayed effect with estimates being higher at 1 and 2 day lags. Results were also stable across the various df allowed per year for seasonality control.

Effects for mortality on the same day of exposure (lag0) were not statistically significant. Positive and significant effects were seen for total and cardiovascular mortality in 1- and 2-day lag models. Respiratory mortality effects were only significant at 2-day lag and among the elderly. Effects were consistently higher for older age groups.

As with ozone, respiratory hospital admissions seem to be more highly associated with $PM_{2.5}$ than cardiovascular hospital admission were, where positive and significant associations were seen with the 1- and 2-day lag models. Greater effects were observed for those older than 75. Cardiovascular hospital admissions results showed little variability with lag periods

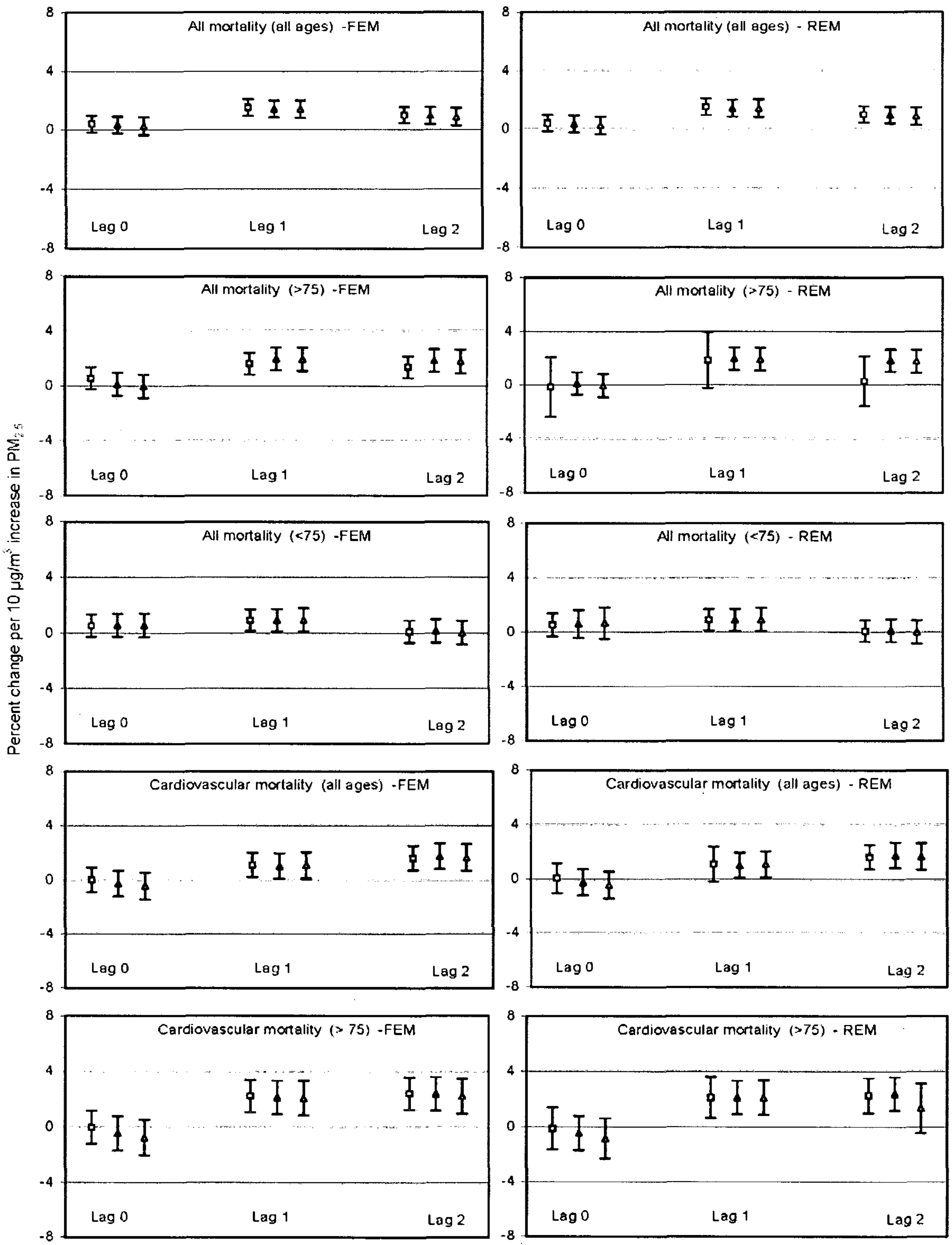

Figure 18 Pooled percent increase and the 95% confidence intervals for mortality outcomes across three age groups associated with a 10 µg/m^3 increase in $PM_{2.5}$ at various lag periods and degrees of freedom per year for seasonality (Δ 4 df; • 8 df; □ 12 df). (FEM: fixed effects model; REM: random effects model).

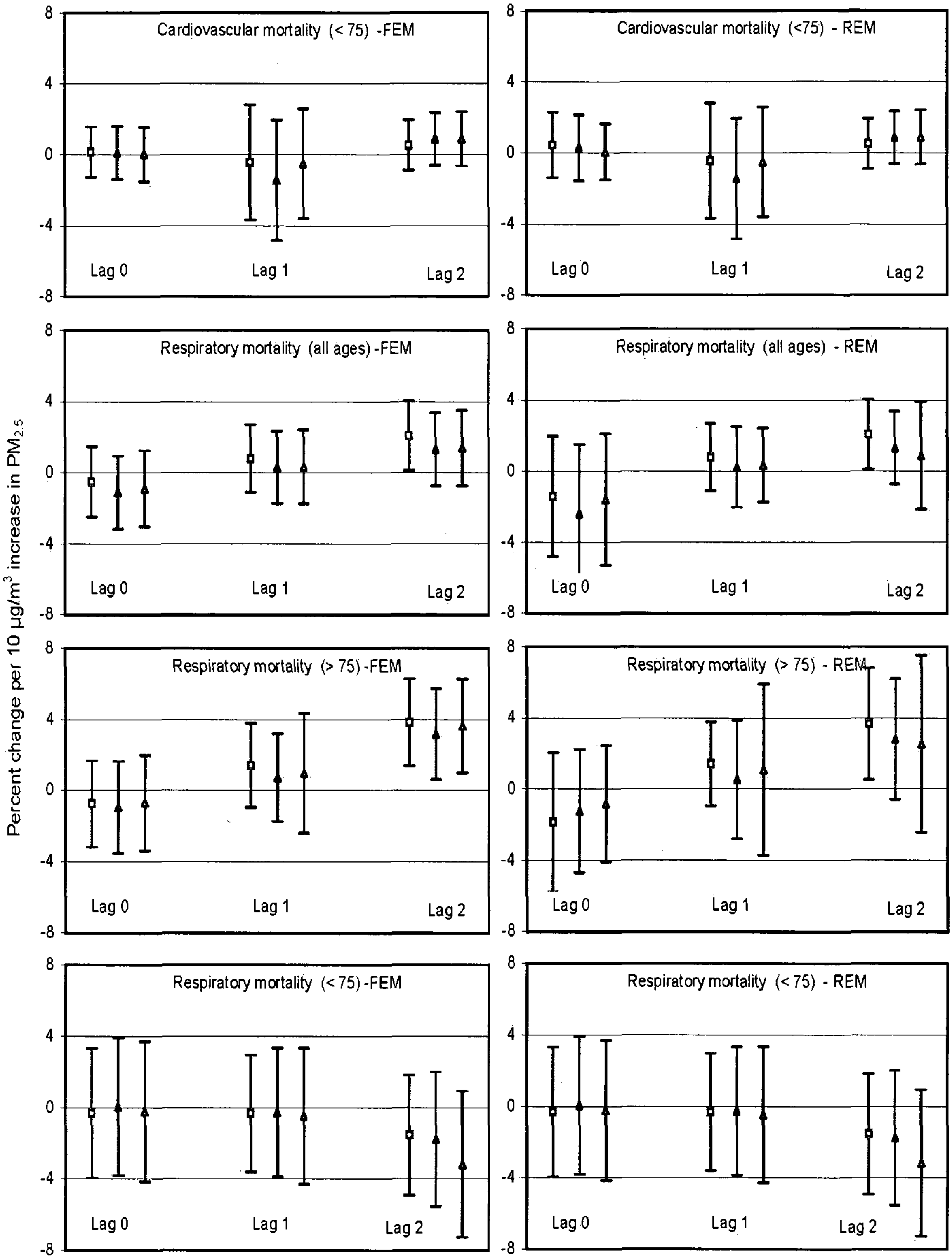

Figure 18 Pooled percent increase and the 95% confidence intervals for mortality ages for all three age groups associated with a 10 µg/m^3 increase in $PM_{2.5}$ at various lag periods and degrees of freedom per year for seasonality (Δ 4 df; • 8 df; □ 12 df). (FEM: fixed effects model; REM: random effects model) (cont'd...)

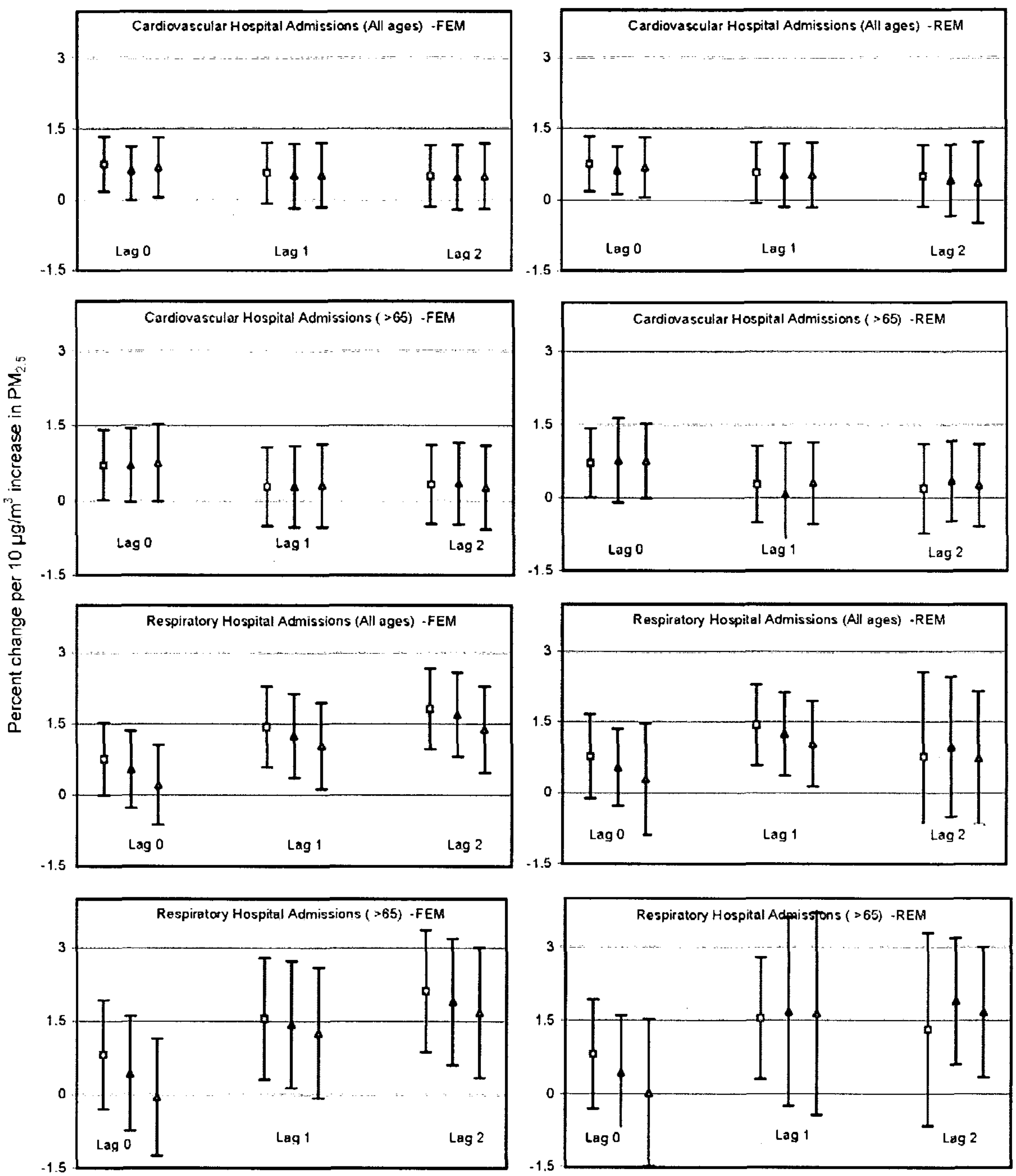

Figure 19 Pooled percent increase and the 95% confidence intervals for hospital admissions for two age groups associated with a 10 µg/m^{3}increase in $PM_{2.5}$ at various lag periods and degrees of freedom per year for seasonality (Δ 4 df; • 8 df; □ 12 df). (FEM: fixed effects model; REM: random effects model).

4.2.5 Summary of effect estimates

Quantitative summary results from the preceding analyses pooled across cities for outcomes associated with ozone and $PM_{2.5}$ are presented in Table 12 and Table 13, respectively. These results were pooled using the fixed effects approach and the city-specific estimates correspond to models utilizing 8 degrees of freedom for seasonality control. Detailed results of the effect estimates (percent change in outcome *($\beta x1000$)*) and the 95% confidence intervals used to prepare the previous graphs can be found in Appendix C.

Table 12 Pooled effect estimates associated with an increase of 10 ppb in the 1-hr maximum ozone concentrations. Results are from fixed effects models with 8 df allowed for seasonality control.

Outcome/Age group	Percent increase (95% CI)					
	lag1		lag02		dist02	
All mortality						
All ages	0.64	(0.45-0.82)	1.12	(0.87-1.38)	1.03	(0.77-1.30)
under 75	0.59	(0.33-0.84)	1.01	(0.66-1.36)	0.95	(0.59-1.31)
75 and over	0.69	(0.42-0.96)	1.25	(0.87-1.62)	1.05	(0.66-1.45)
CVD mortality						
All ages	0.56	(0.27-0.84)	1.25	(0.85-1.65)	1.20	(0.79-1.61)
under 75	0.07	(-0.36-0.51)	0.76	(0.16-1.37)	1.63	(0.01-1.25)
75 and over	0.93	(0.55-1.31)	1.62	(1.09-2.15)	1.40	(0.84-1.96)
Resp mortality						
All ages	0.86	(0.21-1.51)	1.34	(0.44-2.25)	1.49	(0.55- 2.43)
under 75	0.98	(-0.08-2.04)	2.14	(0.67-3.62)	2.47	(0.95-3.98)
75 and over	0.79	(-0.04-1.62)	0.86	(-0.29-2.01)	1.58	(0.33-2.84)
CVD hospital admissions						
All ages	-0.04	(-0.30-0.22)	-0.16	(-0.52-0.21)	-0.17	(-0.55-0.21)
65 and over	-0.13	(-0.45-0.19)	-0.29	(-0.74-0.15)	-0.44	(-0.94- 0.06)
Resp hospital admissions						
All ages	0.61	(0.26-0.97)	1.03	(0.54-1.53)	1.03	(0.53-1.54)
65 and over	0.61	(0.09-1.13)	1.34	(0.62-2.07)	0.50	(-0.29-1.29)

Table 13 Pooled effect estimates associated with an increase of 10 μg/m^3 in the 24-hr average $PM_{2.5}$ concentrations. Results are from fixed effects models with 8 df allowed for seasonality control.

Outcome/Age group	Percent increase (95% CI)					
	lag0		lag1		lag2	
All mortality						
All ages	0.35	(-0.23-5.94)	1.43	(0.84-2.31)	0.98	(0.39-1.57)
under 75	0.57	(-0.26-1.39)	0.91	(0.08-1.73)	0.14	(-0.68-4.97)
75 and over	0.12	(-0.72-5.96)	1.98	(1.14-2.81)	1.85	(1.01-2.68)
Cardiovascular mortality						
All ages	-0.23	(-1.18-0.72)	1.03	(0.09-1.97)	1.77	(0.83-2.71)
under 75	0.11	(-1.37-1.68)	-1.44	(-4.84-1.96)	0.88	(-0.61-2.36)
75 and over	-0.45	(-1.68-0.78)	2.14	(0.92-3.35)	2.39	(1.17-3.61)
Respiratory mortality						
All ages	-1.12	(-3.19-1.95)	0.30	(-1.72-2.33)	1.31	(-0.75-3.36)
under 75	0.04	(-3.80-3.99)	-0.27	(-3.87-3.33)	-1.77	(-5.53-2.88)
75 and over	-0.95	(-3.54-1.64)	0.73	(-1.74-3.21)	3.17	(0.61-5.72)
Cardiovascular HA						
All ages	0.63	(0.13-1.13)	0.52	(-0.15-1.18)	0.48	(-0.19-1.16)
65 and over	0.71	(-0.03-1.45)	0.28	(-0.53-1.15)	0.34	(-0.48-1.16)
Respiratory HA						
All ages	0.54	(-0.27-1.36)	1.25	(0.36-2.13)	1.69	(0.81-2.57)
65 and over	0.43	(-0.73-1.69)	1.43	(0.14-2.73)	1.90	(0.60-3.19)

4.2.6 Two pollutant models

Two pollutant models that control for either ozone or $PM_{2.5}$ were applied for all outcomes and age groups using the previous day's pollutant levels (lag1) and 8 df per year for seasonality control. City-specific results for mortality and hospital admissions are presented in Figure 20-Figure 22 and Figure 23- Figure 24, respectively. Pooled results are provided in Figure 25 and Figure 26 along with results from single pollutant models for comparison. Several effect estimates for St John (Figure 21) and other cities (Figure 22) are missing because the corresponding city-specific models failed to converge with the data available. The estimates obtained from these models could not be considered accurate and were not included in the combined estimates.

In general, effects for $PM_{2.5}$ were robust to ozone adjustment, although they were slightly reduced across all age groups and outcomes (except for cardiovascular mortality (<75 age group). However, when ozone estimates were controlled for $PM_{2.5}$, effects were not always reduced (Table 14). In fact, effect estimates sometimes increased significantly. The magnitude of the increase in ozone effects when going from one to two pollutant models varied from 43% (respiratory hospital admissions) to 525% (cardiovascular hospital admission).

Effect estimates for ozone in single pollutant models were much narrower compared to those from two pollutant models (Figure 20-Figure 26). This was a result of the difference in amount of data available for $PM_{2.5}$ and ozone. As mentioned before, single pollutant ozone models had daily data over the full time-period. In the two-pollutant models, however, the data for both pollutants was limited to the days where $PM_{2.5}$ data was available (every 6^{th} day) and for shorter time periods. The loss of a substantial amount of data when fitting the two pollutant models was presumed to have led to the relatively wide CI around ozone estimates.

To confirm whether this was the reason for the variation in confidence intervals' sizes, single pollutant models for ozone were repeated using data available only on days with $PM_{2.5}$ data. An example of the results is shown in Figure A-1 in Appendix A. As expected, the CI intervals around the ozone estimates in both models were similar in size.

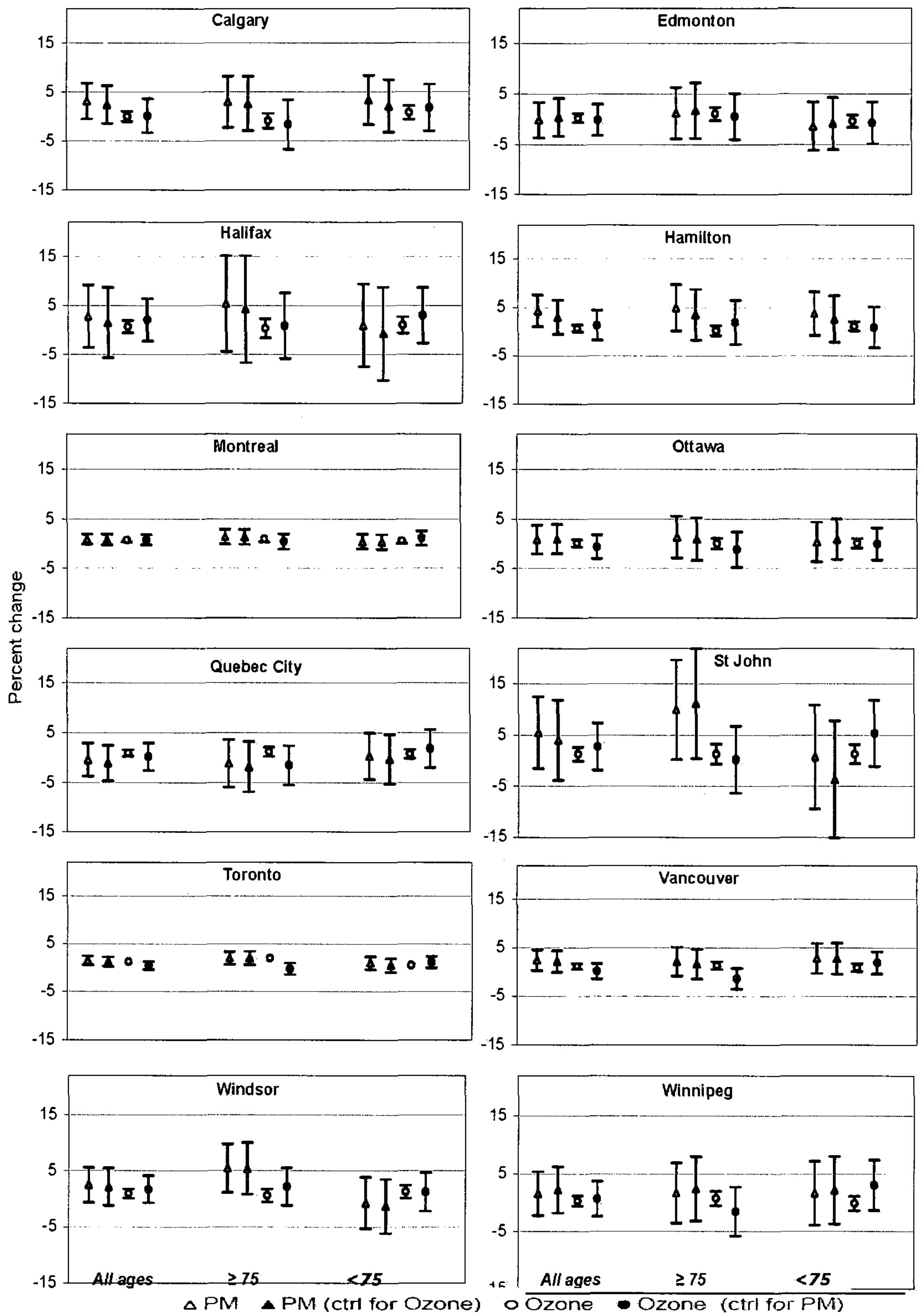

Figure 20 Estimated percent change and the 95% confidence intervals for total mortality in single and two pollutant models for three age groups associated with a 10 ppb increase in ozone levels and 10 $\mu g/m^3$ increase $PM_{2.5}$ levels. Effect estimates were evaluated at a 1-day lag and 8 df per year for time.

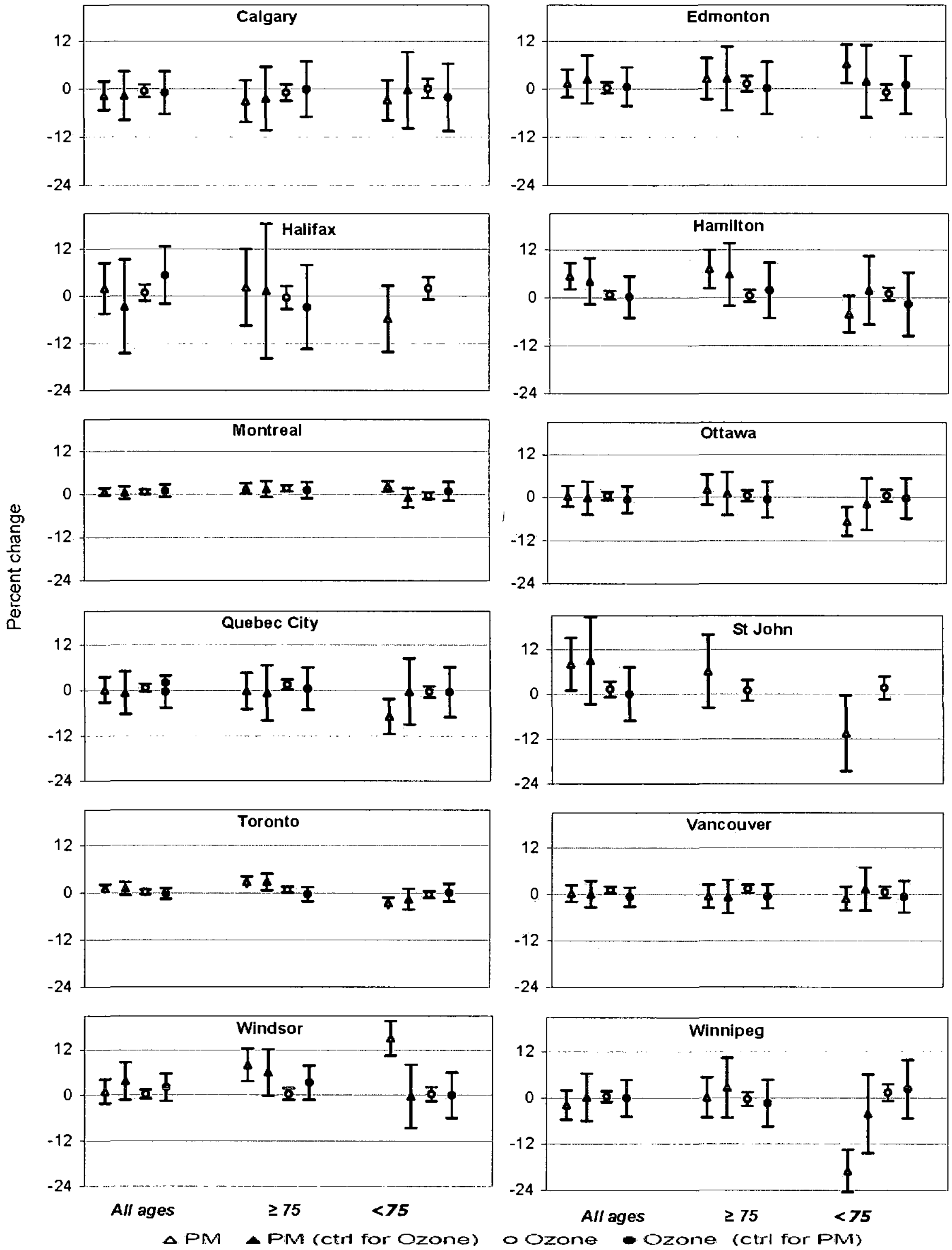

Figure 21 Estimated percent change and the 95% confidence intervals for cardiovascular mortality in single and two pollutant models for three age groups associated with a 10 ppb increase in ozone levels and 10 μg/m^3 increase in $PM_{2.5}$ levels. Effect estimates were evaluated at a 1-day lag and 8 df per year for time.

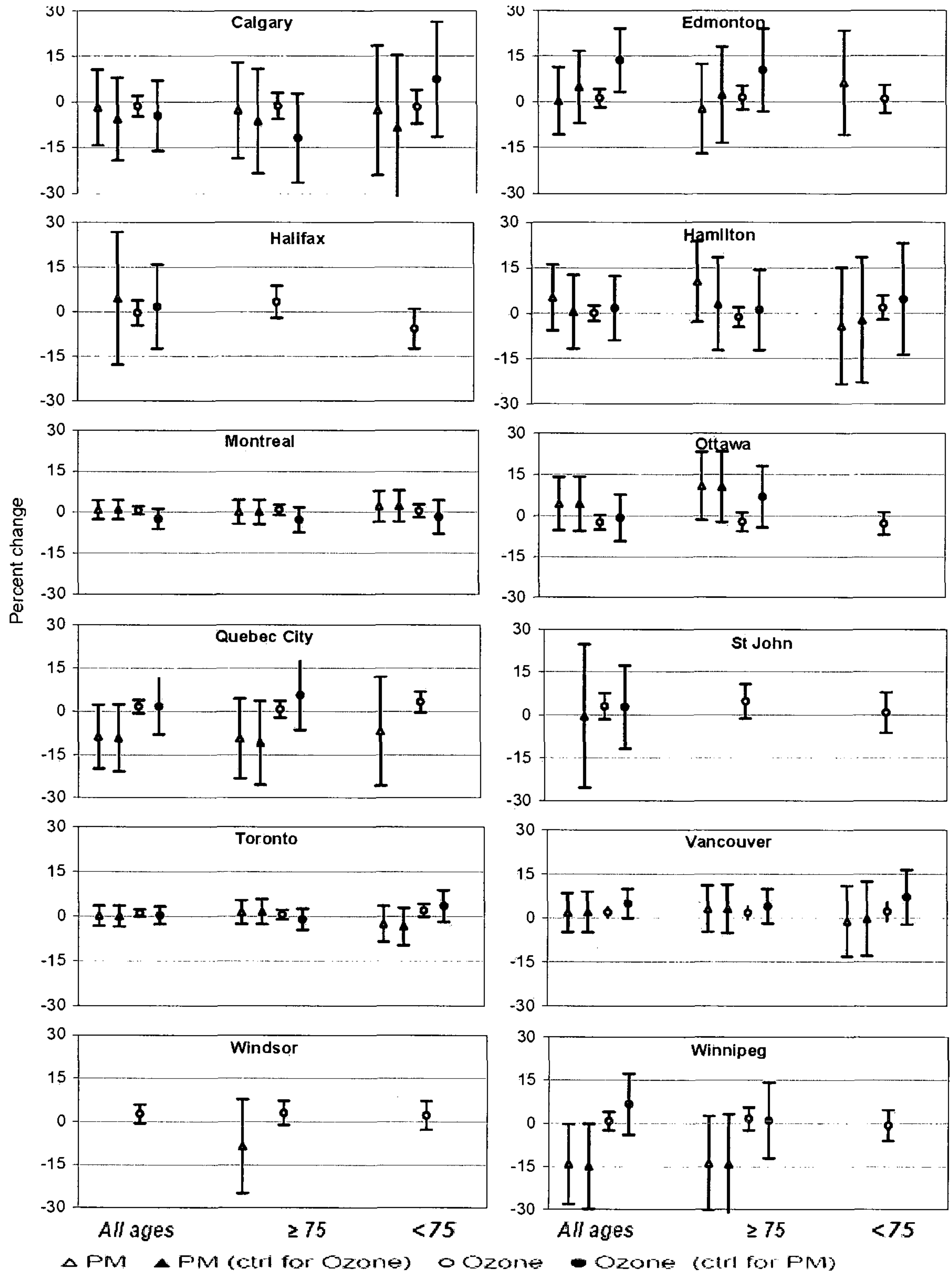

Figure 22 Estimated percent change and the 95% confidence intervals for respiratory mortality in single and two pollutant models associated with a 10 ppb increase in ozone levels and 10 $\mu g/m^3$ increase $PM_{2.5}$ levels. Effect estimates were evaluated at a 1-day lag and 8 df per year for time. Cities with missing correspond to models that did not converge.

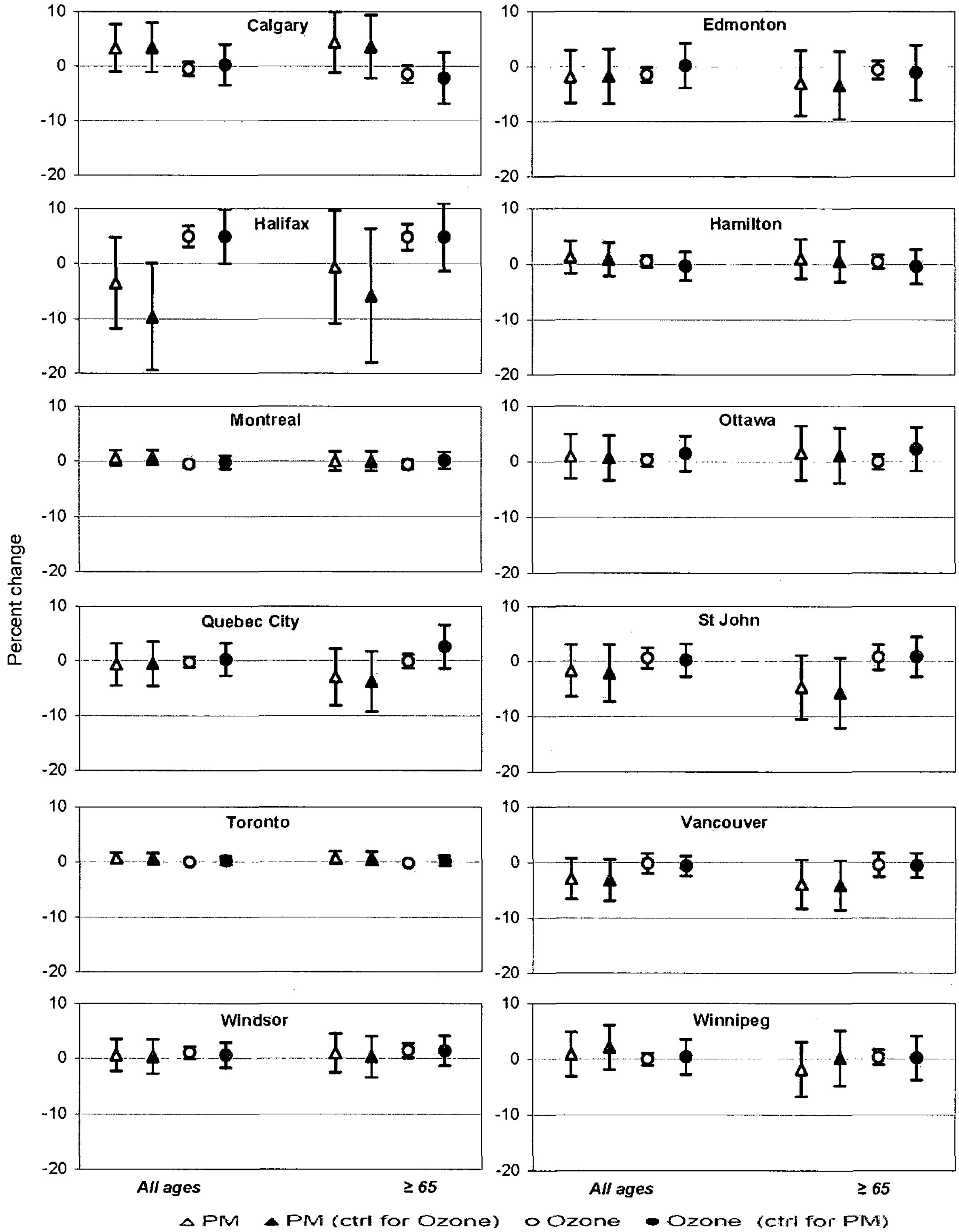

Figure 23 Estimated percent change and the 95% confidence intervals for cardiovascular hospital admissions in single and two pollutant models associated with a 10 ppb increase in ozone levels and 10 μg/m^3 increase $PM_{2.5}$ levels. Effect estimates were evaluated at a 1-day lag and 8 df per year for time.

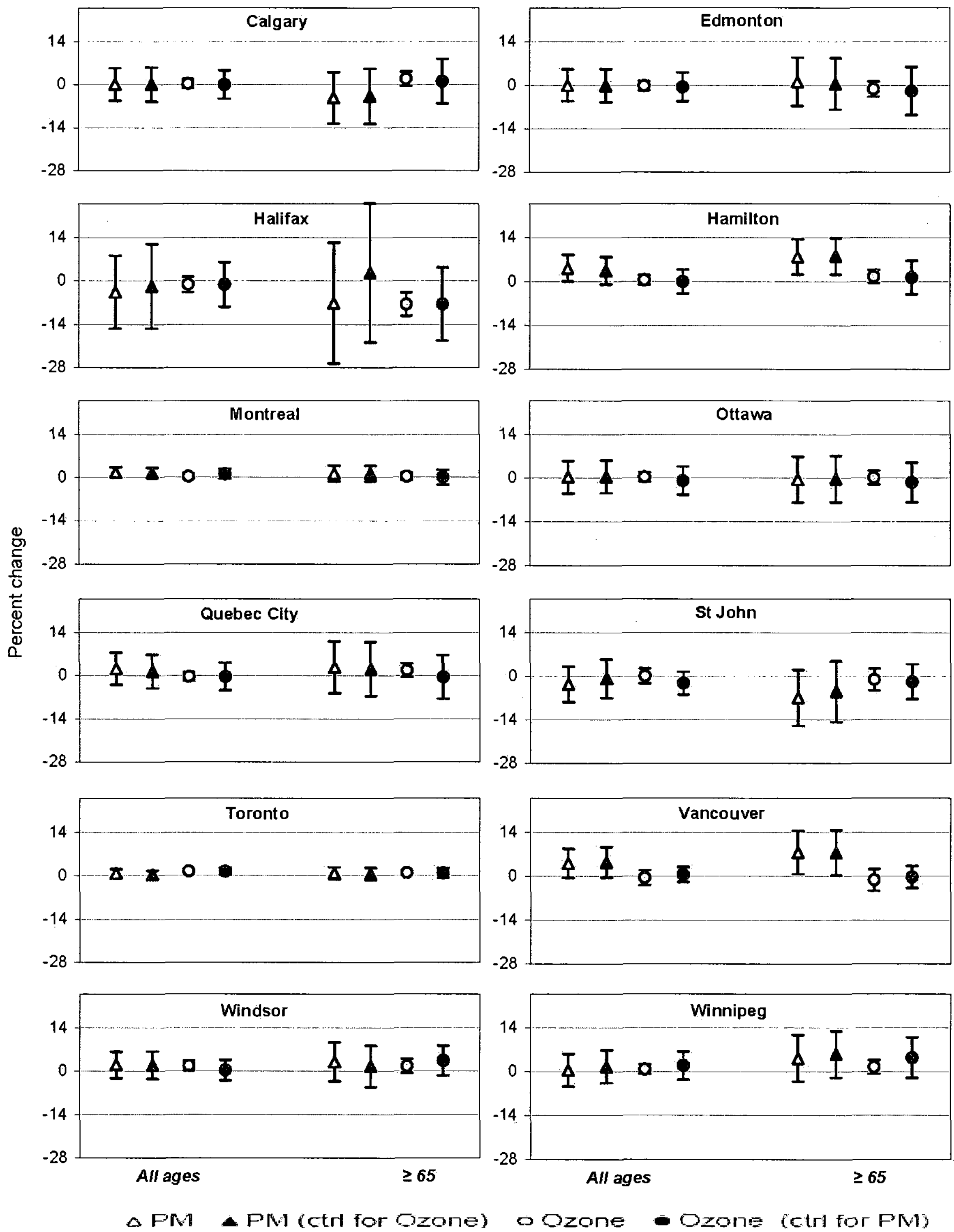

Figure 24 Estimated percent change and the 95% confidence intervals for respiratory hospital admissions in single and two pollutant models associated with a 10 ppb increase in ozone levels and 10 μg/m^3 increase $PM_{2.5}$ levels. Effect estimates were evaluated at a 1-day lag and 8 df per year for time.

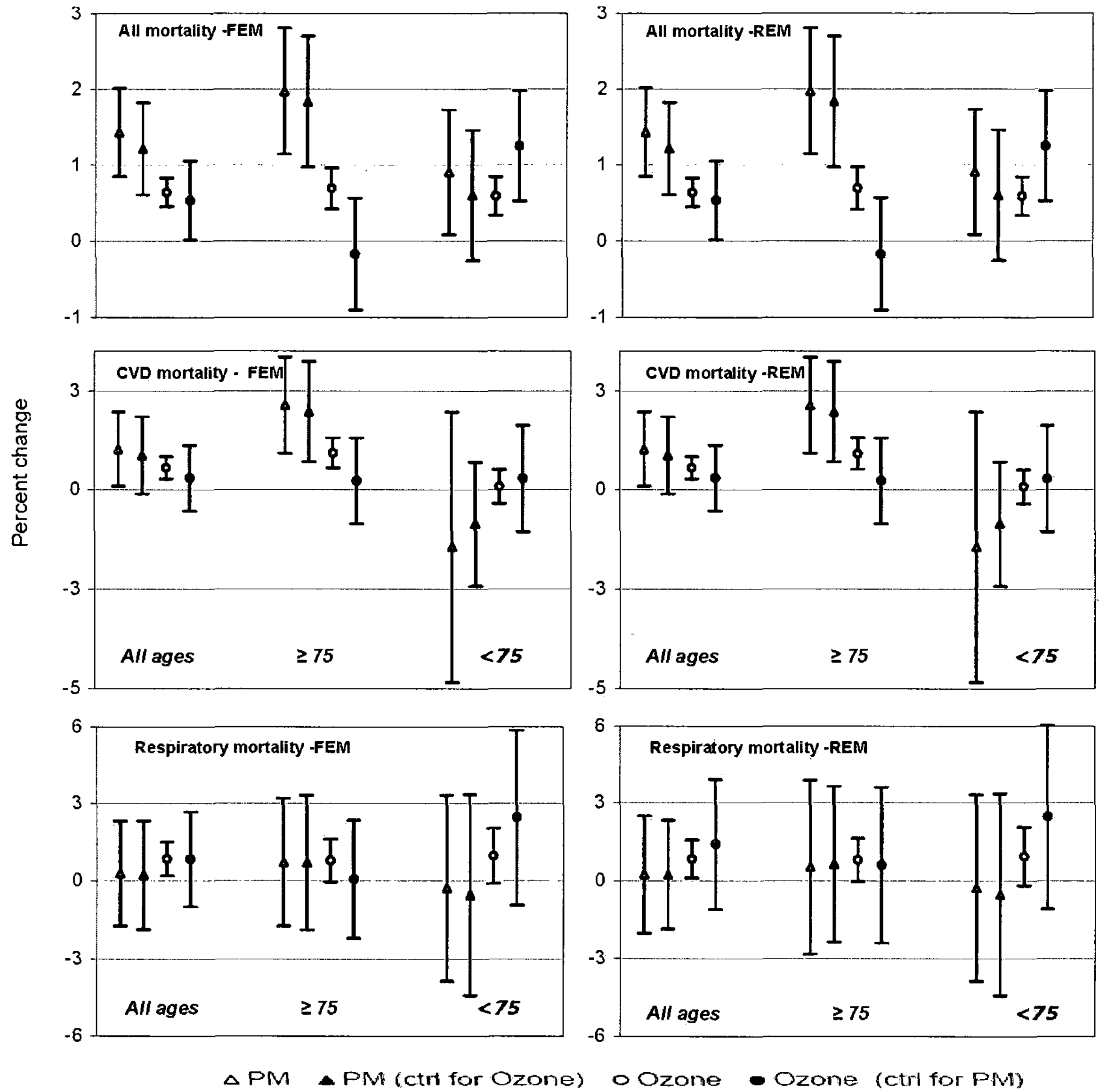

Figure 25 Pooled percent increase and the 95% confidence intervals for mortality outcomes for three age groups associated with a 10 μg/m^3 increase in $PM_{2.5}$ and 10 ppb increase in ozone in single and two pollutant models. City-specific effect estimates were evaluated at a 1-day lag and 8 df per year for time.

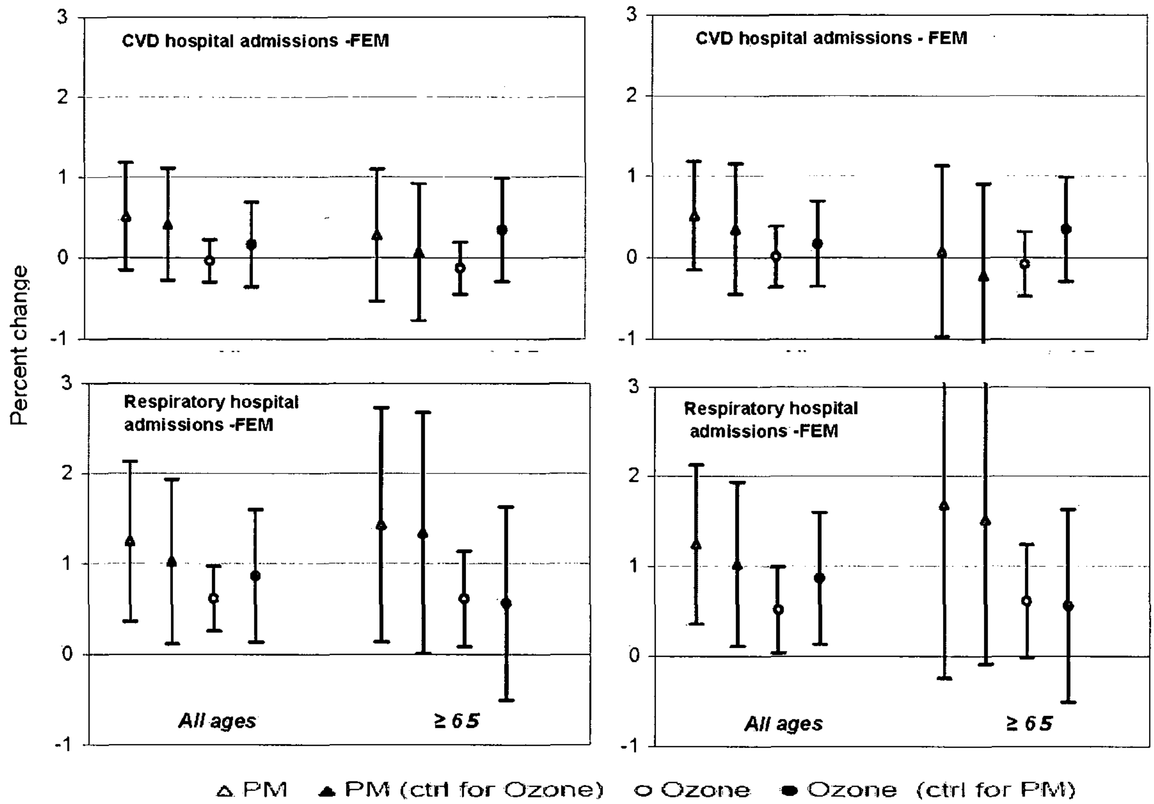

Figure 26 Pooled percent increase and the 95% confidence intervals for hospital admissions for two age groups associated with a 10 μg/m^3 increase in $PM_{2.5}$ and 10 ppb increase in ozone in single and two pollutant models. City-specific effect estimates were evaluated at a 1-day lag and 8 df per year for time.

Table 14 Pooled percent change in mortality and hospital admissions associated with an increase in the previous day's pollutant levels (10 ppb for ozone and 10 μg/m^3 for $PM_{2.5}$) in single and two pollutant models.

Outcome/ age group	Ozone		$PM_{2.5}$	
	One pollutant	Two pollutant	One pollutant	Two pollutant
Total mortality				
All ages	**0.64 (0.45- 0.82)**	**0.53 (0.01- 1.05)**	**1.43 (0.84- 2.01)**	**1.21 (0.60- 1.82)**
75 and over	**0.69 (0.42- 0.96)**	- 0.18 (- 0.91- 0.56)	**1.98 (1.14- 2.81)**	**1.83 (0.97- 2.70)**
under 75	**0.59 (0.33- 0.84)**	**1.25 (0.52- 1.97)**	**0.90 (0.08- 1.73)**	0.60 (- 0.26- 1.46)
Cardiovascular mortality				
All ages	**0.56 (0.27- 0.84)**	0.29 (- 0.54- 1.13)	**1.03 (0.09- 1.97)**	0.87 (- 0.11- 1.85)
75 and over	**0.93 (0.55- 1.31)**	0.22 (- 0.87- 1.31)	**2.14 (0.92- 3.35)**	**1.98 (0.71- 3.24)**
under 75	0.07 (- 0.36- 0.51)	0.28 (- 1.06- 1.63)	- 1.44 (- 4.84- 1.97)	- 0.86 (- 2.43- 0.70)
Respiratory mortality				
All ages	**0.86 (0.21- 1.51)**	0.85 (- 0.98- 2.68)	0.30 (- 1.72- 2.33)	0.23 (- 1.86- 2.32)
75 and over	0.79 (- 0.04- 1.62)	0.08 (- 2.21- 2.36)	0.73 (- 1.74- 3.21)	0.72 (- 1.89- 3.33)
under 75	0.98 (- 0.08- 2.04)	2.46 (- 1.09- 6.02)	- 0.27 (- 3.87- 3.33)	- 0.54 (- 4.42- 3.35)
Cardiovascular hospital admissions				
All ages	- 0.04 (- 0.30- 0.22)	0.17 (- 0.36- 0.69)	0.52 (- 0.15- 1.18)	0.42 (- 0.28- 1.11)
65 and over	- 0.13 (- 0.45- 0.19)	0.35 (- 0.29- 0.98)	0.28 (- 0.54- 1.10)	0.07 (- 0.78- 0.92)
Respiratory hospital admissions				
All ages	**0.61 (0.26- 0.97)**	**0.87 (0.14- 1.59)**	**1.25 (0.36- 2.13)**	**1.02 (0.12- 1.93)**
65 and over	**0.61 (0.09- 1.13)**	0.56 (- 0.50- 1.63)	**1.43 (0.14- 2.73)**	**1.34 (0.01- 2.67)**

4.2.7 Effect modification

The presence of heterogeneity between city-specific estimates was not substantial in the majority of models applied. Four outcomes that displayed the highest heterogeneity based on the I^2 index were selected for effect modification analyses: 1) respiratory hospital admissions with ozone (assessed at lag02, 8 df for time, for ≥65 years, I^2 index 47%), 2) cardiovascular mortality with ozone (assessed at lag02, 8df for time, for <75 years, I^2 index 22%), 3) respiratory hospital admissions with $PM_{2.5}$ (assessed at lag2, 8 df for time, for all ages, I^2 index 40%), and 4) cardiovascular mortality with $PM_{2.5}$ (assessed at lag0, 8 df for time, for <75 years, I^2 index 16%). City-specific estimates, βs, were regressed on potential effect modifiers at the city-level, by weighted linear regression with weights inversely proportional to the variance of each city's β. Twenty-nine variables were tested for each of the outcomes listed above, where each potential effect modifier was included in each model individually. Sixteen linear associations were found significant at the 95% confidence level.

Three ecologic covariates were identified as potential effect modifiers of the associations between ozone exposure and respiratory hospital admissions. For $PM_{2.5}$ 13 potential effect modifiers were identified.

Table 15 provides results of the effect modification analysis of $PM_{2.5}$ and ozone for three health outcomes. Results significant at the 95% confidence level are presented. Results represent the percent increases in daily number of deaths or hospital admissions associated with an increase of 10 units of ozone or $PM_{2.5}$ at two different values for the effect modifier, corresponding to the 25th and the 75th percentiles of the city-specific distribution. Results can be seen as showing pollutant effects in a city characterized by a level of the effect modifier corresponding to the 25th or 75th percentile. Detailed results of the weighted linear regression models for each pollutant are provided in Appendix A (Table A-1 and Table A-2).

Table 15 Percent change in hospital admissions/mortality associated with a 10 unit increase[a] in $PM_{2.5}$ or ozone concentrations at the 25th and 75th percentile of the city-specific distributions of covariates that displayed significant effect modification.

Outcome/ Effect Modifier	Percent change (95% CI)		p-value
	25th centile	75th centile	
Respiratory HA[b] and ozone			
Area	1.96 (0.51, 3.42)	1.67 (0.3, 3.04)	0.04
Population density	0.273 (-1.45, 1.2)	1.11 (-0.27, 2.49)	0.05
Inactive	0.78 (-0.398, 1.96)	1.74 (0.59, 2.9)	0.01
Respiratory HA[c] and $PM_{2.5}$			
External migrants, 1 yr mobility status	-0.5 (-2.55, 1.55)	0.35 (-1.3, 2.01)	0.01
External migrants, 5 yr mobility status	-0.45 (-2.24, 1.34)	0.25 (-1.27, 1.77)	0.00
Average income	0.46 (-1.24, 2.13)	2.24 (0.76, 3.72)	0.02
Gini coefficient	2.38 (0.67, 4.09)	1.53 (-0.05, 3.1)	0.05
Life expectancy	-0.17 (-2.13, 1.78)	1.18 (-0.26, 2.62)	0.01
Smokers	1.5 (0.12, 2.87)	0.15 (-1.6, 1.91)	0.01
Heavy drinkers	0.88 (-0.7, 2.47)	-0.63 (-2.98, 1.73)	0.02
Stress	2.56 (0.86, 4.26)	1.82 (0.3, 3.34)	0.03
Doctor density	2.16 (0.51, 3.8)	0.6 (-1.31, 2.52)	0.05
CVD mortality[d] and $PM_{2.5}$			
Area	-0.72 (-3.45, 2.02)	-0.17 (-2.79, 2.46)	0.05
Unemployment, males	1.72 (-1.32, 4.77)	0.16 (-2.44, 2.76)	0.05
Manufacturing	2.75 (-0.88, 6.38)	-0.24 (-2.85, 2.37)	0.04
Stress	1.6 (-0.89, 4.09)	0.47 (-1.8, 2.75)	0.01

[a]10 ppb increase in ozone or 10 μg/m^3 increase in PM2.5
[b]Respiratory hospital admissions for 65 and over (lag02)
[c]Respiratory hospital admissions for all ages (lag2)
[d]Cardiovascular mortality under 75 (lag0)
Note: all effect estimates were obtained from models with 8df per year to control for seasonality

Chapter 5

DISCUSSION

The association of two ambient air pollutants, ozone and $PM_{2.5}$, with mortality and hospital admissions in 12 Canadian cities was examined. Statistically significant associations were observed across all outcomes (except cardiovascular hospital admissions), generally higher among the elderly. Risk estimates were robust to seasonality control when more than 5 degrees of freedom per year of data available were allowed. Sensitivity of risk estimates was observed to varying lag structures depending on the outcome being assessed. $PM_{2.5}$ effect estimates were relatively robust when adjusting for ozone in two pollutant models, indicating that there is no confounding of effect by ozone. Although there was no significant heterogeneity detected between cities in the vast majority of models applied, several potential effect modifiers were identified when heterogeneity was present.

5.1 Summary of findings

5.1.1 Effect of degrees of freedom for seasonality

The effect of varying the degree of freedom in the smoothing function of calendar time was explored. Across all outcomes, effects estimates were found to stabilize beyond 5 df per year of data. Results obtained are in agreement with other studies that have explored the sensitivity of degrees of freedom for seasonality control. Peng *et al.* conducted a simulation study that compared various methods commonly used to adjust for seasonal and long-term trends. By examining the variability of the regression coefficient, β, using 1-20 df per year, results indicated that the bias in β was only serious for df between 1 and 4 with natural splines (and between 1 and 6 df with penalized splines) and was stable afterwards (80). Another study in California found that effects estimates decreased with increasing df when evaluated at 4, 8 and 12 df per year with a greater reduction observed going from 4 to 8 df (19).

Although there is no preferred method to choose the optimal degrees of freedom, Touloumi *et al.* (61) suggest that the approach followed in the NMMAPS study (7 df per year), yields conservative air pollution effects estimates, since this value of df is large enough to ensure adequate control for seasonal and long-term trends. Several of the time-series studies reviewed in Chapter 2 selected a fixed value for df to be used in analyses, based on sensitivity analyses or results from previous studies (19;22;35;65). These values were in range of 4-12 df per year of available data. To provide estimates of effects across a range of degrees of values in this study, values of 4, 8 and 12 per year were selected for the remaining analyses.

Natural cubic splines were used in all analyses presented in this thesis. Penalized splines have also been used in time-series studies and both methods are believed to yield comparable results. Ozone risk estimates associated with ozone obtained from both approaches were compared using the Toronto data set. Results of the sensitivity analysis can be seen in Figure A-2 (Appendix), which confirm the comparability of risk estimates based on natural splines and penalized splines.

The effect of varying the df for the temperature variable was not explored. It is generally accepted that the effect estimates are not as sensitive to the method used to control for temperature as they are to controlling for calendar time (23). The approach followed in APHENA for controlling for temperature was adopted in this study, where 3 degrees of freedom were allowed in the smooth function of temperature in all the models.

5.1.2 Effect of lag structure

Several lag periods were applied to explore whether exposure to air pollution levels exhibits a delayed effect on health outcomes. Results indicate that effect estimates are sensitive to lag periods depending on the outcome. For mortality associations with ozone, greater effects were seen with the 3-day average lag (lag02) and the distributed lag models (dist02) relative to other lag structures examined. The sensitivity observed to varying lag structures suggests that health effects of ozone are not immediate and are not only dependent on same day concentrations but on the recent days' ozone levels as well. For respiratory hospital admissions, same day lag models provided estimates that were not significant. A delayed effect of ozone on this outcome was clear, with the highest effects observed for lag2 and lag02 models.

Published studies reviewed in Chapter 2 have looked at a wide range of lag structures. Similar to the selection of df, many multi-city studies, justify their selection of one or two lag structures for the analyses by findings of previous studies (11;19;22;54;67). Based on our analyses, three structures (lag1, lag02 and dist02) were selected for the remaining analyses on ozone. For $PM_{2.5}$, combined lag models could not be applied because daily data was not available; effects for this pollutant were estimated at 3 single day lags (lag0, lag1 and lag2).

5.1.3 *Health effects of ozone*

The 1-hour maximum daily average for ozone was used as the measure for ozone exposure in this study. Although the World health Organization suggests that the 8-hour average is a better indicator for respiratory function and lung inflammation (81), many previous studies have used the 1-hour average. Thus, its use in this study facilitated the comparison of results with previous findings. However, correlation coefficients between the 1-hr and 8-hr maximum ozone levels were in the 0.94–0.97 range across the 12 Canadian cities (see Table A-4 in Appendix A). Thus, similar results are expected to be obtained using either measurement. Results of both measures were compared in APHEA 2, and led to similar results (11).

5.1.3.1 Mortality

Pooled effect estimates across cities for ozone were positive and significant for total and cause specific mortality. Results observed were in the range of 0.59% to 2.14% increase in mortality for a 10 ppb increase in the 1-hr maximum ozone levels. In general, higher effects were obtained for the ≥75 age group. The majority of studies reviewed found significant associations that are comparable to those estimated in this study (9;14;24;64;68-70).

A slightly stronger effect was detected for respiratory mortality, which is consistent with other studies. In APHEA 2, a stronger association between ozone and respiratory mortality was found (2.26%) relative to other mortality outcomes (0.9% cardiovascular mortality and 0.66% for total mortality) per 10 ppb increase in the 1-hr maximum ozone levels (11). In a study within NMMAPS that looked at 95 US urban communities, a positive and significant association (0.64% increase) per 10 ppb increase in the previous week's ozone levels was estimated for respiratory and cardiovascular mortality, slightly higher than the estimate for total mortality (0.52%). Further, in Australian study of four cities, a significant association was obtained only for respiratory mortality (2.2% increases per 10 ppb) but not for other outcomes (24).

Effects of 1- and 2-day lag models for respiratory and cardiovascular mortality were stronger than effects of same day models. Similar results have been reported where respiratory outcomes for deaths were more affected by pollution levels on previous days (20;82). However, they also observed that cardiovascular deaths were more affected by same day pollution, which was not the case here.

The greatest effect estimates were observed with combined lag models. The strong effects estimated with the 3-day average (lag02) and the distributed lag models (dist02) suggest that the effect of ozone is not only dependent on same day exposure but also on the exposure resulting from the previous 2 days. This indicates that single day lag models may underestimate the cumulative effect of ozone on mortality due to repeated exposure to high levels of ozone. Hence, the combined and distributed lag models may be more appropriate for estimating ozone health effects. Previous findings suggest that multi-day exposure lags are higher than single day lags (9;14;64;82). Bell et al (9;64) considered lag models that took into account the previous week's ozone levels in 95 US cities and found that effects were consistently higher than those of single day lag models.

Meta-analyses that have looked at the health effects of ozone have found positive effects for both total and cardiovascular mortality (68) or only total mortality (69;70).

Estimates are slightly lower in this study than in APHENA although the same datasets was used. It was hypothesized that the use of a shorter time-series and the inclusion of additional covariates in the models (two terms for temperature control) in APHENA, may have led to slightly higher results compared to those of this study. A sensitivity analysis exploring the effect of varying the number of temperature terms included in the time series was carried out. Results show that the use of one term (same day temperature (temp0)) or two terms (same day and previous day temperature (temp01)) for the temperature variable produced comparable risk estimates (see Figure A-3 in Appendix A). The difference in results between this study and the Canadian APHENA results requires further investigation.

5.1.3.2 *Hospital Admissions*

For hospital admissions associations with ozone, significant and positive effects were estimated for respiratory hospital admissions (0.6% to 1.34% increase per 10 ppb ozone), with an apparent stronger effect at a lag of 1 or 2 days relative to same day exposure. The lag effect on hospitalizations is supported by other published findings (65;66).

Results are comparable to previous findings. In a study of 16 Canadian cities, a 1.4% increase was estimated for hospital admissions resulting from a 10 ppb increase in the previous day's ozone levels (66). In APHENA, respiratory hospital admissions were significantly associated with ozone, although results were higher than those found in this study were (2% increases per 10 ppb increase in ozone for those ≥65 at lag01). On the contrary, meta-analyses that have looked at this association have not found significant effects (54;68).

Cardiovascular hospital admissions effects were negative and not statistically significant for all models and age groups. This finding is in agreement with other studies such as APHENA. Meta-analyses conducted on European studies also support this null association (14;54;68).

5.1.4 *Health effects of $PM_{2.5}$*

5.1.4.1 *Mortality*

Fine particulate matter showed statistically significant effect estimates combined across cities. For total and cardiovascular mortality, estimates were in the range of 0.91-2.39% increase per 10 $\mu g/m^3$ increase in $PM_{2.5}$. Results of this study are in agreement with previous study findings where estimates reported have generally been in the range of 0.8%-2.4% increase (83). A number of the studies reviewed in Chapter 3 showed comparable findings (15;19;22), although others have found no significant effect on mortality (24;68).

The only significant estimate detected for respiratory mortality was a 3.17% increase for ≥65 at a 2-day lag. It is unusual to detect a relatively strong association for this age group when other groups considered did not show any significant effects. Compared to respiratory diseases, cardiovascular diseases are more prevalent which leads to increased power to detect weak associations (26). It is possible that due to low number of respiratory related deaths and hospital admissions the models applied were not able to detect the weak association and that the 3.17% increase observed was obtained by chance.

Effects were consistently higher for older age groups supporting the hypothesis that the elderly may be more susceptible to the effects of $PM_{2.5}$, a result of exacerbation of pre-existing conditions that are more prevalent among individuals in this age group. Older people may also be at a higher risk to oxidation effects of air pollution because of reduced antioxidant defenses (84).

Effects of mortality on the same day of exposure (lag0) were not significant. Rather, across all mortality outcomes and two age groups (all ages and ≥75) the effect of $PM_{2.5}$ was strongest at 1-day lag (and sometimes at 2-day lag) compared to the effect of same day exposure, suggesting a delayed $PM_{2.5}$ effect. As with the case of ozone, findings reported in the literature have not been consistent on $PM_{2.5}$. For example, a study in Montreal found that cardiovascular mortality was more affected by exposure to $PM_{2.5}$ in previous days (10), while a study in 10 US cities found a stronger same-day exposure effect (82). Results have also been inconsistent for respiratory deaths. Previous studies have reported stronger effects on day exposure levels (35) or exposure in the prior 1 or 2 days (21). This inconsistency may be simply a result of the different chemical components of the $PM_{2.5}$ mixture with different chemicals responsible for immediate or delayed responses in individuals across the various study locations. This may also be explained by the different population structures where certain subpopulations are more vulnerable to air pollution (85).

5.1.4.2 *Hospital admissions*

Similar to ozone, fine particulate matter was found be more highly associated with respiratory hospital admissions, where positive and significant associations were seen with the 1-day and 2-day lag models (estimated effects were between 1.25% and 1.90% increase per 10 $\mu g/m^3$ $PM_{2.5}$ levels). Greater effects were observed for those 75 years of age or older. Cardiovascular hospital admissions results were positive but not significant and showed less variability with lag periods. In agreement with the findings of this study, the lack of a significant association between $PM_{2.5}$ and cardiovascular hospital admissions has been reported in a French study (67) and a meta-analysis (68). However, other recent works have found a significant association (16;35).

5.1.5 *Two pollutant models*

To investigate potential confounding by either ozone or $PM_{2.5}$, two-pollutant models that controlled for the second pollutant were applied and compared to results of single pollutant models. $PM_{2.5}$ estimates were slightly reduced but were in general robust when controlled for potential confounding by ozone. Ozone and $PM_{2.5}$ levels were not strongly correlated across the 12 cities; correlation coefficients varied between -0.24 and 0.46. The weak correlation and the stability of estimates when ozone was included in the model, suggest that the effect of $PM_{2.5}$ is not confounded by ozone.

On the other hand, ozone estimates were found to be sensitive to $PM_{2.5}$ adjustment. Estimates either decreased or increased upon $PM_{2.5}$ adjustment, but did not show a particular trend when going from one to two-pollutant models. Previous studies have found ozone results to be robust to PM adjustment (9;64;65). It is possible that two pollutant models are best applied when daily data is available for both pollutants, which was not the case in this study. For example, in a study within NMMAPS (9), two pollutant models were restricted to cities with daily data for both ozone and PM. Perhaps, repeating the analyses with daily measurements for $PM_{2.5}$ would give results that are more stable.

Note on pooling city-specific estimates

City specific results were pooled using the inverse variance method. As a result, larger cities, with smaller uncertainty around the estimated effects, were attributed more weight. In particular, estimates of Toronto and Montreal alone contributed approximately 50% of final estimate in the case of ozone and 70% in the case of $PM_{2.5}$. These numbers rise to 60% and 75%, respectively if including Vancouver. Thus, one could safely say that the estimated health effects based on Toronto and Montreal (and possibly Vancouver) provide a good indication of the magnitude of the pooled effect across the 12 cities, with the available data. An example of the weights attributed to every city can be found in Table A-5 (Appendix A). Similar percentages were observed across all other outcomes and age groups.

5.1.6 Effect modification

City-specific results in general did not display significant heterogeneity across outcomes and age groups assessed based on the I^2 index. This finding is supported by findings of APHENA where no heterogeneity among Canadian cities was found (14). Nevertheless, four outcomes that showed some level of heterogeneity among cites were examined for effect modification by 29 variables.

Ozone effects on respiratory hospital admissions among the elderly (>65) were modified by *area of city*, *population density* and the *proportion of inactive individuals*. Hospital admissions are not likely to be affected by these variables per se, but by other factors associated with them. For example, the ozone effect was found to be stronger in cities with higher proportions of inactive people. It is possible that people with inactive lifestyles also make other choices that do not support healthy lifestyles, which may in turn affect their overall health status and increase their susceptibility to effects of air pollution.

Relatively more ecologic covariates were found to modify the effect of $PM_{2.5}$ compared with ozone. Again, variables including *area*, *percent manufacture* and *number of external migrants* may be linked to another factor that would affect the relationship between PM and mortality or hospital admissions. Lower effect estimates were associated with higher *unemployment*, which is contrary to previous study findings. Several studies have reported that unemployment acts as an effect modifier where increasing rates are associated with increasing pollution effects (9;14;64). *Life expectancy* was also identified as an effect modifier with higher PM effects in cities with higher life expectancy. Cities with higher life expectancy have a greater proportion of elderly; hence, a larger population vulnerable to the effects of air pollution. Life expectancy was found to modify the PM health effect in a similar manner in a European study within the APHEA 2 project (86).

It was also found that the higher the *density of general practitioners*, the lower the effects when looking at respiratory hospital admissions and PM. This may result because with a higher density of doctors, people can receive treatment faster than cities with a lower density, thereby preventing the need to be admitted to the hospital.

Several city-level characteristics were found to modify the effect in the opposite sense of what would be expected, such as the *average income*, the *Gini coefficient* and *proportion of smokers, heavy drinkers* and *stressed*. For example, the *Gini coefficient* is a measure of social inequality where higher coefficients imply greater inequality of income distribution. Based on the *fundamental social causes* hypothesis by Link and Phelan (87), a greater effect of air pollution would be expected in cities with a higher Gini, contrary to what was found in this study. Link and Phelan explain that socioeconomic differences in health outcomes can be explained by measures of income and education levels. However, these measures in reality represent factors such as power and knowledge and thus the means to take advantage of all relevant health information that support healthy lifestyles. In contrast, people of lower socioeconomic status have reduced access to new knowledge and therefore do not have the same capability to avoid health risks.

Previous findings on effect modification have been inconsistent where several studies have concluded that the effect of air pollution is not modified by city-level variables or have only reported geographical variations (11;15;35;69;70). However, Ostro *et al.* (19) reported that effect of PM was higher among females, whites, diabetics, or persons with less than high school education. In addition, Bell and Dominici (64) looked at effect modification patters in 98 US communities and reported that higher estimates were associated with higher unemployment, fraction of African American population, public transportation use, lower temperature and lower prevalence of central air conditioning.

It is important to note that the use of only 12 cities in this study may have limited the effect modification analyses. Although the effect of ozone and $PM_{2.5}$ was found to be modified by several city-specific characteristics, results cannot be considered as strong evidence for effect modification. As several previous studies have reported, it is possible that effect modification with the covariates considered does not occur in the case of short-term exposure to air pollution. Perhaps repeating this analysis with a greater number of cities would give greater power to detect heterogeneity –if present- and allow stronger conclusions to be made regarding effect modification.

5.1.7 Biological mechanisms

The exact biological mechanisms by which air pollution leads to morbidity and premature deaths are still under research. However, much of the current evidence suggests that exposure to ozone and PM induces oxidative stress and inflammation in the lung tissue that lead to local and systemic events. The inflammatory response in the lungs has been demonstrated in animal and controlled human studies (88-90). Inflammation in the lungs triggers the release of cytokines and chemokines that lead to sub-clinical systemic inflammation that may alter the vascular system (88;91;92).

Observed cardiovascular effects can be partially explained by activation of pulmonary neural reflexes that result from interactions between pollutants and lung receptors. Increases in fibrinogen levels and reductions in heart rate, two risk factors for cardiac diseases that lead to hospital admissions, have been associated exposure to air pollution. Reductions in heart rate can lead to decreased parasympathetic input which may in turn lead arrhythmia and cardiovascular mortality (93;94) .

Lung inflammation is also believed to exacerbate underlying lung diseases by weakening lung defense mechanisms. Animals with chronic obstructive pulmonary diseases (COPD) or chronic lung inflammation have been found to be more vulnerable to combustion particles compared to normal animals (95;96). Influenza infections have also been shown to be exacerbated by air pollution in experiments (97;98). Further, studies on mice and humans indicate that PM may accelerate the development of atherosclerosis (99;100).

Other studies have detected PM in the heart muscle and brain cells indicating its ability to diffuse into the bloodstream which may lead to direct toxic effects (88;91).

5.2 Methodological considerations

5.2.1 Strengths

Time-series studies that have been based on single cities have been strongly criticized due to their limited generalizability to other locations. Critics have also noted the inconsistencies in findings among these studies which is a result of different statistical approaches applied in each location (8;101). The use of different methodological approaches in each study has led to the selective use of models that give the strongest effects estimates.

This time-series study examined the associations of two ambient air pollutants and health outcomes in 12 Canadian cities, with a total exposed population of 9-10 million Canadians. Statistical methods applied were uniform across all cities enabling the direct pooling of city-specific results. The results of this study can most likely be generalized to regions with similar structure as the Canadian population.

Further, evidence on the health effects of short-term exposure to $PM_{2.5}$ is limited (35) because the use of this pollutant as an exposure in time-series is relatively recent. Therefore, this study adds to the literature quantitative evidence of the significant effects of fine PM. Fine particulate matter has a greater probability of reaching the small airways of lungs relative to larger particles and is therefore believed to be a better health indicator. However, previous studies have focused on larger particles due to the availability of data or have used conversion factors to convert between the two particle fractions. This study was based on measurements of $PM_{2.5}$ as recorded by fixed monitors in each city; hence, errors inherent in conversion factors were not introduced into the measurements. Further, analyses in previous studies have sometimes been hindered by the different measurements methods that were used for each city (17). However, across the 12 Canadian cities included in this study, air pollution and mortality data was collected under a common framework and subject to the same quality assurance programs.

5.2.2 *Potential Limitations*

Misclassification of exposure is a well-recognized limitation inherent in ecological studies. In this time-series study, concentrations of ambient air pollution obtained from fixed outdoor monitors throughout each city were used as a surrogate measure for the population average personal exposure. This method assumes that exposure among all individuals in a given area is identical and does not take into account the differences in activity patterns (ex. time spent outdoors) (8). The feasibility of obtaining such data, usually collected for regulatory purposes, at a low cost and no burden to study subjects, has made it convenient to use in time-series studies. As a result, time-series studies have been criticized to be subject to exposure misclassification especially among subpopulations believed to be at a higher risk (8). Because the activity patterns among children or the elderly may differ from that of the general population, effects estimated from studies that look at the whole population are most likely to underestimate the true effects among these subgroups (102). The use of fixed monitor measurements is supported by previous studies that have shown a strong correlation between outdoor, indoor and personal exposure to particulate matter (103;104). It has also been reported that the presence of error in measurement of the exposure would lead to non-differential misclassification of exposure and hence underestimation of health effects (105-107). Jerret *et al.* (106) showed that the health effects were three times higher when analyses were based on individual's proximity to high traffic regions compared to using community average concentrations. Models that correct for measurement error have also been developed (107).

Another limitation in this study was availability of $PM_{2.5}$ data. Having measurements for every sixth day led to effect estimates with greater uncertainty than those calculated for ozone (which had daily data). $PM_{2.5}$ has only been collected on a daily basis since the late 1990s in Canada. Perhaps repeating this study once an appreciable time-period has been attained would lead to estimates that are more accurate. The unavailability of daily PM data may have also contributed to greater heterogeneity between city estimates since several effect modifiers detected were found to modify the PM effect in ways that could not be explained or contrary to what would be expected.

Confounding of co-pollutants in the $PM_{2.5}$ effect has been looked at in other studies. $PM_{2.5}$ is highly correlated with other co-pollutants and it is often difficult to disentangle which component of the air pollution mixture is the one responsible for the observed health effects (54;108). This study did not look at potential confounding of co-pollutants beyond ozone.

Some previous studies have looked at effect of seasonal variation in the levels of ozone, where higher effects were detected in the summer when ozone levels are typically higher (11;54;66). This was not explored in this study. Perhaps future work can examine the effects by season.

Further, the power to detect heterogeneity between city estimates and consequently potential effect modifiers was limited by the low number of cities. It is recommended to repeat effect modification analyses with a larger number of cities to arrive at more conclusive results regarding potential effect modifiers.

Finally, the potential bias that can be introduced by use of mortality and hospital admission data has been considered. A Canadian study by Stieb *et al* (109) looked at the classification of cardio-respiratory diseases in emergency department visits. Findings found a fair degree of agreement in the diagnosis of seven independent assessments with no evidence of diagnostic bias in relation to daily air pollution. The databases in this study have been subject to quality control by CIHI. Nevertheless, if errors were present in the management of data, this would result in non-differential misclassification bias, as such errors would not likely be related to variation in air pollution levels.

5.3 Public health implications

Results of this study indicate a substantial public health burden from ozone and $PM_{2.5}$ pollution. Further reductions in the levels of these two pollutants would bring considerable health and economic benefits to Canadians. For example, based on the calculated effects in this study, a 10 ppb increase in 1-hr maximum ozone levels would correspond to an additional 1368 (95% CI, 985-759) premature deaths each year in the 12 cities considered in this study[1]. Similarly, a 10 μg/m³ increase in daily average of $PM_{2.5}$ would correspond to 1148 (95% CI, 521-2319) premature deaths annually in these cities[2]. These numbers are much higher when considering the total Canadian population. Further, these deaths would only be underestimations of the total mortality burden from such increases in pollutant levels because they represent only short-term effects. Long-term effects of these two pollutants have been reported to be much greater (2). Reductions in air pollution levels would also reduce hospital admissions related to air pollution exposure especially among the elderly and those with pre-existing cardiovascular and respiratory diseases.

Previous studies have looked at the exposure-response relationship between air pollutants and mortality in an attempt to identify a threshold concentration, below which air pollution would not lead to increases in deaths. The existence of such a threshold would be appealing for use when deriving air

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[1] Estimates of the 3-day average (lag02) model for ozone with 8 df for seasonality. Average annual deaths were based on mortality between 1980 and 2000.

[2] Estimates of the 2-day lag (lag2) model for $PM_{2.5}$ with 8 df for seasonality. Average annual deaths were based on mortality between 1980 and 2000.

quality guidelines. However, recent findings of recent epidemiological studies do not support the hypothesis of a threshold value; rather they have consistently detected associations at the pollution levels considered with results that support a linear dose-response relationship (11;14;54). Given that air pollution cannot be completely eliminated, air quality management should focus on reducing pollutant concentrations to the lowest levels that can be reasonably achieved.

Chapter 6

CONCLUSION

This study supports previous findings that have linked short-term exposure to ozone and $PM_{2.5}$ with mortality and hospital admissions. Effect estimates were robust to confounding adjustment of seasonality but sensitive to lag structures. Statistically significant central estimates of the increase in mortality and respiratory hospital admissions associated with a 10 ppb increase the 1-hr maximum ozone ranged from 0.56% to 2.14% and 0.6% to 1.34%, respectively. For $PM_{2.5}$, central estimates of the increases in mortality and respiratory hospital admissions ranged from 0.91% to 3.17% and 1.25% to 1.90%, respectively. Cardiovascular hospital admissions were not significantly associated with either pollutant. Although estimated effects are relatively weak, they represent a substantial health burden given the size of the exposed population. Based on these results, it is reasonable to assume that reductions in air pollution would likely lead to considerable health benefits by reducing premature deaths and hospital admissions.

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APPENDIX A

Additional Tables and Figures

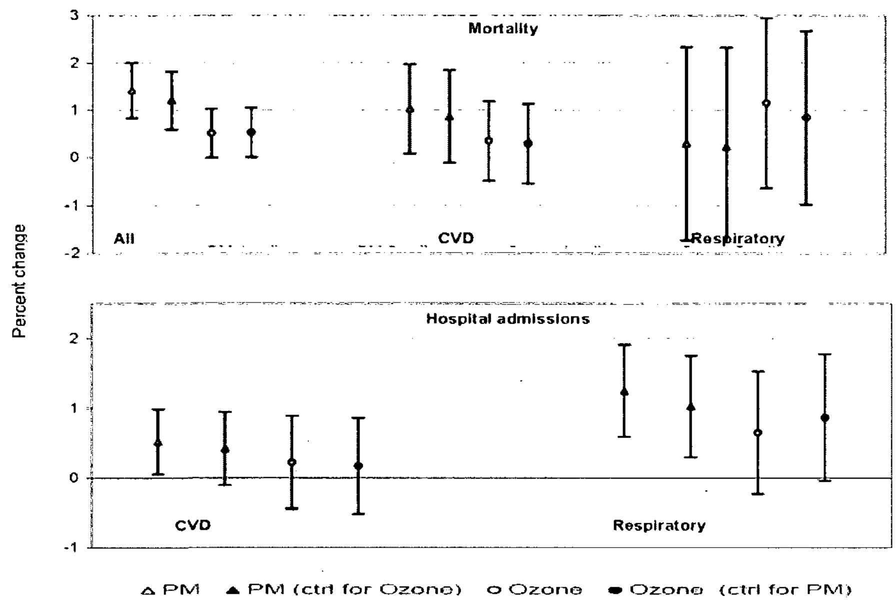

Figure A-1 Effect estimates of single and two pollutant models using data limited to days where $PM_{2.5}$ data was available.

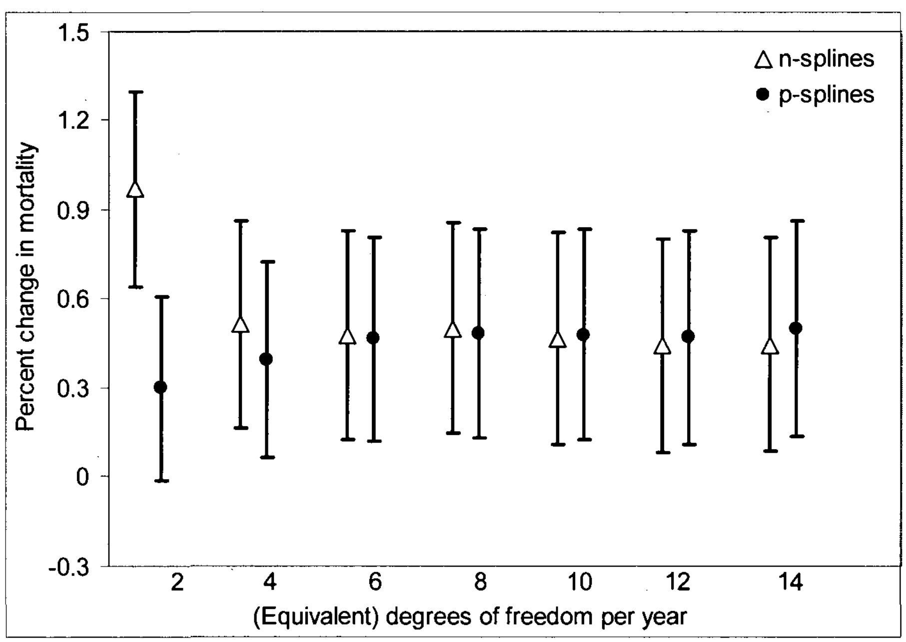

Figure A-2 Comparison of risk estimates using natural cubic splines and penalized splines in the time series models. Results represent the percent change in total morality (all ages) associated with a 10 ppb increase in the 1-hr maximum ozone levels (lag1) in Toronto.

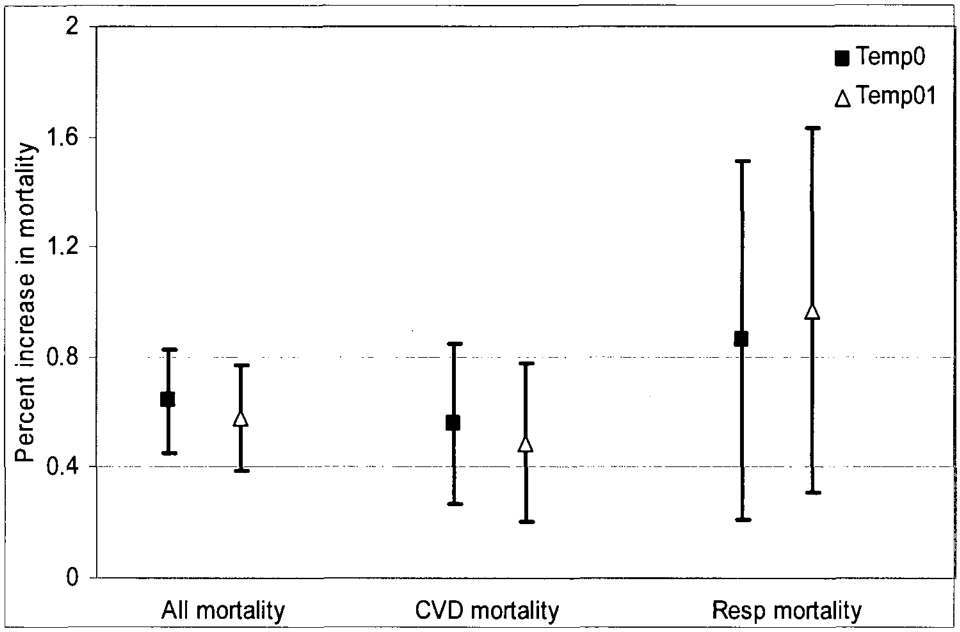

Figure A-3 The effect of varying the temperature terms in the time series model on risk estimates. Results represent the pooled percent increase in mortality outcomes per 10 ppb increase in the maximum 1-hr ozone levels with a 1-day lag. Note: *temp0* refers to models with one temperature term (same day); *temp01* refers to models with two temperature terms (same day and previous day).

Table A-1 Results of the weighted linear regression of ecological covariate onto city specific estimates (ozone effect modification analyses).

Covariate	Ozone					
	Resp HA			CVD mortality		
	Effect	*p-value*	R^2	*Effect*	*p-value*	R^2
Area (Km2)	**0.00**	**0.04**	**0.36**	0.00	0.67	0.02
Population (no.)	0.00	0.51	0.02	0.00	0.40	0.07
Over 65	42.70	0.16	0.19	6.97	0.76	0.01
Over 75	78.69	0.26	0.13	25.80	0.61	0.03
Under 16	-47.10	0.11	0.24	22.37	0.30	0.11
Unemployment rate, both sexes (%)	0.25	0.41	0.07	-0.12	0.54	0.04
Unemployment rate, males (%)	0.29	0.29	0.11	-0.08	0.65	0.02
Unemployment rate, females (%)	0.16	0.63	0.02	-0.17	0.44	0.06
External migrants, 1 year (no.)	0.00	0.78	0.01	0.00	0.41	0.07
External migrants, 5 year (no.)	0.00	0.55	0.04	0.00	0.41	0.07
Population density (Km2)	0.00	0.05	0.34	0.00	0.45	0.06
Percent Manufacture (%)	0.14	0.16	0.19	0.00	0.97	0.00
Percent Primary (%)	-0.33	0.29	0.11	0.04	0.89	0.00
Low income (%)	0.16	0.31	0.10	-0.06	0.61	0.03
Average household income ($)	0.00	0.63	0.02	0.00	0.80	0.01
Gini coefficient	12.80	0.58	0.03	-6.13	0.69	0.02
Life expectancy (years)	-0.41	0.48	0.05	-0.60	0.13	0.21
Good self health (%)	0.34	0.39	0.08	-0.17	0.49	0.05
Smokers (%)	0.15	0.31	0.10	-0.02	0.89	0.00
Heavy drinkers (%)	0.02	0.95	0.00	0.11	0.49	0.05
Inactive (%)	**0.21**	**0.01**	**0.55**	-0.04	0.62	0.03
Obesity (%)	0.09	0.66	0.02	0.17	0.20	0.16
High blood pressure (%)	0.39	0.29	0.11	0.20	0.46	0.06
Depression (%)	-0.75	0.10	0.24	0.28	0.38	0.08
Stress (%)	0.21	0.13	0.21	-0.07	0.49	0.05
Unmet health needs (%)	-0.05	0.83	0.01	0.12	0.40	0.07
Doctor density (/100,000)	-0.01	0.78	0.01	-0.01	0.69	0.02
Specialist density (/100,000)	0.02	0.43	0.06	0.00	0.85	0.00
Low education	18.80	0.15	0.20	5.72	0.53	0.04

Table A-2 Results of the weighted linear regression of ecological covariate onto city specific estimates ($PM_{2.5}$ effect modification analyses).

Covariate	$PM_{2.5}$					
	Resp HA			CVD mortality		
	Effect	*p-value*	R^2	*Effect*	*p-value*	R^2
Area (Km^2)	0.00	0.62	0.03	**0.00**	**0.05**	**0.34**
Population (no.)	0.00	0.08	0.27	0.00	0.98	0.00
Over 65	21.94	0.62	0.03	-91.44	0.09	0.27
Over 75	34.27	0.73	0.01	-173.86	0.15	0.19
Under 16	-34.38	0.38	0.08	72.36	0.16	0.19
Unemployment, both sexes (%)	-0.37	0.27	0.12	-0.77	0.07	0.30
Unemployment, males (%)	-0.25	0.45	0.06	**-0.77**	**0.05**	**0.34**
Unemployment, females (%)	-0.51	0.13	0.21	-0.72	0.11	0.24
External migrants, 1 yr (no.)	**0.00**	**0.01**	**0.50**	0.00	0.74	0.01
External migrants, 5 year (no.)	**0.00**	**0.00**	**0.58**	0.00	0.79	0.01
Population density (/Km^2)	0.00	0.12	0.22	0.00	0.15	0.19
Manufacture (%)	0.13	0.38	0.08	**-0.35**	**0.04**	**0.35**
Primary industry (%)	-0.64	0.16	0.19	0.45	0.49	0.05
Low income (%)	-0.24	0.18	0.17	-0.38	0.09	0.26
Average income ($)	**0.00**	**0.02**	**0.46**	0.00	0.13	0.22
Gina coefficient	**-42.81**	**0.05**	**0.34**	-46.76	0.12	0.23
Life expectancy (yr)	**1.55**	**0.01**	**0.48**	0.68	0.51	0.04
Good self-health (%)	-0.78	0.11	0.23	-0.70	0.35	0.09
Smokers (%)	**-0.45**	**0.01**	**0.49**	-0.35	0.17	0.18
Heavy drinkers (%)	**-0.59**	**0.02**	**0.44**	-0.13	0.75	0.01
Inactive (%)	0.13	0.39	0.07	-0.26	0.12	0.23
Obesity (%)	0.01	0.98	0.00	0.09	0.83	0.01
High blood pressure (%)	0.71	0.17	0.18	-0.51	0.55	0.04
Depression (%)	0.06	0.93	0.00	1.43	0.09	0.26
Stress (%)	**-0.40**	**0.03**	**0.38**	**-0.61**	**0.01**	**0.50**
Unmet health needs (%)	-0.40	0.10	0.25	-0.04	0.93	0.00
Doctor density (/100,000)	**-0.08**	**0.05**	**0.33**	0.00	0.98	0.00
Specialist density (/100,000)	-0.06	0.03	0.05	-0.02	0.59	0.03
Low education	21.31	0.31	0.10	-43.95	0.09	0.25

Table A-3 Comparison of effect estimates in single and two-pollutant models. Estimates were obtained from models allowing 8 df per year for time at a one-day lag for all ages, and are associated with an increase of 10 ppb in 1-hr maximum ozone levels and 10µg/m^3 in $PM_{2.5}$ levels.

Outcome/ age group		Ozone			PM2.5		
		1 poll	2 poll	% change	1 poll	2 poll	% change
Total mortality							
	All ages	0.64	0.53	-17	1.43	1.21	-15
	75 and over	0.69	-0.18	-126	1.98	1.83	-8
	under 75	0.59	1.25	112	0.9	0.6	-33
CVD mortality							
	All ages	0.56	0.29	-48	1.03	0.87	-16
	75 and over	0.93	0.22	-76	2.14	1.98	-7
	under 75	0.07	0.28	300	-1.44	-0.86	40
Resp mortality							
	All ages	0.86	0.85	-1	0.3	0.23	-23
	75 and over	0.79	0.08	-90	0.73	0.72	-1
	under 75	0.98	2.46	151	-0.27	-0.54	-100
CVD hospital admissions							
	All ages	-0.04	0.17	525	0.52	0.42	-19
	65 and over	-0.13	0.35	369	0.28	0.07	-75
Resp hospital admission							
	All ages	0.61	0.87	43	1.25	1.02	-18
	65 and over	0.61	0.56	-8	1.43	1.34	-6

* CVD: cardiovascular; RESP: respiratory

Table A-4 Correlation coefficients between the 1-hr and 8-hr maximum daily ozone levels from 1981-2000.

City	Correlation
Calgary	0.96
Edmonton	0.97
Halifax	0.94
Hamilton	0.96
Montreal	0.97
Ottawa	0.95
Quebec City	0.94
St Johns	0.94
Toronto	0.97
Vancouver	0.97
Windsor	0.97
Winnipeg	0.97

Table A-5 Weights (%) attributed to each city specific estimate when pooling across cities.

	PM2.5					Ozone				
	Mortality			HA		Mortality			HA	
	All	CVD	RESP	CVD	RESP	All	CVD	RESP	CVD	RESP
Calgary	3	3	3	2	3	3	3	4	5	6
Edmonton	3	3	3	2	3	4	4	5	4	6
Halifax	1	1		1	1	2	2	2	2	2
Hamilton	3	3	3	5	4	7	7	7	7	6
Montreal	32	31	35	25	28	20	20	20	18	18
Ottawa	4	4	4	3	3	6	7	6	6	5
Quebec City	3	3	3	3	3	8	8	8	8	7
St John	1	1	0	2	2	2	2	2	2	2
Toronto	38	36	37	48	44	27	26	26	29	27
Vancouver	7	8	9	3	4	10	11	13	12	13
Windsor	3	4		5	4	5	6	4	6	5
Winnipeg	2	3	2	1	1	4	4	4	3	3

APPENDIX B

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Yours sincerely

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APPENDIX C

Detailed Results

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Calgary	0	4	0.64	-0.34	1.62
All mortality	All	Edmonton	0	4	0.11	-0.72	0.94
All mortality	All	Halifax	0	4	1.07	-0.15	2.29
All mortality	All	Hamilton	0	4	1.23	0.54	1.92
All mortality	All	Montreal	0	4	0.72	0.33	1.12
All mortality	All	Ottawa	0	4	0.35	-0.35	1.04
All mortality	All	Quebec City	0	4	0.85	0.23	1.48
All mortality	All	St Johns	0	4	1.13	-0.18	2.44
All mortality	All	Toronto	0	4	0.46	0.11	0.81
All mortality	All	Vancouver	0	4	1.09	0.55	1.63
All mortality	All	Windsor	0	4	0.16	-0.64	0.96
All mortality	All	Winnipeg	0	4	1.03	0.17	1.89
All mortality	All	Calgary	0	8	0.83	-0.19	1.85
All mortality	All	Edmonton	0	8	0.06	-0.82	0.93
All mortality	All	Halifax	0	8	1.08	-0.19	2.34
All mortality	All	Hamilton	0	8	1.08	0.37	1.78
All mortality	All	Montreal	0	8	0.52	0.11	0.93
All mortality	All	Ottawa	0	8	0.33	-0.39	1.05
All mortality	All	Quebec City	0	8	0.88	0.23	1.52
All mortality	All	St Johns	0	8	1.06	-0.29	2.41
All mortality	All	Toronto	0	8	0.44	0.08	0.79
All mortality	All	Vancouver	0	8	0.96	0.39	1.54
All mortality	All	Windsor	0	8	0.24	-0.57	1.06
All mortality	All	Winnipeg	0	8	1.03	0.12	1.94
All mortality	All	Calgary	0	12	0.82	-0.22	1.87
All mortality	All	Edmonton	0	12	0.07	-0.82	0.95
All mortality	All	Halifax	0	12	0.93	-0.36	2.23
All mortality	All	Hamilton	0	12	0.97	0.26	1.69
All mortality	All	Montreal	0	12	0.37	-0.04	0.79
All mortality	All	Ottawa	0	12	0.42	-0.32	1.16
All mortality	All	Quebec City	0	12	0.88	0.22	1.54
All mortality	All	St Johns	0	12	1.11	-0.26	2.48
All mortality	All	Toronto	0	12	0.37	0.01	0.73
All mortality	All	Vancouver	0	12	1.11	0.53	1.70
All mortality	All	Windsor	0	12	0.19	-0.63	1.01
All mortality	All	Winnipeg	0	12	0.89	-0.04	1.82
All mortality	All	Calgary	1	4	-0.12	-1.09	0.86
All mortality	All	Edmonton	1	4	0.25	-0.57	1.08
All mortality	All	Halifax	1	4	0.76	-0.46	1.97
All mortality	All	Hamilton	1	4	0.79	0.10	1.48
All mortality	All	Montreal	1	4	0.90	0.50	1.29
All mortality	All	Ottawa	1	4	0.13	-0.56	0.83
All mortality	All	Quebec City	1	4	0.84	0.21	1.46
All mortality	All	St Johns	1	4	1.26	-0.06	2.57
All mortality	All	Toronto	1	4	0.51	0.16	0.86
All mortality	All	Vancouver	1	4	1.09	0.55	1.64
All mortality	All	Windsor	1	4	0.86	0.07	1.66
All mortality	All	Winnipeg	1	4	0.35	-0.51	1.20

Table C-1 . City specific percent change (*β x1000*) in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Calgary	1	8	0.01	-1.01	1.03
All mortality	All	Edmonton	1	8	0.22	-0.65	1.09
All mortality	All	Halifax	1	8	0.72	-0.54	1.99
All mortality	All	Hamilton	1	8	0.64	-0.07	1.34
All mortality	All	Montreal	1	8	0.75	0.34	1.16
All mortality	All	Ottawa	1	8	0.09	-0.63	0.82
All mortality	All	Quebec City	1	8	0.92	0.27	1.57
All mortality	All	St Johns	1	8	1.29	-0.07	2.64
All mortality	All	Toronto	1	8	0.50	0.15	0.86
All mortality	All	Vancouver	1	8	1.11	0.53	1.68
All mortality	All	Windsor	1	8	0.95	0.14	1.76
All mortality	All	Winnipeg	1	8	0.28	-0.64	1.19
All mortality	All	Calgary	1	12	-0.05	-1.09	0.99
All mortality	All	Edmonton	1	12	0.25	-0.64	1.14
All mortality	All	Halifax	1	12	0.63	-0.67	1.93
All mortality	All	Hamilton	1	12	0.53	-0.19	1.25
All mortality	All	Montreal	1	12	0.61	0.20	1.03
All mortality	All	Ottawa	1	12	0.19	-0.55	0.92
All mortality	All	Quebec City	1	12	0.92	0.26	1.59
All mortality	All	St Johns	1	12	1.35	-0.02	2.72
All mortality	All	Toronto	1	12	0.44	0.08	0.80
All mortality	All	Vancouver	1	12	1.27	0.68	1.86
All mortality	All	Windsor	1	12	0.91	0.09	1.73
All mortality	All	Winnipeg	1	12	0.13	-0.80	1.07
All mortality	All	Calgary	2	4	0.06	-0.92	1.03
All mortality	All	Edmonton	2	4	0.18	-0.64	1.01
All mortality	All	Halifax	2	4	-0.18	-1.40	1.05
All mortality	All	Hamilton	2	4	0.38	-0.32	1.07
All mortality	All	Montreal	2	4	0.63	0.24	1.02
All mortality	All	Ottawa	2	4	0.28	-0.42	0.97
All mortality	All	Quebec City	2	4	-0.12	-0.74	0.51
All mortality	All	St Johns	2	4	1.42	0.11	2.74
All mortality	All	Toronto	2	4	0.60	0.25	0.95
All mortality	All	Vancouver	2	4	0.33	-0.21	0.87
All mortality	All	Windsor	2	4	0.48	-0.32	1.28
All mortality	All	Winnipeg	2	4	0.77	-0.09	1.62
All mortality	All	Calgary	2	8	0.19	-0.83	1.21
All mortality	All	Edmonton	2	8	0.16	-0.71	1.03
All mortality	All	Halifax	2	8	-0.19	-1.46	1.09
All mortality	All	Hamilton	2	8	0.19	-0.52	0.89
All mortality	All	Montreal	2	8	0.62	0.21	1.03
All mortality	All	Ottawa	2	8	0.29	-0.44	1.01
All mortality	All	Quebec City	2	8	-0.10	-0.75	0.55
All mortality	All	St Johns	2	8	1.47	0.11	2.82
All mortality	All	Toronto	2	8	0.61	0.25	0.96
All mortality	All	Vancouver	2	8	0.35	-0.22	0.92
All mortality	All	Windsor	2	8	0.59	-0.22	1.41
All mortality	All	Winnipeg	2	8	0.77	-0.14	1.68

Table C-1 . City specific percent change (*β x1000*) in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Calgary	2	12	0.14	-0.91	1.18
All mortality	All	Edmonton	2	12	0.21	-0.68	1.10
All mortality	All	Halifax	2	12	-0.26	-1.57	1.05
All mortality	All	Hamilton	2	12	0.08	-0.64	0.81
All mortality	All	Montreal	2	12	0.49	0.07	0.90
All mortality	All	Ottawa	2	12	0.39	-0.35	1.13
All mortality	All	Quebec City	2	12	-0.13	-0.80	0.54
All mortality	All	St Johns	2	12	1.53	0.16	2.90
All mortality	All	Toronto	2	12	0.56	0.20	0.92
All mortality	All	Vancouver	2	12	0.47	-0.12	1.06
All mortality	All	Windsor	2	12	0.56	-0.26	1.39
All mortality	All	Winnipeg	2	12	0.65	-0.29	1.58
All mortality	All	Calgary	1	4	0.39	-0.79	1.57
All mortality	All	Edmonton	1	4	0.26	-0.72	1.24
All mortality	All	Halifax	1	4	1.22	-0.19	2.64
All mortality	All	Hamilton	1	4	1.57	0.73	2.41
All mortality	All	Montreal	1	4	1.30	0.82	1.77
All mortality	All	Ottawa	1	4	0.37	-0.46	1.20
All mortality	All	Quebec City	1	4	1.24	0.49	1.99
All mortality	All	St Johns	1	4	1.58	0.03	3.12
All mortality	All	Toronto	1	4	0.72	0.30	1.14
All mortality	All	Vancouver	1	4	1.50	0.87	2.12
All mortality	All	Windsor	1	4	0.69	-0.27	1.64
All mortality	All	Winnipeg	1	4	1.03	0.01	2.04
All mortality	All	Calgary	1	8	0.62	-0.65	1.88
All mortality	All	Edmonton	1	8	0.19	-0.87	1.25
All mortality	All	Halifax	1	8	1.19	-0.31	2.68
All mortality	All	Hamilton	1	8	1.35	0.49	2.21
All mortality	All	Montreal	1	8	1.00	0.50	1.50
All mortality	All	Ottawa	1	8	0.31	-0.56	1.19
All mortality	All	Quebec City	1	8	1.32	0.53	2.11
All mortality	All	St Johns	1	8	1.54	-0.07	3.14
All mortality	All	Toronto	1	8	0.68	0.25	1.12
All mortality	All	Vancouver	1	8	1.44	0.77	2.12
All mortality	All	Windsor	1	8	0.82	-0.15	1.80
All mortality	All	Winnipeg	1	8	1.01	-0.10	2.12
All mortality	All	Calgary	1	12	0.59	-0.71	1.89
All mortality	All	Edmonton	1	12	0.22	-0.86	1.31
All mortality	All	Halifax	1	12	1.02	-0.53	2.57
All mortality	All	Hamilton	1	12	1.22	0.33	2.10
All mortality	All	Montreal	1	12	0.79	0.28	1.30
All mortality	All	Ottawa	1	12	0.46	-0.44	1.36
All mortality	All	Quebec City	1	12	1.37	0.55	2.19
All mortality	All	St Johns	1	12	1.63	-0.01	3.28
All mortality	All	Toronto	1	12	0.60	0.16	1.04
All mortality	All	Vancouver	1	12	1.69	0.99	2.39
All mortality	All	Windsor	1	12	0.75	-0.25	1.74
All mortality	All	Winnipeg	1	12	0.82	-0.33	1.97

Table C-1 . City specific percent change (β x1000) in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI Lower	Upper
All mortality	All	Calgary	2	4	0.34	-0.98	1.66
All mortality	All	Edmonton	2	4	0.35	-0.74	1.44
All mortality	All	Halifax	2	4	1.01	-0.55	2.57
All mortality	All	Hamilton	2	4	1.73	0.77	2.70
All mortality	All	Montreal	2	4	1.65	1.11	2.19
All mortality	All	Ottawa	2	4	0.57	-0.38	1.51
All mortality	All	Quebec City	2	4	1.06	0.21	1.91
All mortality	All	St Johns	2	4	2.12	0.37	3.86
All mortality	All	Toronto	2	4	1.05	0.56	1.53
All mortality	All	Vancouver	2	4	1.39	0.70	2.09
All mortality	All	Windsor	2	4	0.90	-0.18	1.98
All mortality	All	Winnipeg	2	4	1.27	0.15	2.39
All mortality	All	Calgary	2	8	0.60	-0.84	2.05
All mortality	All	Edmonton	2	8	0.29	-0.91	1.50
All mortality	All	Halifax	2	8	0.94	-0.74	2.62
All mortality	All	Hamilton	2	8	1.44	0.44	2.44
All mortality	All	Montreal	2	8	1.34	0.76	1.92
All mortality	All	Ottawa	2	8	0.51	-0.50	1.52
All mortality	All	Quebec City	2	8	1.12	0.21	2.03
All mortality	All	St Johns	2	8	2.15	0.32	3.98
All mortality	All	Toronto	2	8	1.02	0.52	1.52
All mortality	All	Vancouver	2	8	1.41	0.65	2.17
All mortality	All	Windsor	2	8	1.15	0.03	2.27
All mortality	All	Winnipeg	2	8	1.29	0.03	2.55
All mortality	All	Calgary	2	12	0.57	-0.94	2.07
All mortality	All	Edmonton	2	12	0.35	-0.89	1.60
All mortality	All	Halifax	2	12	0.80	-0.95	2.56
All mortality	All	Hamilton	2	12	1.27	0.23	2.31
All mortality	All	Montreal	2	12	1.08	0.48	1.67
All mortality	All	Ottawa	2	12	0.73	-0.32	1.78
All mortality	All	Quebec City	2	12	1.15	0.20	2.10
All mortality	All	St Johns	2	12	2.32	0.43	4.21
All mortality	All	Toronto	2	12	0.93	0.41	1.44
All mortality	All	Vancouver	2	12	1.73	0.94	2.53
All mortality	All	Windsor	2	12	1.08	-0.07	2.22
All mortality	All	Winnipeg	2	12	1.07	-0.25	2.39
All mortality	All	Calgary	dist02	4	0.53	-0.79	1.86
All mortality	All	Edmonton	dist02	4	0.28	-0.81	1.38
All mortality	All	Halifax	dist02	4	0.78	-0.87	2.44
All mortality	All	Hamilton	dist02	4	1.79	0.79	2.79
All mortality	All	Montreal	dist02	4	1.4	0.85	1.96
All mortality	All	Ottawa	dist02	4	0.66	-0.29	1.63
All mortality	All	Quebec City	dist02	4	0.97	0.09	1.85
All mortality	All	St Johns	dist02	4	2.33	0.53	4.12
All mortality	All	Toronto	dist02	4	0.97	0.47	1.47
All mortality	All	Vancouver	dist02	4	1.3	0.59	2
All mortality	All	Windsor	dist02	4	0.56	-0.58	1.7
All mortality	All	Winnipeg	dist02	4	1.26	0.1	2.42

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Calgary	dist02	8	0.82	-0.63	2.27
All mortality	All	Edmonton	dist02	8	0.2	-1.01	1.42
All mortality	All	Halifax	dist02	8	0.79	-0.98	2.57
All mortality	All	Hamilton	dist02	8	1.47	0.44	2.5
All mortality	All	Montreal	dist02	8	1.06	0.47	1.66
All mortality	All	Ottawa	dist02	8	0.64	-0.38	1.67
All mortality	All	Quebec City	dist02	8	1.02	0.08	1.96
All mortality	All	St Johns	dist02	8	2.39	0.51	4.27
All mortality	All	Toronto	dist02	8	0.95	0.43	1.47
All mortality	All	Vancouver	dist02	8	1.29	0.52	2.06
All mortality	All	Windsor	dist02	8	0.81	-0.37	2
All mortality	All	Winnipeg	dist02	8	1.32	0.02	2.63
All mortality	All	Calgary	dist02	12	0.77	-0.73	2.28
All mortality	All	Edmonton	dist02	12	0.28	-0.98	1.54
All mortality	All	Halifax	dist02	12	0.54	-1.32	2.41
All mortality	All	Hamilton	dist02	12	1.3	0.22	2.38
All mortality	All	Montreal	dist02	12	0.77	0.15	1.38
All mortality	All	Ottawa	dist02	12	0.85	-0.22	1.93
All mortality	All	Quebec City	dist02	12	1.08	0.08	2.07
All mortality	All	St Johns	dist02	12	2.57	0.63	4.51
All mortality	All	Toronto	dist02	12	0.85	0.31	1.38
All mortality	All	Vancouver	dist02	12	1.62	0.8	2.44
All mortality	All	Windsor	dist02	12	0.77	-0.45	1.99
All mortality	All	Winnipeg	dist02	12	1.09	-0.26	2.44
All mortality	≥75	Calgary	1	4	-0.864	-2.30	0.57
All mortality	≥75	Edmonton	1	4	0.988	-0.25	2.23
All mortality	≥75	Halifax	1	4	0.332	-1.54	2.21
All mortality	≥75	Hamilton	1	4	0.334	-0.71	1.38
All mortality	≥75	Montreal	1	4	1.009	0.42	1.60
All mortality	≥75	Ottawa	1	4	0.143	-0.90	1.19
All mortality	≥75	Quebec City	1	4	1.059	0.14	1.98
All mortality	≥75	St Johns	1	4	1.138	-0.79	3.07
All mortality	≥75	Toronto	1	4	0.507	0.00	1.02
All mortality	≥75	Vancouver	1	4	1.236	0.49	1.98
All mortality	≥75	Windsor	1	4	0.508	-0.62	1.64
All mortality	≥75	Winnipeg	1	4	0.570	-0.64	1.78
All mortality	≥75	Calgary	1	8	-0.891	-2.39	0.61
All mortality	≥75	Edmonton	1	8	1.030	-0.28	2.34
All mortality	≥75	Halifax	1	8	0.322	-1.63	2.28
All mortality	≥75	Hamilton	1	8	0.149	-0.91	1.21
All mortality	≥75	Montreal	1	8	0.943	0.33	1.56
All mortality	≥75	Ottawa	1	8	0.083	-1.01	1.17
All mortality	≥75	Quebec City	1	8	1.139	0.18	2.10
All mortality	≥75	St Johns	1	8	1.243	-0.74	3.22
All mortality	≥75	Toronto	1	8	0.518	0.00	1.04
All mortality	≥75	Vancouver	1	8	1.295	0.50	2.09
All mortality	≥75	Windsor	1	8	0.615	-0.54	1.77
All mortality	≥75	Winnipeg	1	8	0.702	-0.59	1.99

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	≥75	Calgary	1	12	-1.097	-2.63	0.44
All mortality	≥75	Edmonton	1	12	1.045	-0.29	2.38
All mortality	≥75	Halifax	1	12	0.259	-1.75	2.27
All mortality	≥75	Hamilton	1	12	-0.109	-1.19	0.97
All mortality	≥75	Montreal	1	12	0.733	0.11	1.35
All mortality	≥75	Ottawa	1	12	0.102	-1.01	1.22
All mortality	≥75	Quebec City	1	12	1.106	0.13	2.09
All mortality	≥75	St Johns	1	12	1.423	-0.59	3.44
All mortality	≥75	Toronto	1	12	0.425	-0.10	0.95
All mortality	≥75	Vancouver	1	12	1.516	0.70	2.33
All mortality	≥75	Windsor	1	12	0.558	-0.61	1.73
All mortality	≥75	Winnipeg	1	12	0.636	-0.68	1.95
All mortality	≥75	Calgary	2	4	-0.154	-2.09	1.79
All mortality	≥75	Edmonton	2	4	1.345	-0.29	2.98
All mortality	≥75	Halifax	2	4	1.095	-1.31	3.50
All mortality	≥75	Hamilton	2	4	1.296	-0.16	2.75
All mortality	≥75	Montreal	2	4	1.753	0.95	2.56
All mortality	≥75	Ottawa	2	4	0.451	-0.97	1.87
All mortality	≥75	Quebec City	2	4	1.280	0.03	2.53
All mortality	≥75	St Johns	2	4	1.666	-0.89	4.22
All mortality	≥75	Toronto	2	4	1.258	0.55	1.96
All mortality	≥75	Vancouver	2	4	1.730	0.77	2.69
All mortality	≥75	Windsor	2	4	0.884	-0.66	2.42
All mortality	≥75	Winnipeg	2	4	0.876	-0.71	2.47
All mortality	≥75	Calgary	2	8	-0.203	-2.32	1.92
All mortality	≥75	Edmonton	2	8	1.480	-0.34	3.30
All mortality	≥75	Halifax	2	8	0.932	-1.66	3.52
All mortality	≥75	Hamilton	2	8	0.900	-0.60	2.40
All mortality	≥75	Montreal	2	8	1.449	0.59	2.31
All mortality	≥75	Ottawa	2	8	0.300	-1.22	1.82
All mortality	≥75	Quebec City	2	8	1.306	-0.03	2.65
All mortality	≥75	St Johns	2	8	1.705	-0.99	4.40
All mortality	≥75	Toronto	2	8	1.269	0.54	2.00
All mortality	≥75	Vancouver	2	8	1.832	0.78	2.88
All mortality	≥75	Windsor	2	8	1.147	-0.45	2.75
All mortality	≥75	Winnipeg	2	8	1.101	-0.69	2.89
All mortality	≥75	Calgary	2	12	-0.511	-2.72	1.70
All mortality	≥75	Edmonton	2	12	1.518	-0.36	3.40
All mortality	≥75	Halifax	2	12	0.794	-1.92	3.51
All mortality	≥75	Hamilton	2	12	0.418	-1.14	1.98
All mortality	≥75	Montreal	2	12	1.038	0.15	1.93
All mortality	≥75	Ottawa	2	12	0.349	-1.24	1.94
All mortality	≥75	Quebec City	2	12	1.229	-0.18	2.64
All mortality	≥75	St Johns	2	12	2.015	-0.76	4.79
All mortality	≥75	Toronto	2	12	1.115	0.36	1.87
All mortality	≥75	Vancouver	2	12	2.289	1.19	3.39
All mortality	≥75	Windsor	2	12	1.094	-0.55	2.73
All mortality	≥75	Winnipeg	2	12	1.010	-0.86	2.88

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	≥75	Calgary	dist02	4	0.25	-1.69	2.21
All mortality	≥75	Edmonton	dist02	4	1.33	-0.17	2.84
All mortality	≥75	Halifax	dist02	4	1.12	-0.17	2.42
All mortality	≥75	Hamilton	dist02	4	1.72	0.74	2.7
All mortality	≥75	Montreal	dist02	4	0.27	-1.85	2.41
All mortality	≥75	Ottawa	dist02	4	0.92	-0.61	2.47
All mortality	≥75	Quebec City	dist02	4	1.09	-0.3	2.48
All mortality	≥75	St Johns	dist02	4	1.82	0.74	2.89
All mortality	≥75	Toronto	dist02	4	-0.06	-2.29	2.15
All mortality	≥75	Vancouver	dist02	4	0.44	-1.17	2.06
All mortality	≥75	Windsor	dist02	4	1.03	-0.43	2.49
All mortality	≥75	Winnipeg	dist02	4	2.29	1.16	3.42
All mortality	≥75	Calgary	dist02	8	1.24	-0.41	2.9
All mortality	≥75	Edmonton	dist02	8	1.45	0.63	2.28
All mortality	≥75	Halifax	dist02	8	1.29	-1.32	3.92
All mortality	≥75	Hamilton	dist02	8	0.32	-1.3	1.95
All mortality	≥75	Montreal	dist02	8	1.41	-0.42	3.25
All mortality	≥75	Ottawa	dist02	8	1.07	0.18	1.96
All mortality	≥75	Quebec City	dist02	8	1.41	-1.34	4.17
All mortality	≥75	St Johns	dist02	8	0.64	-1.05	2.33
All mortality	≥75	Toronto	dist02	8	1.48	-0.42	3.39
All mortality	≥75	Vancouver	dist02	8	0.62	-0.29	1.53
All mortality	≥75	Windsor	dist02	8	1.75	-1.09	4.61
All mortality	≥75	Winnipeg	dist02	8	0.57	-1.16	2.32
All mortality	≥75	Calgary	dist02	12	0.92	-1.62	3.48
All mortality	≥75	Edmonton	dist02	12	0.63	-0.82	2.08
All mortality	≥75	Halifax	dist02	12	1.14	0.41	1.88
All mortality	≥75	Hamilton	dist02	12	0.9	-0.73	2.54
All mortality	≥75	Montreal	dist02	12	0.9	-1.83	3.64
All mortality	≥75	Ottawa	dist02	12	0.48	-1.07	2.04
All mortality	≥75	Quebec City	dist02	12	1.16	0.4	1.92
All mortality	≥75	St Johns	dist02	12	1.19	-0.64	3.04
All mortality	≥75	Toronto	dist02	12	0.78	-2.1	3.66
All mortality	≥75	Vancouver	dist02	12	0.51	-1.11	2.13
All mortality	≥75	Windsor	dist02	12	1	0.21	1.78
All mortality	≥75	Winnipeg	dist02	12	1.06	-0.85	2.98
All mortality	<75	Calgary	1	4	0.541	-0.79	1.87
All mortality	<75	Edmonton	1	4	-0.320	-1.43	0.78
All mortality	<75	Halifax	1	4	1.066	-0.53	2.67
All mortality	<75	Hamilton	1	4	1.153	0.22	2.08
All mortality	<75	Montreal	1	4	0.809	0.28	1.34
All mortality	<75	Ottawa	1	4	0.127	-0.80	1.06
All mortality	<75	Quebec City	1	4	0.630	-0.22	1.48
All mortality	<75	St Johns	1	4	1.367	-0.43	3.17
All mortality	<75	Toronto	1	4	0.520	0.04	1.00
All mortality	<75	Vancouver	1	4	0.950	0.17	1.73
All mortality	<75	Windsor	1	4	1.206	0.09	2.32
All mortality	<75	Winnipeg	1	4	0.123	-1.09	1.33

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	<75	Calgary	1	8	0.767	-0.63	2.16
All mortality	<75	Edmonton	1	8	-0.432	-1.60	0.74
All mortality	<75	Halifax	1	8	1.009	-0.66	2.67
All mortality	<75	Hamilton	1	8	1.019	0.07	1.96
All mortality	<75	Montreal	1	8	0.598	0.05	1.15
All mortality	<75	Ottawa	1	8	0.092	-0.88	1.06
All mortality	<75	Quebec City	1	8	0.698	-0.19	1.58
All mortality	<75	St Johns	1	8	1.323	-0.53	3.17
All mortality	<75	Toronto	1	8	0.485	0.00	0.97
All mortality	<75	Vancouver	1	8	0.905	0.08	1.73
All mortality	<75	Windsor	1	8	1.284	0.14	2.42
All mortality	<75	Winnipeg	1	8	-0.154	-1.44	1.13
All mortality	<75	Calgary	1	12	0.856	-0.57	2.28
All mortality	<75	Edmonton	1	12	-0.381	-1.57	0.81
All mortality	<75	Halifax	1	12	0.892	-0.81	2.60
All mortality	<75	Hamilton	1	12	1.032	0.07	2.00
All mortality	<75	Montreal	1	12	0.516	-0.04	1.07
All mortality	<75	Ottawa	1	12	0.234	-0.75	1.22
All mortality	<75	Quebec City	1	12	0.736	-0.17	1.64
All mortality	<75	St Johns	1	12	1.282	-0.60	3.16
All mortality	<75	Toronto	1	12	0.456	-0.04	0.95
All mortality	<75	Vancouver	1	12	1.007	0.16	1.86
All mortality	<75	Windsor	1	12	1.256	0.10	2.41
All mortality	<75	Winnipeg	1	12	-0.376	-1.69	0.94
All mortality	<75	Calgary	2	4	0.801	-1.00	2.60
All mortality	<75	Edmonton	2	4	-0.411	-1.87	1.04
All mortality	<75	Halifax	2	4	0.944	-1.11	3.00
All mortality	<75	Hamilton	2	4	2.074	0.78	3.37
All mortality	<75	Montreal	2	4	1.571	0.85	2.30
All mortality	<75	Ottawa	2	4	0.656	-0.61	1.92
All mortality	<75	Quebec City	2	4	0.857	-0.29	2.01
All mortality	<75	St Johns	2	4	2.520	0.13	4.91
All mortality	<75	Toronto	2	4	0.865	0.21	1.53
All mortality	<75	Vancouver	2	4	1.037	0.03	2.04
All mortality	<75	Windsor	2	4	0.928	-0.59	2.44
All mortality	<75	Winnipeg	2	4	1.652	0.07	3.24
All mortality	<75	Calgary	2	8	1.281	-0.69	3.25
All mortality	<75	Edmonton	2	8	-0.653	-2.26	0.96
All mortality	<75	Halifax	2	8	0.929	-1.28	3.13
All mortality	<75	Hamilton	2	8	1.867	0.53	3.20
All mortality	<75	Montreal	2	8	1.253	0.47	2.03
All mortality	<75	Ottawa	2	8	0.657	-0.69	2.01
All mortality	<75	Quebec City	2	8	0.935	-0.30	2.17
All mortality	<75	St Johns	2	8	2.522	0.02	5.02
All mortality	<75	Toronto	2	8	0.807	0.13	1.49
All mortality	<75	Vancouver	2	8	0.947	-0.15	2.04
All mortality	<75	Windsor	2	8	1.151	-0.42	2.72
All mortality	<75	Winnipeg	2	8	1.463	-0.32	3.24

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
All mortality	<75	Calgary	2	12	1.496	-0.55	3.55
All mortality	<75	Edmonton	2	12	-0.574	-2.24	1.09
All mortality	<75	Halifax	2	12	0.807	-1.49	3.11
All mortality	<75	Hamilton	2	12	1.935	0.55	3.32
All mortality	<75	Montreal	2	12	1.108	0.30	1.91
All mortality	<75	Ottawa	2	12	0.997	-0.41	2.40
All mortality	<75	Quebec City	2	12	1.050	-0.25	2.35
All mortality	<75	St Johns	2	12	2.575	0.00	5.15
All mortality	<75	Toronto	2	12	0.759	0.06	1.46
All mortality	<75	Vancouver	2	12	1.127	-0.03	2.28
All mortality	<75	Windsor	2	12	1.070	-0.54	2.68
All mortality	<75	Winnipeg	2	12	1.115	-0.75	2.98
All mortality	<75	Calgary	dist02	4	0.82	-0.99	2.63
All mortality	<75	Edmonton	dist02	4	2.15	0.81	3.5
All mortality	<75	Halifax	dist02	4	0.83	-0.35	2.03
All mortality	<75	Hamilton	dist02	4	0.84	-0.17	1.86
All mortality	<75	Montreal	dist02	4	1.27	-0.71	3.26
All mortality	<75	Ottawa	dist02	4	1.9	0.52	3.29
All mortality	<75	Quebec City	dist02	4	0.94	-0.34	2.23
All mortality	<75	St Johns	dist02	4	0.72	-0.4	1.84
All mortality	<75	Toronto	dist02	4	1.5	-0.55	3.56
All mortality	<75	Vancouver	dist02	4	1.97	0.53	3.41
All mortality	<75	Windsor	dist02	4	1.09	-0.26	2.45
All mortality	<75	Winnipeg	dist02	4	0.88	-0.29	2.07
All mortality	<75	Calgary	dist02	8	-0.45	-1.92	1.01
All mortality	<75	Edmonton	dist02	8	1.36	0.62	2.11
All mortality	<75	Halifax	dist02	8	3.23	0.78	5.68
All mortality	<75	Hamilton	dist02	8	0.79	-0.81	2.4
All mortality	<75	Montreal	dist02	8	-0.75	-2.38	0.87
All mortality	<75	Ottawa	dist02	8	1.06	0.26	1.86
All mortality	<75	Quebec City	dist02	8	3.24	0.67	5.81
All mortality	<75	St Johns	dist02	8	0.98	-0.69	2.66
All mortality	<75	Toronto	dist02	8	-0.66	-2.34	1.02
All mortality	<75	Vancouver	dist02	8	0.88	0.05	1.71
All mortality	<75	Windsor	dist02	8	3.26	0.61	5.91
All mortality	<75	Winnipeg	dist02	8	0.97	-0.74	2.69
All mortality	<75	Calgary	dist02	12	0.65	-1.52	2.84
All mortality	<75	Edmonton	dist02	12	0.68	-0.6	1.97
All mortality	<75	Halifax	dist02	12	0.81	0.13	1.5
All mortality	<75	Hamilton	dist02	12	1.6	-0.03	3.23
All mortality	<75	Montreal	dist02	12	0.66	-1.67	3
All mortality	<75	Ottawa	dist02	12	0.74	-0.63	2.12
All mortality	<75	Quebec City	dist02	12	0.76	0.05	1.47
All mortality	<75	St Johns	dist02	12	1.43	-0.4	3.28
All mortality	<75	Toronto	dist02	12	0.29	-2.15	2.75
All mortality	<75	Vancouver	dist02	12	1.08	-0.35	2.52
All mortality	<75	Windsor	dist02	12	0.71	-0.01	1.44
All mortality	<75	Winnipeg	dist02	12	1.09	-0.82	3.02

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	All	Calgary	0	4	1.43	-0.09	2.95
CVD mortality	All	Edmonton	0	4	-0.23	-1.52	1.06
CVD mortality	All	Halifax	0	4	-0.26	-2.23	1.71
CVD mortality	All	Hamilton	0	4	1.57	0.51	2.63
CVD mortality	All	Montreal	0	4	0.65	0.03	1.27
CVD mortality	All	Ottawa	0	4	1.15	0.09	2.22
CVD mortality	All	Quebec City	0	4	0.63	-0.34	1.59
CVD mortality	All	St Johns	0	4	0.95	-1.03	2.93
CVD mortality	All	Toronto	0	4	0.45	-0.10	1.01
CVD mortality	All	Vancouver	0	4	1.34	0.51	2.17
CVD mortality	All	Windsor	0	4	-0.55	-1.70	0.60
CVD mortality	All	Winnipeg	0	4	1.25	-0.06	2.55
CVD mortality	All	Calgary	0	8	1.58	-0.01	3.16
CVD mortality	All	Edmonton	0	8	-0.52	-1.88	0.84
CVD mortality	All	Halifax	0	8	-0.05	-2.11	2.00
CVD mortality	All	Hamilton	0	8	1.45	0.37	2.53
CVD mortality	All	Montreal	0	8	0.26	-0.39	0.91
CVD mortality	All	Ottawa	0	8	0.84	-0.26	1.95
CVD mortality	All	Quebec City	0	8	0.59	-0.42	1.59
CVD mortality	All	St Johns	0	8	0.83	-1.20	2.87
CVD mortality	All	Toronto	0	8	0.40	-0.17	0.96
CVD mortality	All	Vancouver	0	8	1.17	0.29	2.04
CVD mortality	All	Windsor	0	8	-0.44	-1.61	0.74
CVD mortality	All	Winnipeg	0	8	1.36	-0.03	2.74
CVD mortality	All	Calgary	0	12	1.59	-0.03	3.21
CVD mortality	All	Edmonton	0	12	-0.46	-1.84	0.93
CVD mortality	All	Halifax	0	12	-0.34	-2.45	1.76
CVD mortality	All	Hamilton	0	12	1.16	0.06	2.26
CVD mortality	All	Montreal	0	12	0.13	-0.52	0.79
CVD mortality	All	Ottawa	0	12	0.66	-0.47	1.79
CVD mortality	All	Quebec City	0	12	0.55	-0.48	1.58
CVD mortality	All	St Johns	0	12	0.78	-1.29	2.85
CVD mortality	All	Toronto	0	12	0.33	-0.24	0.91
CVD mortality	All	Vancouver	0	12	1.28	0.38	2.18
CVD mortality	All	Windsor	0	12	-0.47	-1.67	0.72
CVD mortality	All	Winnipeg	0	12	1.22	-0.19	2.64
CVD mortality	All	Calgary	1	4	-0.43	-1.95	1.08
CVD mortality	All	Edmonton	1	4	0.55	-0.73	1.84
CVD mortality	All	Halifax	1	4	0.55	-1.41	2.52
CVD mortality	All	Hamilton	1	4	0.81	-0.25	1.87
CVD mortality	All	Montreal	1	4	1.06	0.44	1.68
CVD mortality	All	Ottawa	1	4	0.79	-0.27	1.86
CVD mortality	All	Quebec City	1	4	0.72	-0.25	1.68
CVD mortality	All	St Johns	1	4	1.34	-0.64	3.33
CVD mortality	All	Toronto	1	4	0.33	-0.22	0.89
CVD mortality	All	Vancouver	1	4	1.21	0.39	2.04
CVD mortality	All	Windsor	1	4	0.21	-0.94	1.36
CVD mortality	All	Winnipeg	1	4	0.39	-0.91	1.69

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	All	Calgary	1	8	-0.46	-2.05	1.12
CVD mortality	All	Edmonton	1	8	0.38	-0.98	1.74
CVD mortality	All	Halifax	1	8	0.89	-1.16	2.94
CVD mortality	All	Hamilton	1	8	0.69	-0.39	1.77
CVD mortality	All	Montreal	1	8	0.72	0.07	1.37
CVD mortality	All	Ottawa	1	8	0.48	-0.63	1.59
CVD mortality	All	Quebec City	1	8	0.69	-0.31	1.70
CVD mortality	All	St Johns	1	8	1.30	-0.74	3.33
CVD mortality	All	Toronto	1	8	0.28	-0.29	0.84
CVD mortality	All	Vancouver	1	8	1.19	0.31	2.07
CVD mortality	All	Windsor	1	8	0.32	-0.85	1.49
CVD mortality	All	Winnipeg	1	8	0.34	-1.04	1.73
CVD mortality	All	Calgary	1	12	-0.56	-2.18	1.06
CVD mortality	All	Edmonton	1	12	0.48	-0.91	1.86
CVD mortality	All	Halifax	1	12	0.71	-1.39	2.81
CVD mortality	All	Hamilton	1	12	0.37	-0.73	1.48
CVD mortality	All	Montreal	1	12	0.60	-0.05	1.26
CVD mortality	All	Ottawa	1	12	0.28	-0.85	1.42
CVD mortality	All	Quebec City	1	12	0.70	-0.33	1.73
CVD mortality	All	St Johns	1	12	1.27	-0.79	3.34
CVD mortality	All	Toronto	1	12	0.21	-0.36	0.79
CVD mortality	All	Vancouver	1	12	1.32	0.41	2.22
CVD mortality	All	Windsor	1	12	0.29	-0.89	1.48
CVD mortality	All	Winnipeg	1	12	0.22	-1.20	1.63
CVD mortality	All	Calgary	2	4	0.35	-1.16	1.86
CVD mortality	All	Edmonton	2	4	0.70	-0.58	1.99
CVD mortality	All	Halifax	2	4	-0.42	-2.39	1.55
CVD mortality	All	Hamilton	2	4	0.82	-0.24	1.88
CVD mortality	All	Montreal	2	4	1.25	0.63	1.87
CVD mortality	All	Ottawa	2	4	0.59	-0.47	1.66
CVD mortality	All	Quebec City	2	4	-0.36	-1.33	0.61
CVD mortality	All	St Johns	2	4	1.94	-0.04	3.92
CVD mortality	All	Toronto	2	4	1.23	0.68	1.78
CVD mortality	All	Vancouver	2	4	0.43	-0.40	1.26
CVD mortality	All	Windsor	2	4	0.40	-0.75	1.54
CVD mortality	All	Winnipeg	2	4	0.55	-0.62	1.73
CVD mortality	All	Calgary	2	8	0.38	-1.21	1.96
CVD mortality	All	Edmonton	2	8	0.62	-0.75	1.98
CVD mortality	All	Halifax	2	8	0.00	-2.06	2.05
CVD mortality	All	Hamilton	2	8	0.69	-0.40	1.77
CVD mortality	All	Montreal	2	8	1.02	0.37	1.66
CVD mortality	All	Ottawa	2	8	0.30	-0.82	1.41
CVD mortality	All	Quebec City	2	8	-0.45	-1.46	0.56
CVD mortality	All	St Johns	2	8	2.00	-0.03	4.03
CVD mortality	All	Toronto	2	8	1.23	0.67	1.80
CVD mortality	All	Vancouver	2	8	0.35	-0.53	1.23
CVD mortality	All	Windsor	2	8	0.42	-0.48	1.33
CVD mortality	All	Winnipeg	2	8	0.54	-0.65	1.73

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	All	Calgary	2	12	0.29	-1.33	1.91
CVD mortality	All	Edmonton	2	12	0.71	-0.68	2.10
CVD mortality	All	Halifax	2	12	-0.20	-2.31	1.90
CVD mortality	All	Hamilton	2	12	0.38	-0.73	1.48
CVD mortality	All	Montreal	2	12	0.91	0.25	1.56
CVD mortality	All	Ottawa	2	12	0.08	-1.05	1.22
CVD mortality	All	Quebec City	2	12	-0.49	-1.53	0.54
CVD mortality	All	St Johns	2	12	2.03	-0.03	4.09
CVD mortality	All	Toronto	2	12	1.21	0.63	1.78
CVD mortality	All	Vancouver	2	12	0.42	-0.48	1.33
CVD mortality	All	Windsor	2	12	0.40	-0.75	1.54
CVD mortality	All	Winnipeg	2	12	1.60	0.30	2.90
CVD mortality	All	Calgary	1	4	0.79	-1.04	2.62
CVD mortality	All	Edmonton	1	4	0.21	-1.31	1.74
CVD mortality	All	Halifax	1	4	-0.03	-2.31	2.26
CVD mortality	All	Hamilton	1	4	1.81	0.53	3.10
CVD mortality	All	Montreal	1	4	1.35	0.60	2.10
CVD mortality	All	Ottawa	1	4	1.43	0.15	2.70
CVD mortality	All	Quebec City	1	4	1.04	-0.12	2.19
CVD mortality	All	St Johns	1	4	1.53	-0.80	3.85
CVD mortality	All	Toronto	1	4	0.57	-0.10	1.25
CVD mortality	All	Vancouver	1	4	1.72	0.76	2.68
CVD mortality	All	Windsor	1	4	-0.31	-1.68	1.06
CVD mortality	All	Winnipeg	1	4	1.19	-0.35	2.74
CVD mortality	All	Calgary	1	8	0.89	-1.07	2.84
CVD mortality	All	Edmonton	1	8	-0.14	-1.80	1.51
CVD mortality	All	Halifax	1	8	0.30	-2.12	2.72
CVD mortality	All	Hamilton	1	8	1.65	0.34	2.97
CVD mortality	All	Montreal	1	8	0.76	-0.04	1.55
CVD mortality	All	Ottawa	1	8	1.01	-0.33	2.35
CVD mortality	All	Quebec City	1	8	1.01	-0.21	2.23
CVD mortality	All	St Johns	1	8	1.40	-1.02	3.81
CVD mortality	All	Toronto	1	8	0.49	-0.20	1.18
CVD mortality	All	Vancouver	1	8	1.60	0.57	2.64
CVD mortality	All	Windsor	1	8	-0.16	-1.57	1.25
CVD mortality	All	Winnipeg	1	8	1.30	-0.38	2.99
CVD mortality	All	Calgary	1	12	0.83	-1.19	2.85
CVD mortality	All	Edmonton	1	12	-0.04	-1.73	1.66
CVD mortality	All	Halifax	1	12	-0.07	-2.58	2.43
CVD mortality	All	Hamilton	1	12	1.23	-0.13	2.59
CVD mortality	All	Montreal	1	12	0.57	-0.24	1.38
CVD mortality	All	Ottawa	1	12	0.75	-0.63	2.14
CVD mortality	All	Quebec City	1	12	1.03	-0.24	2.29
CVD mortality	All	St Johns	1	12	1.39	-1.08	3.85
CVD mortality	All	Toronto	1	12	0.40	-0.31	1.10
CVD mortality	All	Vancouver	1	12	1.80	0.72	2.87
CVD mortality	All	Windsor	1	12	-0.22	-1.66	1.22
CVD mortality	All	Winnipeg	1	12	1.08	-0.66	2.82

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
CVD mortality	All	Calgary	2	4	0.88	-1.17	2.93
CVD mortality	All	Edmonton	2	4	0.60	-1.10	2.30
CVD mortality	All	Halifax	2	4	-0.07	-2.58	2.45
CVD mortality	All	Hamilton	2	4	2.20	0.72	3.68
CVD mortality	All	Montreal	2	4	2.11	1.26	2.96
CVD mortality	All	Ottawa	2	4	1.62	0.18	3.07
CVD mortality	All	Quebec City	2	4	0.66	-0.65	1.97
CVD mortality	All	St Johns	2	4	2.29	-0.33	4.92
CVD mortality	All	Toronto	2	4	1.30	0.54	2.07
CVD mortality	All	Vancouver	2	4	1.61	0.55	2.67
CVD mortality	All	Windsor	2	4	0.06	-1.50	1.61
CVD mortality	All	Winnipeg	2	4	1.96	0.26	3.67
CVD mortality	All	Calgary	2	8	1.02	-1.22	3.25
CVD mortality	All	Edmonton	2	8	0.27	-1.61	2.15
CVD mortality	All	Halifax	2	8	0.38	-2.33	3.08
CVD mortality	All	Hamilton	2	8	1.99	0.46	3.51
CVD mortality	All	Montreal	2	8	1.45	0.53	2.36
CVD mortality	All	Ottawa	2	8	1.14	-0.41	2.69
CVD mortality	All	Quebec City	2	8	0.59	-0.81	1.99
CVD mortality	All	St Johns	2	8	2.32	-0.43	5.07
CVD mortality	All	Toronto	2	8	1.26	0.46	2.05
CVD mortality	All	Vancouver	2	8	1.54	0.37	2.70
CVD mortality	All	Windsor	2	8	0.31	-1.31	1.93
CVD mortality	All	Winnipeg	2	8	2.27	0.35	4.18
CVD mortality	All	Calgary	2	12	0.91	-1.42	3.24
CVD mortality	All	Edmonton	2	12	0.42	-1.53	2.36
CVD mortality	All	Halifax	2	12	0.04	-2.79	2.86
CVD mortality	All	Hamilton	2	12	1.45	-0.14	3.04
CVD mortality	All	Montreal	2	12	1.23	0.29	2.17
CVD mortality	All	Ottawa	2	12	0.80	-0.81	2.41
CVD mortality	All	Quebec City	2	12	0.55	-0.92	2.02
CVD mortality	All	St Johns	2	12	2.38	-0.45	5.21
CVD mortality	All	Toronto	2	12	1.18	0.37	2.00
CVD mortality	All	Vancouver	2	12	1.79	0.56	3.01
CVD mortality	All	Windsor	2	12	0.28	-1.38	1.93
CVD mortality	All	Winnipeg	2	12	2.03	0.03	4.03
CVD mortality	All	Calgary	dist02	4	1.18	-0.87	3.25
CVD mortality	All	Edmonton	dist02	4	0.33	-1.38	2.05
CVD mortality	All	Halifax	dist02	4	-0.33	-3	2.33
CVD mortality	All	Hamilton	dist02	4	2.42	0.88	3.95
CVD mortality	All	Montreal	dist02	4	1.98	1.11	2.86
CVD mortality	All	Ottawa	dist02	4	1.66	0.18	3.14
CVD mortality	All	Quebec City	dist02	4	0.51	-0.84	1.87
CVD mortality	All	St Johns	dist02	4	2.29	-0.39	4.99
CVD mortality	All	Toronto	dist02	4	1.28	0.48	2.08
CVD mortality	All	Vancouver	dist02	4	1.49	0.4	2.57
CVD mortality	All	Windsor	dist02	4	-0.34	-1.99	1.3
CVD mortality	All	Winnipeg	dist02	4	1.95	0.19	3.71

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	All	Calgary	dist02	8	1.39	-0.85	3.65
CVD mortality	All	Edmonton	dist02	8	-0.05	-1.96	1.85
CVD mortality	All	Halifax	dist02	8	0.27	-2.59	3.14
CVD mortality	All	Hamilton	dist02	8	2.2	0.62	3.78
CVD mortality	All	Montreal	dist02	8	1.32	0.38	2.26
CVD mortality	All	Ottawa	dist02	8	1.14	-0.43	2.72
CVD mortality	All	Quebec City	dist02	8	0.41	-1.03	1.87
CVD mortality	All	St Johns	dist02	8	2.42	-0.39	5.25
CVD mortality	All	Toronto	dist02	8	1.27	0.44	2.09
CVD mortality	All	Vancouver	dist02	8	1.39	0.2	2.58
CVD mortality	All	Windsor	dist02	8	-0.05	-1.77	1.66
CVD mortality	All	Winnipeg	dist02	8	2.34	0.36	4.31
CVD mortality	All	Calgary	dist02	12	1.28	-1.06	3.62
CVD mortality	All	Edmonton	dist02	12	0.1	-1.86	2.07
CVD mortality	All	Halifax	dist02	12	-0.18	-3.2	2.83
CVD mortality	All	Hamilton	dist02	12	1.63	-0.01	3.27
CVD mortality	All	Montreal	dist02	12	1.1	0.12	2.07
CVD mortality	All	Ottawa	dist02	12	0.76	-0.88	2.41
CVD mortality	All	Quebec City	dist02	12	0.37	-1.16	1.9
CVD mortality	All	St Johns	dist02	12	2.41	-0.5	5.33
CVD mortality	All	Toronto	dist02	12	1.19	0.34	2.04
CVD mortality	All	Vancouver	dist02	12	1.64	0.38	2.89
CVD mortality	All	Windsor	dist02	12	-0.1	-1.87	1.66
CVD mortality	All	Winnipeg	dist02	12	2.28	0.22	4.34
CVD mortality	≥75	Calgary	1	4	-0.801	-2.79	1.19
CVD mortality	≥75	Edmonton	1	4	1.166	-0.57	2.90
CVD mortality	≥75	Halifax	1	4	-0.617	-3.43	2.20
CVD mortality	≥75	Hamilton	1	4	0.583	-0.86	2.03
CVD mortality	≥75	Montreal	1	4	1.881	1.03	2.73
CVD mortality	≥75	Ottawa	1	4	0.722	-0.73	2.17
CVD mortality	≥75	Quebec City	1	4	1.425	0.12	2.73
CVD mortality	≥75	St Johns	1	4	0.999	-1.65	3.65
CVD mortality	≥75	Toronto	1	4	0.739	0.01	1.47
CVD mortality	≥75	Vancouver	1	4	1.425	0.38	2.47
CVD mortality	≥75	Windsor	1	4	0.097	-1.37	1.56
CVD mortality	≥75	Winnipeg	1	4	-0.418	-2.11	1.28
CVD mortality	≥75	Calgary	1	8	-0.878	-2.96	1.20
CVD mortality	≥75	Edmonton	1	8	1.320	-0.52	3.16
CVD mortality	≥75	Halifax	1	8	-0.346	-3.29	2.60
CVD mortality	≥75	Hamilton	1	8	0.481	-0.99	1.95
CVD mortality	≥75	Montreal	1	8	1.665	0.78	2.55
CVD mortality	≥75	Ottawa	1	8	0.475	-1.03	1.98
CVD mortality	≥75	Quebec City	1	8	1.548	0.20	2.90
CVD mortality	≥75	St Johns	1	8	0.991	-1.73	3.71
CVD mortality	≥75	Toronto	1	8	0.788	0.04	1.53
CVD mortality	≥75	Vancouver	1	8	1.506	0.40	2.61
CVD mortality	≥75	Windsor	1	8	0.328	-1.17	1.82
CVD mortality	≥75	Winnipeg	1	8	-0.348	-2.15	1.45

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	≥75	Calgary	1	12	-1.102	-3.22	1.02
CVD mortality	≥75	Edmonton	1	12	1.443	-0.43	3.31
CVD mortality	≥75	Halifax	1	12	-0.166	-3.19	2.86
CVD mortality	≥75	Hamilton	1	12	0.022	-1.48	1.52
CVD mortality	≥75	Montreal	1	12	1.528	0.63	2.42
CVD mortality	≥75	Ottawa	1	12	0.414	-1.13	1.96
CVD mortality	≥75	Quebec City	1	12	1.583	0.20	2.97
CVD mortality	≥75	St Johns	1	12	1.074	-1.69	3.84
CVD mortality	≥75	Toronto	1	12	0.730	-0.03	1.49
CVD mortality	≥75	Vancouver	1	12	1.640	0.51	2.77
CVD mortality	≥75	Windsor	1	12	0.299	-1.22	1.81
CVD mortality	≥75	Winnipeg	1	12	-0.431	-2.27	1.41
CVD mortality	≥75	Calgary	2	4	0.836	-1.85	3.52
CVD mortality	≥75	Edmonton	2	4	1.075	-1.21	3.36
CVD mortality	≥75	Halifax	2	4	-0.567	-4.16	3.03
CVD mortality	≥75	Hamilton	2	4	2.359	0.34	4.37
CVD mortality	≥75	Montreal	2	4	2.822	1.66	3.98
CVD mortality	≥75	Ottawa	2	4	1.168	-0.80	3.13
CVD mortality	≥75	Quebec City	2	4	1.245	-0.53	3.02
CVD mortality	≥75	St Johns	2	4	2.358	-1.15	5.86
CVD mortality	≥75	Toronto	2	4	1.835	0.82	2.85
CVD mortality	≥75	Vancouver	2	4	1.794	0.46	3.13
CVD mortality	≥75	Windsor	2	4	-0.026	-2.02	1.97
CVD mortality	≥75	Winnipeg	2	4	-0.037	-2.26	2.18
CVD mortality	≥75	Calgary	2	8	0.849	-2.09	3.78
CVD mortality	≥75	Edmonton	2	8	1.359	-1.18	3.90
CVD mortality	≥75	Halifax	2	8	-0.229	-4.10	3.64
CVD mortality	≥75	Hamilton	2	8	2.217	0.14	4.29
CVD mortality	≥75	Montreal	2	8	2.272	1.02	3.52
CVD mortality	≥75	Ottawa	2	8	0.694	-1.41	2.80
CVD mortality	≥75	Quebec City	2	8	1.340	-0.56	3.24
CVD mortality	≥75	St Johns	2	8	2.447	-1.23	6.13
CVD mortality	≥75	Toronto	2	8	1.969	0.92	3.02
CVD mortality	≥75	Vancouver	2	8	1.923	0.46	3.39
CVD mortality	≥75	Windsor	2	8	0.373	-1.70	2.44
CVD mortality	≥75	Winnipeg	2	8	0.146	-2.35	2.64
CVD mortality	≥75	Calgary	2	12	0.522	-2.53	3.58
CVD mortality	≥75	Edmonton	2	12	1.555	-1.08	4.19
CVD mortality	≥75	Halifax	2	12	0.164	-3.89	4.22
CVD mortality	≥75	Hamilton	2	12	1.432	-0.73	3.60
CVD mortality	≥75	Montreal	2	12	2.015	0.73	3.30
CVD mortality	≥75	Ottawa	2	12	0.577	-1.62	2.78
CVD mortality	≥75	Quebec City	2	12	1.338	-0.66	3.33
CVD mortality	≥75	St Johns	2	12	2.741	-1.05	6.53
CVD mortality	≥75	Toronto	2	12	1.924	0.84	3.01
CVD mortality	≥75	Vancouver	2	12	2.205	0.67	3.74
CVD mortality	≥75	Windsor	2	12	0.346	-1.78	2.47
CVD mortality	≥75	Winnipeg	2	12	-0.111	-2.72	2.50

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	≥75	Calgary	dist02	4	1.4	-1.29	4.11
CVD mortality	≥75	Edmonton	dist02	4	2.7	0.61	4.79
CVD mortality	≥75	Halifax	dist02	4	0.89	-0.94	2.73
CVD mortality	≥75	Hamilton	dist02	4	1.61	0.25	2.98
CVD mortality	≥75	Montreal	dist02	4	1.53	-1.41	4.49
CVD mortality	≥75	Ottawa	dist02	4	2.57	0.43	4.72
CVD mortality	≥75	Quebec City	dist02	4	0.91	-1.06	2.88
CVD mortality	≥75	St Johns	dist02	4	1.76	0.26	3.26
CVD mortality	≥75	Toronto	dist02	4	1.13	-1.93	4.21
CVD mortality	≥75	Vancouver	dist02	4	1.81	-0.42	4.06
CVD mortality	≥75	Windsor	dist02	4	0.9	-1.17	2.97
CVD mortality	≥75	Winnipeg	dist02	4	2.03	0.45	3.6
CVD mortality	≥75	Calgary	dist02	8	0.66	-1.65	2.98
CVD mortality	≥75	Edmonton	dist02	8	2.54	1.34	3.74
CVD mortality	≥75	Halifax	dist02	8	2.14	-1.45	5.73
CVD mortality	≥75	Hamilton	dist02	8	-0.85	-2.96	1.25
CVD mortality	≥75	Montreal	dist02	8	0.91	-1.66	3.48
CVD mortality	≥75	Ottawa	dist02	8	1.93	0.64	3.22
CVD mortality	≥75	Quebec City	dist02	8	2.4	-1.37	6.17
CVD mortality	≥75	St Johns	dist02	8	-0.34	-2.53	1.85
CVD mortality	≥75	Toronto	dist02	8	1.13	-1.53	3.8
CVD mortality	≥75	Vancouver	dist02	8	1.65	0.32	2.98
CVD mortality	≥75	Windsor	dist02	8	2.6	-1.29	6.5
CVD mortality	≥75	Winnipeg	dist02	8	-0.41	-2.68	1.84
CVD mortality	≥75	Calgary	dist02	12	-1.49	-5.32	2.33
CVD mortality	≥75	Edmonton	dist02	12	1.21	-0.79	3.22
CVD mortality	≥75	Halifax	dist02	12	1.68	0.62	2.73
CVD mortality	≥75	Hamilton	dist02	12	0.07	-2.21	2.36
CVD mortality	≥75	Montreal	dist02	12	-0.92	-5.03	3.18
CVD mortality	≥75	Ottawa	dist02	12	0.66	-1.48	2.81
CVD mortality	≥75	Quebec City	dist02	12	1.85	0.76	2.94
CVD mortality	≥75	St Johns	dist02	12	0.26	-2.31	2.84
CVD mortality	≥75	Toronto	dist02	12	-0.67	-5	3.64
CVD mortality	≥75	Vancouver	dist02	12	0.53	-1.71	2.78
CVD mortality	≥75	Windsor	dist02	12	1.8	0.68	2.93
CVD mortality	≥75	Winnipeg	dist02	12	0.1	-2.58	2.78
CVD mortality	<75	Calgary	1	4	0.125	-2.22	2.46
CVD mortality	<75	Edmonton	1	4	-0.205	-2.13	1.72
CVD mortality	<75	Halifax	1	4	1.671	-1.07	4.42
CVD mortality	<75	Hamilton	1	4	1.085	-0.48	2.65
CVD mortality	<75	Montreal	1	4	0.141	-0.77	1.05
CVD mortality	<75	Ottawa	1	4	0.856	-0.72	2.43
CVD mortality	<75	Quebec City	1	4	-0.147	-1.58	1.28
CVD mortality	<75	St Johns	1	4	1.753	-1.23	4.74
CVD mortality	<75	Toronto	1	4	-0.229	-1.08	0.62
CVD mortality	<75	Vancouver	1	4	0.859	-0.51	2.22
CVD mortality	<75	Windsor	1	4	0.374	-1.47	2.22
CVD mortality	<75	Winnipeg	1	4	1.562	-0.48	3.60

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	<75	Calgary	1	8	0.143	-2.30	2.59
CVD mortality	<75	Edmonton	1	8	-0.780	-2.81	1.25
CVD mortality	<75	Halifax	1	8	2.026	-0.83	4.88
CVD mortality	<75	Hamilton	1	8	0.959	-0.63	2.55
CVD mortality	<75	Montreal	1	8	-0.342	-1.29	0.60
CVD mortality	<75	Ottawa	1	8	0.461	-1.17	2.10
CVD mortality	<75	Quebec City	1	8	-0.351	-1.84	1.14
CVD mortality	<75	St Johns	1	8	1.660	-1.40	4.72
CVD mortality	<75	Toronto	1	8	-0.419	-1.28	0.45
CVD mortality	<75	Vancouver	1	8	0.639	-0.81	2.08
CVD mortality	<75	Windsor	1	8	0.295	-1.59	2.18
CVD mortality	<75	Winnipeg	1	8	1.350	-0.81	3.51
CVD mortality	<75	Calgary	1	12	0.215	-2.28	2.71
CVD mortality	<75	Edmonton	1	12	-0.722	-2.79	1.34
CVD mortality	<75	Halifax	1	12	1.486	-1.44	4.41
CVD mortality	<75	Hamilton	1	12	0.785	-0.84	2.41
CVD mortality	<75	Montreal	1	12	-0.452	-1.41	0.51
CVD mortality	<75	Ottawa	1	12	0.109	-1.56	1.78
CVD mortality	<75	Quebec City	1	12	-0.390	-1.92	1.14
CVD mortality	<75	St Johns	1	12	1.540	-1.57	4.65
CVD mortality	<75	Toronto	1	12	-0.488	-1.36	0.39
CVD mortality	<75	Vancouver	1	12	0.756	-0.73	2.24
CVD mortality	<75	Windsor	1	12	0.279	-1.63	2.19
CVD mortality	<75	Winnipeg	1	12	1.191	-1.02	3.41
CVD mortality	<75	Calgary	2	4	1.015	-2.15	4.18
CVD mortality	<75	Edmonton	2	4	0.013	-2.52	2.54
CVD mortality	<75	Halifax	2	4	0.410	-3.11	3.93
CVD mortality	<75	Hamilton	2	4	2.026	-0.16	4.21
CVD mortality	<75	Montreal	2	4	1.310	0.06	2.56
CVD mortality	<75	Ottawa	2	4	2.114	-0.02	4.25
CVD mortality	<75	Quebec City	2	4	-0.046	-1.98	1.89
CVD mortality	<75	St Johns	2	4	2.166	-1.80	6.13
CVD mortality	<75	Toronto	2	4	0.583	-0.59	1.76
CVD mortality	<75	Vancouver	2	4	1.297	-0.46	3.05
CVD mortality	<75	Windsor	2	4	0.184	-2.31	2.68
CVD mortality	<75	Winnipeg	2	4	4.827	2.16	7.49
CVD mortality	<75	Calgary	2	8	1.276	-2.19	4.74
CVD mortality	<75	Edmonton	2	8	-1.073	-3.87	1.72
CVD mortality	<75	Halifax	2	8	0.928	-2.85	4.71
CVD mortality	<75	Hamilton	2	8	1.773	-0.48	4.02
CVD mortality	<75	Montreal	2	8	0.516	-0.83	1.86
CVD mortality	<75	Ottawa	2	8	1.610	-0.67	3.89
CVD mortality	<75	Quebec City	2	8	-0.313	-2.38	1.76
CVD mortality	<75	St Johns	2	8	2.091	-2.05	6.24
CVD mortality	<75	Toronto	2	8	0.297	-0.91	1.51
CVD mortality	<75	Vancouver	2	8	0.855	-1.07	2.78
CVD mortality	<75	Windsor	2	8	0.166	-2.43	2.76
CVD mortality	<75	Winnipeg	2	8	5.278	2.30	8.25

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	<75	Calgary	2	12	1.471	-2.13	5.07
CVD mortality	<75	Edmonton	2	12	-1.005	-3.89	1.88
CVD mortality	<75	Halifax	2	12	-0.005	-3.94	3.93
CVD mortality	<75	Hamilton	2	12	1.475	-0.87	3.82
CVD mortality	<75	Montreal	2	12	0.320	-1.07	1.71
CVD mortality	<75	Ottawa	2	12	1.002	-1.37	3.38
CVD mortality	<75	Quebec City	2	12	-0.407	-2.59	1.78
CVD mortality	<75	St Johns	2	12	1.938	-2.34	6.21
CVD mortality	<75	Toronto	2	12	0.191	-1.05	1.43
CVD mortality	<75	Vancouver	2	12	1.056	-0.97	3.08
CVD mortality	<75	Windsor	2	12	0.158	-2.50	2.82
CVD mortality	<75	Winnipeg	2	12	5.149	2.03	8.27
CVD mortality	<75	Calgary	dist02	4	0.95	-2.24	4.14
CVD mortality	<75	Edmonton	dist02	4	2.1	-0.15	4.36
CVD mortality	<75	Halifax	dist02	4	0.04	-1.97	2.05
CVD mortality	<75	Hamilton	dist02	4	1.28	-0.51	3.07
CVD mortality	<75	Montreal	dist02	4	1.23	-2.25	4.72
CVD mortality	<75	Ottawa	dist02	4	1.83	-0.49	4.16
CVD mortality	<75	Quebec City	dist02	4	-0.18	-2.35	1.97
CVD mortality	<75	St Johns	dist02	4	0.73	-1.23	2.69
CVD mortality	<75	Toronto	dist02	4	1.48	-2.14	5.11
CVD mortality	<75	Vancouver	dist02	4	1.41	-1.01	3.84
CVD mortality	<75	Windsor	dist02	4	-0.28	-2.57	2
CVD mortality	<75	Winnipeg	dist02	4	0.95	-1.11	3.02
CVD mortality	<75	Calgary	dist02	8	-0.08	-2.64	2.47
CVD mortality	<75	Edmonton	dist02	8	1.35	0.06	2.63
CVD mortality	<75	Halifax	dist02	8	2.44	-1.62	6.51
CVD mortality	<75	Hamilton	dist02	8	0.45	-2.19	3.11
CVD mortality	<75	Montreal	dist02	8	-1.25	-4.09	1.57
CVD mortality	<75	Ottawa	dist02	8	0.63	-0.74	2.01
CVD mortality	<75	Quebec City	dist02	8	2.39	-1.86	6.65
CVD mortality	<75	St Johns	dist02	8	0.37	-2.4	3.14
CVD mortality	<75	Toronto	dist02	8	-1.16	-4.09	1.76
CVD mortality	<75	Vancouver	dist02	8	0.45	-0.97	1.87
CVD mortality	<75	Windsor	dist02	8	2.16	-2.24	6.57
CVD mortality	<75	Winnipeg	dist02	8	0.38	-2.45	3.23
CVD mortality	<75	Calgary	dist02	12	0.75	-2.97	4.49
CVD mortality	<75	Edmonton	dist02	12	2.14	-0.03	4.32
CVD mortality	<75	Halifax	dist02	12	0.74	-0.47	1.95
CVD mortality	<75	Hamilton	dist02	12	4.63	1.88	7.39
CVD mortality	<75	Montreal	dist02	12	1.33	-2.68	5.34
CVD mortality	<75	Ottawa	dist02	12	1.64	-0.69	3.97
CVD mortality	<75	Quebec City	dist02	12	0.47	-0.77	1.73
CVD mortality	<75	St Johns	dist02	12	5.29	2.22	8.37
CVD mortality	<75	Toronto	dist02	12	0.29	-3.91	4.51
CVD mortality	<75	Vancouver	dist02	12	0.95	-1.47	3.38
CVD mortality	<75	Windsor	dist02	12	0.38	-0.9	1.67
CVD mortality	<75	Winnipeg	dist02	12	5.44	2.22	8.65

Table C-1 . City specific percent change (*β x1000*) in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Calgary	0	4	-1.81	-5.05	1.43
Resp mortality	All	Edmonton	0	4	0.44	-2.37	3.25
Resp mortality	All	Halifax	0	4	0.37	-3.67	4.41
Resp mortality	All	Hamilton	0	4	1.17	-1.30	3.64
Resp mortality	All	Montreal	0	4	-0.35	-1.77	1.07
Resp mortality	All	Ottawa	0	4	-1.37	-3.91	1.17
Resp mortality	All	Quebec City	0	4	-0.23	-2.43	1.98
Resp mortality	All	St Johns	0	4	1.33	-3.15	5.81
Resp mortality	All	Toronto	0	4	-0.54	-1.81	0.74
Resp mortality	All	Vancouver	0	4	0.67	-1.07	2.40
Resp mortality	All	Windsor	0	4	4.05	0.91	7.19
Resp mortality	All	Winnipeg	0	4	0.00	-3.00	3.00
Resp mortality	All	Calgary	0	8	-0.96	-4.35	2.43
Resp mortality	All	Edmonton	0	8	1.11	-1.87	4.08
Resp mortality	All	Halifax	0	8	0.98	-3.22	5.18
Resp mortality	All	Hamilton	0	8	0.86	-1.65	3.37
Resp mortality	All	Montreal	0	8	0.20	-1.27	1.68
Resp mortality	All	Ottawa	0	8	-0.11	-2.74	2.52
Resp mortality	All	Quebec City	0	8	0.69	-1.60	2.98
Resp mortality	All	St Johns	0	8	2.90	-1.69	7.48
Resp mortality	All	Toronto	0	8	-0.27	-1.57	1.03
Resp mortality	All	Vancouver	0	8	0.72	-1.12	2.55
Resp mortality	All	Windsor	0	8	4.65	1.47	7.84
Resp mortality	All	Winnipeg	0	8	0.70	-2.49	3.88
Resp mortality	All	Calgary	0	12	-1.18	-4.65	2.30
Resp mortality	All	Edmonton	0	12	0.66	-2.37	3.69
Resp mortality	All	Halifax	0	12	1.03	-3.27	5.32
Resp mortality	All	Hamilton	0	12	0.53	-2.03	3.10
Resp mortality	All	Montreal	0	12	-0.18	-1.68	1.32
Resp mortality	All	Ottawa	0	12	0.31	-2.38	3.00
Resp mortality	All	Quebec City	0	12	0.72	-1.62	3.07
Resp mortality	All	St Johns	0	12	2.86	-1.82	7.54
Resp mortality	All	Toronto	0	12	-0.63	-1.95	0.68
Resp mortality	All	Vancouver	0	12	1.45	-0.44	3.33
Resp mortality	All	Windsor	0	12	4.56	1.32	7.80
Resp mortality	All	Winnipeg	0	12	0.36	-2.89	3.60
Resp mortality	All	Calgary	1	4	-2.17	-5.40	1.05
Resp mortality	All	Edmonton	1	4	0.50	-2.30	3.31
Resp mortality	All	Halifax	1	4	-0.96	-5.02	3.10
Resp mortality	All	Hamilton	1	4	0.35	-2.13	2.83
Resp mortality	All	Montreal	1	4	0.31	-1.11	1.73
Resp mortality	All	Ottawa	1	4	-3.39	-5.94	-0.84
Resp mortality	All	Quebec City	1	4	0.54	-1.66	2.75
Resp mortality	All	St Johns	1	4	1.41	-3.06	5.88
Resp mortality	All	Toronto	1	4	0.81	-0.46	2.08
Resp mortality	All	Vancouver	1	4	1.57	-0.16	3.30
Resp mortality	All	Windsor	1	4	2.06	-1.11	5.22
Resp mortality	All	Winnipeg	1	4	0.18	-2.82	3.17

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Calgary	1	8	-1.41	-4.79	1.97
Resp mortality	All	Edmonton	1	8	1.16	-1.81	4.14
Resp mortality	All	Halifax	1	8	-0.33	-4.55	3.88
Resp mortality	All	Hamilton	1	8	0.06	-2.46	2.58
Resp mortality	All	Montreal	1	8	0.79	-0.69	2.26
Resp mortality	All	Ottawa	1	8	-2.48	-5.13	0.16
Resp mortality	All	Quebec City	1	8	1.65	-0.65	3.94
Resp mortality	All	St Johns	1	8	3.02	-1.56	7.61
Resp mortality	All	Toronto	1	8	1.10	-0.19	2.39
Resp mortality	All	Vancouver	1	8	1.90	0.06	3.74
Resp mortality	All	Windsor	1	8	2.63	-0.58	5.84
Resp mortality	All	Winnipeg	1	8	0.80	-2.38	3.99
Resp mortality	All	Calgary	1	12	-1.63	-5.09	1.84
Resp mortality	All	Edmonton	1	12	0.80	-2.23	3.84
Resp mortality	All	Halifax	1	12	-0.27	-4.59	4.04
Resp mortality	All	Hamilton	1	12	-0.19	-2.77	2.39
Resp mortality	All	Montreal	1	12	0.43	-1.07	1.92
Resp mortality	All	Ottawa	1	12	-2.13	-4.84	0.58
Resp mortality	All	Quebec City	1	12	1.74	-0.61	4.08
Resp mortality	All	St Johns	1	12	3.02	-1.66	7.70
Resp mortality	All	Toronto	1	12	0.77	-0.54	2.08
Resp mortality	All	Vancouver	1	12	2.72	0.84	4.61
Resp mortality	All	Windsor	1	12	2.47	-0.80	5.75
Resp mortality	All	Winnipeg	1	12	0.54	-2.71	3.78
Resp mortality	All	Calgary	2	4	-2.77	-6.00	0.46
Resp mortality	All	Edmonton	2	4	-0.13	-2.94	2.67
Resp mortality	All	Halifax	2	4	-3.13	-7.24	0.97
Resp mortality	All	Hamilton	2	4	2.31	-0.17	4.80
Resp mortality	All	Montreal	2	4	0.64	-0.78	2.05
Resp mortality	All	Ottawa	2	4	-1.99	-4.53	0.54
Resp mortality	All	Quebec City	2	4	-1.39	-3.61	0.82
Resp mortality	All	St Johns	2	4	-0.33	-4.85	4.18
Resp mortality	All	Toronto	2	4	1.19	-0.08	2.45
Resp mortality	All	Vancouver	2	4	-0.06	-1.80	1.67
Resp mortality	All	Windsor	2	4	0.93	-2.23	4.10
Resp mortality	All	Winnipeg	2	4	0.53	-2.46	3.52
Resp mortality	All	Calgary	2	8	-2.09	-5.47	1.29
Resp mortality	All	Edmonton	2	8	0.41	-2.56	3.39
Resp mortality	All	Halifax	2	8	-2.47	-6.75	1.80
Resp mortality	All	Hamilton	2	8	2.15	-0.38	4.67
Resp mortality	All	Montreal	2	8	1.23	-0.24	2.71
Resp mortality	All	Ottawa	2	8	-1.23	-3.87	1.41
Resp mortality	All	Quebec City	2	8	-0.52	-2.82	1.79
Resp mortality	All	St Johns	2	8	0.83	-3.81	5.47
Resp mortality	All	Toronto	2	8	1.51	0.22	2.80
Resp mortality	All	Vancouver	2	8	0.24	-1.60	2.08
Resp mortality	All	Windsor	2	8	1.44	-1.78	4.66
Resp mortality	All	Winnipeg	2	8	1.33	-1.84	4.51

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Calgary	2	12	-2.33	-5.80	1.14
Resp mortality	All	Edmonton	2	12	0.14	-2.90	3.17
Resp mortality	All	Halifax	2	12	-2.23	-6.61	2.15
Resp mortality	All	Hamilton	2	12	2.11	-0.47	4.69
Resp mortality	All	Montreal	2	12	0.88	-0.62	2.38
Resp mortality	All	Ottawa	2	12	-0.75	-3.45	1.96
Resp mortality	All	Quebec City	2	12	-0.52	-2.88	1.84
Resp mortality	All	St Johns	2	12	0.61	-4.14	5.35
Resp mortality	All	Toronto	2	12	1.21	-0.10	2.52
Resp mortality	All	Vancouver	2	12	0.97	-0.92	2.86
Resp mortality	All	Windsor	2	12	1.27	-2.01	4.54
Resp mortality	All	Winnipeg	2	12	1.15	-2.09	4.40
Resp mortality	All	Calgary	1	4	-2.81	-6.71	1.09
Resp mortality	All	Edmonton	1	4	0.65	-2.67	3.98
Resp mortality	All	Halifax	1	4	-0.38	-5.08	4.33
Resp mortality	All	Hamilton	1	4	1.33	-1.67	4.33
Resp mortality	All	Montreal	1	4	0.27	-1.44	1.97
Resp mortality	All	Ottawa	1	4	-3.36	-6.39	-0.32
Resp mortality	All	Quebec City	1	4	0.25	-2.39	2.90
Resp mortality	All	St Johns	1	4	2.02	-3.21	7.26
Resp mortality	All	Toronto	1	4	0.30	-1.24	1.84
Resp mortality	All	Vancouver	1	4	1.61	-0.39	3.61
Resp mortality	All	Windsor	1	4	4.48	0.70	8.25
Resp mortality	All	Winnipeg	1	4	0.22	-3.33	3.77
Resp mortality	All	Calgary	1	8	-1.74	-5.92	2.43
Resp mortality	All	Edmonton	1	8	1.68	-1.93	5.29
Resp mortality	All	Halifax	1	8	0.11	-4.86	5.09
Resp mortality	All	Hamilton	1	8	0.83	-2.24	3.90
Resp mortality	All	Montreal	1	8	0.83	-0.98	2.63
Resp mortality	All	Ottawa	1	8	-1.98	-5.18	1.21
Resp mortality	All	Quebec City	1	8	1.67	-1.13	4.46
Resp mortality	All	St Johns	1	8	4.28	-1.17	9.72
Resp mortality	All	Toronto	1	8	0.68	-0.90	2.25
Resp mortality	All	Vancouver	1	8	1.86	-0.30	4.01
Resp mortality	All	Windsor	1	8	5.47	1.60	9.34
Resp mortality	All	Winnipeg	1	8	1.07	-2.82	4.96
Resp mortality	All	Calgary	1	12	-2.10	-6.43	2.22
Resp mortality	All	Edmonton	1	12	1.11	-2.61	4.82
Resp mortality	All	Halifax	1	12	0.10	-5.05	5.25
Resp mortality	All	Hamilton	1	12	0.38	-2.79	3.55
Resp mortality	All	Montreal	1	12	0.26	-1.58	2.11
Resp mortality	All	Ottawa	1	12	-1.45	-4.76	1.87
Resp mortality	All	Quebec City	1	12	1.81	-1.09	4.71
Resp mortality	All	St Johns	1	12	4.30	-1.31	9.92
Resp mortality	All	Toronto	1	12	0.16	-1.45	1.77
Resp mortality	All	Vancouver	1	12	2.98	0.74	5.22
Resp mortality	All	Windsor	1	12	5.36	1.39	9.33
Resp mortality	All	Winnipeg	1	12	0.62	-3.39	4.63

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Calgary	2	4	-4.06	-8.42	0.30
Resp mortality	All	Edmonton	2	4	0.54	-3.15	4.24
Resp mortality	All	Halifax	2	4	-2.50	-7.72	2.72
Resp mortality	All	Hamilton	2	4	2.78	-0.67	6.23
Resp mortality	All	Montreal	2	4	1.16	-0.77	3.10
Resp mortality	All	Ottawa	2	4	-3.86	-7.31	-0.41
Resp mortality	All	Quebec City	2	4	-0.55	-3.54	2.45
Resp mortality	All	St Johns	2	4	1.75	-4.17	7.66
Resp mortality	All	Toronto	2	4	1.13	-0.64	2.89
Resp mortality	All	Vancouver	2	4	1.41	-0.79	3.61
Resp mortality	All	Windsor	2	4	3.96	-0.34	8.26
Resp mortality	All	Winnipeg	2	4	0.69	-3.24	4.63
Resp mortality	All	Calgary	2	8	-3.02	-7.79	1.76
Resp mortality	All	Edmonton	2	8	1.82	-2.29	5.93
Resp mortality	All	Halifax	2	8	-2.10	-7.70	3.51
Resp mortality	All	Hamilton	2	8	2.13	-1.43	5.68
Resp mortality	All	Montreal	2	8	1.70	-0.37	3.77
Resp mortality	All	Ottawa	2	8	-2.54	-6.22	1.15
Resp mortality	All	Quebec City	2	8	0.98	-2.22	4.19
Resp mortality	All	St Johns	2	8	4.30	-1.94	10.53
Resp mortality	All	Toronto	2	8	1.61	-0.22	3.43
Resp mortality	All	Vancouver	2	8	1.75	-0.66	4.17
Resp mortality	All	Windsor	2	8	5.33	0.88	9.77
Resp mortality	All	Winnipeg	2	8	1.80	-2.62	6.22
Resp mortality	All	Calgary	2	12	-3.56	-8.56	1.43
Resp mortality	All	Edmonton	2	12	1.15	-3.12	5.42
Resp mortality	All	Halifax	2	12	-2.20	-8.05	3.65
Resp mortality	All	Hamilton	2	12	1.74	-1.96	5.45
Resp mortality	All	Montreal	2	12	0.97	-1.17	3.10
Resp mortality	All	Ottawa	2	12	-1.80	-5.66	2.07
Resp mortality	All	Quebec City	2	12	1.08	-2.30	4.45
Resp mortality	All	St Johns	2	12	4.28	-2.20	10.76
Resp mortality	All	Toronto	2	12	0.95	-0.93	2.82
Resp mortality	All	Vancouver	2	12	3.16	0.63	5.69
Resp mortality	All	Windsor	2	12	5.18	0.60	9.76
Resp mortality	All	Winnipeg	2	12	1.17	-3.45	5.78
Resp mortality	All	Calgary	dist02	4	-2.35	-4.31	-0.39
Resp mortality	All	Edmonton	dist02	4	-0.45	-2.33	1.42
Resp mortality	All	Halifax	dist02	4	-1.04	-4.34	2.25
Resp mortality	All	Hamilton	dist02	4	0.22	-1.9	2.36
Resp mortality	All	Montreal	dist02	4	2.8	1.68	3.92
Resp mortality	All	Ottawa	dist02	4	0.14	-1.95	2.25
Resp mortality	All	Quebec City	dist02	4	-1.29	-3.24	0.64
Resp mortality	All	St Johns	dist02	4	1.34	-1.84	4.53
Resp mortality	All	Toronto	dist02	4	2.3	1.3	3.29
Resp mortality	All	Vancouver	dist02	4	-1.36	-2.52	-0.21
Resp mortality	All	Windsor	dist02	4	0.59	-1.72	2.91
Resp mortality	All	Winnipeg	dist02	4	2.52	0.01	5.03

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI Lower	Upper
Resp mortality	All	Calgary	dist02	8	-0.74	-2.86	1.37
Resp mortality	All	Edmonton	dist02	8	-0.15	-2.27	1.97
Resp mortality	All	Halifax	dist02	8	-1.85	-5.4	1.68
Resp mortality	All	Hamilton	dist02	8	1.2	-0.99	3.4
Resp mortality	All	Montreal	dist02	8	1.44	0.25	2.64
Resp mortality	All	Ottawa	dist02	8	1.32	-0.9	3.55
Resp mortality	All	Quebec City	dist02	8	-0.31	-2.32	1.7
Resp mortality	All	St Johns	dist02	8	2.51	-0.83	5.85
Resp mortality	All	Toronto	dist02	8	2.64	1.61	3.67
Resp mortality	All	Vancouver	dist02	8	-0.55	-1.82	0.7
Resp mortality	All	Windsor	dist02	8	1.62	-0.78	4.03
Resp mortality	All	Winnipeg	dist02	8	1.64	-1.17	4.45
Resp mortality	All	Calgary	dist02	12	1.31	-0.89	3.53
Resp mortality	All	Edmonton	dist02	12	0	-2.26	2.25
Resp mortality	All	Halifax	dist02	12	-1.6	-5.22	2.02
Resp mortality	All	Hamilton	dist02	12	0.28	-1.97	2.55
Resp mortality	All	Montreal	dist02	12	1.06	-0.16	2.29
Resp mortality	All	Ottawa	dist02	12	1.47	-0.82	3.77
Resp mortality	All	Quebec City	dist02	12	-0.52	-2.6	1.54
Resp mortality	All	St Johns	dist02	12	2.83	-0.61	6.28
Resp mortality	All	Toronto	dist02	12	1.99	0.93	3.05
Resp mortality	All	Vancouver	dist02	12	-0.75	-2.08	0.57
Resp mortality	All	Windsor	dist02	12	1.12	-1.34	3.58
Resp mortality	All	Winnipeg	dist02	12	0.91	-1.96	3.79
Resp mortality	≥75	Calgary	1	4	-2.423	-6.51	1.66
Resp mortality	≥75	Edmonton	1	4	0.864	-2.80	4.53
Resp mortality	≥75	Halifax	1	4	3.526	-1.70	8.75
Resp mortality	≥75	Hamilton	1	4	-0.914	-4.11	2.28
Resp mortality	≥75	Montreal	1	4	0.514	-1.31	2.34
Resp mortality	≥75	Ottawa	1	4	-3.155	-6.49	0.18
Resp mortality	≥75	Quebec City	1	4	-0.554	-3.42	2.31
Resp mortality	≥75	St Johns	1	4	3.040	-2.85	8.93
Resp mortality	≥75	Toronto	1	4	0.295	-1.28	1.87
Resp mortality	≥75	Vancouver	1	4	1.553	-0.53	3.64
Resp mortality	≥75	Windsor	1	4	2.580	-1.59	6.75
Resp mortality	≥75	Winnipeg	1	4	1.123	-2.59	4.83
Resp mortality	≥75	Calgary	1	8	-1.354	-5.63	2.92
Resp mortality	≥75	Edmonton	1	8	1.348	-2.54	5.24
Resp mortality	≥75	Halifax	1	8	3.334	-2.09	8.76
Resp mortality	≥75	Hamilton	1	8	-1.197	-4.44	2.05
Resp mortality	≥75	Montreal	1	8	0.934	-0.97	2.83
Resp mortality	≥75	Ottawa	1	8	-2.279	-5.74	1.19
Resp mortality	≥75	Quebec City	1	8	0.671	-2.30	3.64
Resp mortality	≥75	St Johns	1	8	4.732	-1.29	10.76
Resp mortality	≥75	Toronto	1	8	0.608	-1.00	2.21
Resp mortality	≥75	Vancouver	1	8	1.766	-0.45	3.98
Resp mortality	≥75	Windsor	1	8	3.034	-1.19	7.26
Resp mortality	≥75	Winnipeg	1	8	1.602	-2.34	5.55

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	≥75	Calgary	1	12	-1.565	-5.95	2.82
Resp mortality	≥75	Edmonton	1	12	0.365	-3.61	4.34
Resp mortality	≥75	Halifax	1	12	2.948	-2.63	8.52
Resp mortality	≥75	Hamilton	1	12	-1.737	-5.06	1.59
Resp mortality	≥75	Montreal	1	12	0.504	-1.43	2.44
Resp mortality	≥75	Ottawa	1	12	-2.327	-5.89	1.23
Resp mortality	≥75	Quebec City	1	12	0.805	-2.24	3.85
Resp mortality	≥75	St Johns	1	12	4.909	-1.24	11.05
Resp mortality	≥75	Toronto	1	12	0.327	-1.30	1.96
Resp mortality	≥75	Vancouver	1	12	2.435	0.16	4.71
Resp mortality	≥75	Windsor	1	12	2.777	-1.54	7.09
Resp mortality	≥75	Winnipeg	1	12	1.012	-3.01	5.03
Resp mortality	≥75	Calgary	2	4	-4.505	-10.01	1.00
Resp mortality	≥75	Edmonton	2	4	1.086	-3.74	5.92
Resp mortality	≥75	Halifax	2	4	0.898	-5.89	7.69
Resp mortality	≥75	Hamilton	2	4	0.306	-4.15	4.77
Resp mortality	≥75	Montreal	2	4	1.399	-1.09	3.89
Resp mortality	≥75	Ottawa	2	4	-4.565	-9.09	-0.04
Resp mortality	≥75	Quebec City	2	4	-2.532	-6.42	1.35
Resp mortality	≥75	St Johns	2	4	1.122	-6.76	9.01
Resp mortality	≥75	Toronto	2	4	0.211	-1.99	2.41
Resp mortality	≥75	Vancouver	2	4	1.638	-1.01	4.28
Resp mortality	≥75	Windsor	2	4	5.349	-0.32	11.02
Resp mortality	≥75	Winnipeg	2	4	1.332	-3.55	6.21
Resp mortality	≥75	Calgary	2	8	-3.051	-9.07	2.97
Resp mortality	≥75	Edmonton	2	8	2.046	-3.35	7.44
Resp mortality	≥75	Halifax	2	8	-0.798	-8.08	6.49
Resp mortality	≥75	Hamilton	2	8	-0.449	-5.04	4.14
Resp mortality	≥75	Montreal	2	8	1.675	-0.99	4.34
Resp mortality	≥75	Ottawa	2	8	-3.231	-8.07	1.60
Resp mortality	≥75	Quebec City	2	8	-0.646	-4.80	3.51
Resp mortality	≥75	St Johns	2	8	3.237	-5.06	11.53
Resp mortality	≥75	Toronto	2	8	0.618	-1.65	2.89
Resp mortality	≥75	Vancouver	2	8	1.768	-1.13	4.67
Resp mortality	≥75	Windsor	2	8	6.692	0.84	12.54
Resp mortality	≥75	Winnipeg	2	8	2.180	-3.32	7.68
Resp mortality	≥75	Calgary	2	12	-3.563	-9.88	2.75
Resp mortality	≥75	Edmonton	2	12	0.197	-5.41	5.81
Resp mortality	≥75	Halifax	2	12	-2.306	-9.93	5.31
Resp mortality	≥75	Hamilton	2	12	-1.517	-6.31	3.27
Resp mortality	≥75	Montreal	2	12	0.757	-1.99	3.51
Resp mortality	≥75	Ottawa	2	12	-3.491	-8.58	1.60
Resp mortality	≥75	Quebec City	2	12	-0.506	-4.88	3.87
Resp mortality	≥75	St Johns	2	12	3.383	-5.25	12.01
Resp mortality	≥75	Toronto	2	12	0.034	-2.31	2.37
Resp mortality	≥75	Vancouver	2	12	2.887	-0.15	5.93
Resp mortality	≥75	Windsor	2	12	6.424	0.38	12.47
Resp mortality	≥75	Winnipeg	2	12	1.008	-4.72	6.74

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
Resp mortality	≥75	Calgary	dist02	4	-4.79	-10.34	0.76
Resp mortality	≥75	Edmonton	dist02	4	-0.1	-4.72	4.51
Resp mortality	≥75	Halifax	dist02	4	-2.2	-6.22	1.8
Resp mortality	≥75	Hamilton	dist02	4	1.77	-0.92	4.47
Resp mortality	≥75	Montreal	dist02	4	-3.29	-9.37	2.77
Resp mortality	≥75	Ottawa	dist02	4	-0.66	-5.4	4.07
Resp mortality	≥75	Quebec City	dist02	4	-0.47	-4.78	3.83
Resp mortality	≥75	St Johns	dist02	4	1.93	-1.02	4.89
Resp mortality	≥75	Toronto	dist02	4	-3.67	-10.04	2.69
Resp mortality	≥75	Vancouver	dist02	4	-1.75	-6.71	3.2
Resp mortality	≥75	Windsor	dist02	4	-0.19	-4.73	4.34
Resp mortality	≥75	Winnipeg	dist02	4	3.14	0.04	6.24
Resp mortality	≥75	Calgary	dist02	8	1.46	-3.43	6.37
Resp mortality	≥75	Edmonton	dist02	8	0.87	-1.69	3.44
Resp mortality	≥75	Halifax	dist02	8	-0.63	-8.71	7.44
Resp mortality	≥75	Hamilton	dist02	8	5.79	-0.21	11.81
Resp mortality	≥75	Montreal	dist02	8	2.73	-2.75	8.22
Resp mortality	≥75	Ottawa	dist02	8	1.04	-1.7	3.79
Resp mortality	≥75	Quebec City	dist02	8	1.49	-7	9.99
Resp mortality	≥75	St Johns	dist02	8	7.08	0.86	13.3
Resp mortality	≥75	Toronto	dist02	8	0.86	-4.85	6.58
Resp mortality	≥75	Vancouver	dist02	8	0.09	-2.74	2.93
Resp mortality	≥75	Windsor	dist02	8	1.52	-7.33	10.37
Resp mortality	≥75	Winnipeg	dist02	8	6.91	0.46	13.36
Resp mortality	≥75	Calgary	dist02	12	1.81	-5.38	9
Resp mortality	≥75	Edmonton	dist02	12	-4.1	-8.73	0.52
Resp mortality	≥75	Halifax	dist02	12	0.06	-2.23	2.35
Resp mortality	≥75	Hamilton	dist02	12	0.97	-4.05	5.99
Resp mortality	≥75	Montreal	dist02	12	0.2	-7.51	7.92
Resp mortality	≥75	Ottawa	dist02	12	-2.56	-7.5	2.38
Resp mortality	≥75	Quebec City	dist02	12	0.51	-1.86	2.88
Resp mortality	≥75	St Johns	dist02	12	2.28	-3.37	7.94
Resp mortality	≥75	Toronto	dist02	12	-0.43	-8.52	7.65
Resp mortality	≥75	Vancouver	dist02	12	-2.74	-7.95	2.46
Resp mortality	≥75	Windsor	dist02	12	-0.1	-2.55	2.34
Resp mortality	≥75	Winnipeg	dist02	12	1.3	-4.56	7.18
Resp mortality	<75	Calgary	1	4	-1.687	-6.96	3.58
Resp mortality	<75	Edmonton	1	4	0.027	-4.34	4.40
Resp mortality	<75	Halifax	1	4	-7.320	-13.76	-0.88
Resp mortality	<75	Hamilton	1	4	2.248	-1.68	6.17
Resp mortality	<75	Montreal	1	4	-0.027	-2.27	2.22
Resp mortality	<75	Ottawa	1	4	-3.703	-7.67	0.26
Resp mortality	<75	Quebec City	1	4	2.264	-1.20	5.73
Resp mortality	<75	St Johns	1	4	-0.834	-7.72	6.05
Resp mortality	<75	Toronto	1	4	1.753	-0.38	3.88
Resp mortality	<75	Vancouver	1	4	1.596	-1.51	4.70
Resp mortality	<75	Windsor	1	4	1.318	-3.54	6.18
Resp mortality	<75	Winnipeg	1	4	-1.647	-6.74	3.44

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
Resp mortality	<75	Calgary	1	8	-1.633	-7.16	3.90
Resp mortality	<75	Edmonton	1	8	0.863	-3.75	5.47
Resp mortality	<75	Halifax	1	8	-5.664	-12.36	1.03
Resp mortality	<75	Hamilton	1	8	1.912	-2.09	5.91
Resp mortality	<75	Montreal	1	8	0.541	-1.80	2.88
Resp mortality	<75	Ottawa	1	8	-2.868	-6.98	1.24
Resp mortality	<75	Quebec City	1	8	3.190	-0.41	6.79
Resp mortality	<75	St Johns	1	8	0.816	-6.29	7.92
Resp mortality	<75	Toronto	1	8	2.008	-0.16	4.17
Resp mortality	<75	Vancouver	1	8	2.221	-1.07	5.51
Resp mortality	<75	Windsor	1	8	2.140	-2.82	7.10
Resp mortality	<75	Winnipeg	1	8	-0.765	-6.15	4.62
Resp mortality	<75	Calgary	1	12	-1.863	-7.52	3.79
Resp mortality	<75	Edmonton	1	12	1.421	-3.27	6.12
Resp mortality	<75	Halifax	1	12	-4.846	-11.66	1.97
Resp mortality	<75	Hamilton	1	12	2.173	-1.91	6.26
Resp mortality	<75	Montreal	1	12	0.274	-2.09	2.64
Resp mortality	<75	Ottawa	1	12	-2.167	-6.37	2.03
Resp mortality	<75	Quebec City	1	12	3.127	-0.55	6.80
Resp mortality	<75	St Johns	1	12	0.291	-7.01	7.59
Resp mortality	<75	Toronto	1	12	1.576	-0.62	3.77
Resp mortality	<75	Vancouver	1	12	3.340	-0.04	6.72
Resp mortality	<75	Windsor	1	12	2.090	-2.94	7.12
Resp mortality	<75	Winnipeg	1	12	-0.406	-5.92	5.11
Resp mortality	<75	Calgary	2	4	-3.153	-10.30	3.99
Resp mortality	<75	Edmonton	2	4	-0.166	-5.91	5.58
Resp mortality	<75	Halifax	2	4	-7.012	-15.18	1.16
Resp mortality	<75	Hamilton	2	4	6.456	1.00	11.91
Resp mortality	<75	Montreal	2	4	0.796	-2.28	3.87
Resp mortality	<75	Ottawa	2	4	-2.780	-8.13	2.57
Resp mortality	<75	Quebec City	2	4	2.552	-2.16	7.26
Resp mortality	<75	St Johns	2	4	2.409	-6.56	11.38
Resp mortality	<75	Toronto	2	4	2.776	-0.18	5.73
Resp mortality	<75	Vancouver	2	4	0.887	-3.08	4.86
Resp mortality	<75	Windsor	2	4	2.012	-4.59	8.61
Resp mortality	<75	Winnipeg	2	4	-0.520	-7.17	6.14
Resp mortality	<75	Calgary	2	8	-3.227	-11.06	4.61
Resp mortality	<75	Edmonton	2	8	1.433	-4.93	7.80
Resp mortality	<75	Halifax	2	8	-4.089	-12.90	4.72
Resp mortality	<75	Hamilton	2	8	5.932	0.29	11.57
Resp mortality	<75	Montreal	2	8	1.744	-1.56	5.05
Resp mortality	<75	Ottawa	2	8	-1.668	-7.38	4.04
Resp mortality	<75	Quebec City	2	8	3.614	-1.44	8.67
Resp mortality	<75	St Johns	2	8	5.774	-3.75	15.30
Resp mortality	<75	Toronto	2	8	3.380	0.33	6.43
Resp mortality	<75	Vancouver	2	8	1.742	-2.61	6.09
Resp mortality	<75	Windsor	2	8	3.582	-3.27	10.44
Resp mortality	<75	Winnipeg	2	8	1.030	-6.41	8.47

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	<75	Calgary	2	12	-3.852	-12.03	4.33
Resp mortality	<75	Edmonton	2	12	2.518	-4.09	9.12
Resp mortality	<75	Halifax	2	12	-2.408	-11.55	6.73
Resp mortality	<75	Hamilton	2	12	6.726	0.86	12.59
Resp mortality	<75	Montreal	2	12	1.276	-2.12	4.67
Resp mortality	<75	Ottawa	2	12	-0.003	-5.95	5.94
Resp mortality	<75	Quebec City	2	12	3.482	-1.82	8.79
Resp mortality	<75	St Johns	2	12	5.085	-4.86	15.03
Resp mortality	<75	Toronto	2	12	2.575	-0.56	5.71
Resp mortality	<75	Vancouver	2	12	3.724	-0.85	8.30
Resp mortality	<75	Windsor	2	12	3.522	-3.52	10.56
Resp mortality	<75	Winnipeg	2	12	1.473	-6.32	9.26
Resp mortality	<75	Calgary	dist02	4	-3.01	-10.21	4.18
Resp mortality	<75	Edmonton	dist02	4	6.61	0.96	12.27
Resp mortality	<75	Halifax	dist02	4	3.06	-1.81	7.95
Resp mortality	<75	Hamilton	dist02	4	0.1	-3.95	4.16
Resp mortality	<75	Montreal	dist02	4	-3.13	-11.03	4.75
Resp mortality	<75	Ottawa	dist02	4	6.18	0.34	12.02
Resp mortality	<75	Quebec City	dist02	4	4.43	-0.82	9.68
Resp mortality	<75	St Johns	dist02	4	0.99	-3.45	5.43
Resp mortality	<75	Toronto	dist02	4	-3.75	-11.99	4.48
Resp mortality	<75	Vancouver	dist02	4	7	0.92	13.08
Resp mortality	<75	Windsor	dist02	4	4.51	-0.99	10.02
Resp mortality	<75	Winnipeg	dist02	4	2.94	-1.73	7.62
Resp mortality	<75	Calgary	dist02	8	-0.14	-5.95	5.66
Resp mortality	<75	Edmonton	dist02	8	1.48	-1.68	4.65
Resp mortality	<75	Halifax	dist02	8	3.68	-5.47	12.85
Resp mortality	<75	Hamilton	dist02	8	3.61	-3.37	10.61
Resp mortality	<75	Montreal	dist02	8	1.46	-4.98	7.9
Resp mortality	<75	Ottawa	dist02	8	2.56	-0.83	5.96
Resp mortality	<75	Quebec City	dist02	8	6.85	-2.91	16.61
Resp mortality	<75	St Johns	dist02	8	5.26	-2	12.54
Resp mortality	<75	Toronto	dist02	8	2.65	-4.04	9.35
Resp mortality	<75	Vancouver	dist02	8	2.03	-1.46	5.52
Resp mortality	<75	Windsor	dist02	8	6.18	-4.02	16.38
Resp mortality	<75	Winnipeg	dist02	8	5.19	-2.32	12.71
Resp mortality	<75	Calgary	dist02	12	-6.81	-15.5	1.87
Resp mortality	<75	Edmonton	dist02	12	-1.24	-6.7	4.2
Resp mortality	<75	Halifax	dist02	12	3.09	0.01	6.17
Resp mortality	<75	Hamilton	dist02	12	-1.16	-8.03	5.71
Resp mortality	<75	Montreal	dist02	12	-3.03	-12.38	6.32
Resp mortality	<75	Ottawa	dist02	12	0.05	-5.77	5.87
Resp mortality	<75	Quebec City	dist02	12	3.79	0.61	6.97
Resp mortality	<75	St Johns	dist02	12	0.58	-7.11	8.27
Resp mortality	<75	Toronto	dist02	12	-2.49	-12.26	7.27
Resp mortality	<75	Vancouver	dist02	12	1.75	-4.31	7.83
Resp mortality	<75	Windsor	dist02	12	2.93	-0.33	6.2
Resp mortality	<75	Winnipeg	dist02	12	1.33	-6.68	9.36

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Calgary	0	4	-0.71	-1.89	0.47
CVD HA	All	Edmonton	0	4	0.37	-0.88	1.63
CVD HA	All	Halifax	0	4	1.00	-0.84	2.84
CVD HA	All	Hamilton	0	4	0.37	-0.62	1.36
CVD HA	All	Montreal	0	4	0.31	-0.29	0.91
CVD HA	All	Ottawa	0	4	0.78	-0.27	1.83
CVD HA	All	Quebec City	0	4	-0.05	-0.98	0.88
CVD HA	All	St Johns	0	4	0.19	-1.65	2.03
CVD HA	All	Toronto	0	4	0.22	-0.26	0.70
CVD HA	All	Vancouver	0	4	-0.32	-1.03	0.39
CVD HA	All	Windsor	0	4	-0.30	-1.39	0.78
CVD HA	All	Winnipeg	0	4	0.25	-1.14	1.63
CVD HA	All	Calgary	0	8	-0.68	-1.92	0.55
CVD HA	All	Edmonton	0	8	-0.19	-1.53	1.14
CVD HA	All	Halifax	0	8	0.42	-1.49	2.33
CVD HA	All	Hamilton	0	8	0.28	-0.73	1.29
CVD HA	All	Montreal	0	8	-0.36	-0.98	0.26
CVD HA	All	Ottawa	0	8	0.34	-0.75	1.43
CVD HA	All	Quebec City	0	8	-0.26	-1.21	0.69
CVD HA	All	St Johns	0	8	0.05	-1.84	1.93
CVD HA	All	Toronto	0	8	0.11	-0.39	0.60
CVD HA	All	Vancouver	0	8	-0.60	-1.35	0.15
CVD HA	All	Windsor	0	8	-0.42	-1.53	0.69
CVD HA	All	Winnipeg	0	8	-0.28	-1.75	1.18
CVD HA	All	Calgary	0	12	-0.87	-2.13	0.39
CVD HA	All	Edmonton	0	12	0.01	-1.36	1.38
CVD HA	All	Halifax	0	12	0.57	-1.36	2.50
CVD HA	All	Hamilton	0	12	0.29	-0.73	1.32
CVD HA	All	Montreal	0	12	-0.31	-0.94	0.32
CVD HA	All	Ottawa	0	12	0.40	-0.71	1.50
CVD HA	All	Quebec City	0	12	-0.25	-1.21	0.71
CVD HA	All	St Johns	0	12	-0.12	-2.03	1.80
CVD HA	All	Toronto	0	12	0.11	-0.39	0.60
CVD HA	All	Vancouver	0	12	-0.43	-1.20	0.35
CVD HA	All	Windsor	0	12	-0.44	-1.56	0.68
CVD HA	All	Winnipeg	0	12	-0.29	-1.78	1.20
CVD HA	All	Calgary	1	4	-0.53	-1.71	0.65
CVD HA	All	Edmonton	1	4	-0.68	-1.93	0.58
CVD HA	All	Halifax	1	4	2.55	0.71	4.38
CVD HA	All	Hamilton	1	4	0.58	-0.41	1.57
CVD HA	All	Montreal	1	4	0.21	-0.39	0.80
CVD HA	All	Ottawa	1	4	0.71	-0.34	1.75
CVD HA	All	Quebec City	1	4	-0.01	-0.94	0.92
CVD HA	All	St Johns	1	4	0.66	-1.18	2.49
CVD HA	All	Toronto	1	4	0.14	-0.34	0.62
CVD HA	All	Vancouver	1	4	-0.02	-0.72	0.69
CVD HA	All	Windsor	1	4	1.15	0.07	2.23
CVD HA	All	Winnipeg	1	4	0.71	-0.67	2.09

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Calgary	1	8	-0.50	-1.73	0.73
CVD HA	All	Edmonton	1	8	-1.47	-2.80	-0.13
CVD HA	All	Halifax	1	8	2.13	0.22	4.03
CVD HA	All	Hamilton	1	8	0.50	-0.51	1.51
CVD HA	All	Montreal	1	8	-0.52	-1.14	0.10
CVD HA	All	Ottawa	1	8	0.25	-0.84	1.34
CVD HA	All	Quebec City	1	8	-0.24	-1.19	0.71
CVD HA	All	St Johns	1	8	0.57	-1.30	2.45
CVD HA	All	Toronto	1	8	0.03	-0.46	0.52
CVD HA	All	Vancouver	1	8	-0.14	-0.89	0.61
CVD HA	All	Windsor	1	8	1.10	-0.01	2.20
CVD HA	All	Winnipeg	1	8	0.01	-1.46	1.48
CVD HA	All	Calgary	1	12	-0.67	-1.93	0.58
CVD HA	All	Edmonton	1	12	-1.36	-2.73	0.02
CVD HA	All	Halifax	1	12	2.31	0.39	4.23
CVD HA	All	Hamilton	1	12	0.51	-0.52	1.53
CVD HA	All	Montreal	1	12	-0.47	-1.10	0.16
CVD HA	All	Ottawa	1	12	0.31	-0.79	1.42
CVD HA	All	Quebec City	1	12	-0.22	-1.18	0.74
CVD HA	All	St Johns	1	12	0.46	-1.45	2.37
CVD HA	All	Toronto	1	12	0.04	-0.46	0.54
CVD HA	All	Vancouver	1	12	0.06	-0.71	0.83
CVD HA	All	Windsor	1	12	1.10	-0.02	2.21
CVD HA	All	Winnipeg	1	12	0.04	-1.45	1.53
CVD HA	All	Calgary	2	4	0.09	-1.10	1.27
CVD HA	All	Edmonton	2	4	-0.19	-1.44	1.06
CVD HA	All	Halifax	2	4	1.01	-0.81	2.84
CVD HA	All	Hamilton	2	4	0.19	-0.80	1.18
CVD HA	All	Montreal	2	4	0.35	-0.25	0.94
CVD HA	All	Ottawa	2	4	0.84	-0.21	1.88
CVD HA	All	Quebec City	2	4	0.77	-0.15	1.70
CVD HA	All	St Johns	2	4	-0.66	-2.49	1.18
CVD HA	All	Toronto	2	4	-0.01	-0.49	0.47
CVD HA	All	Vancouver	2	4	0.06	-0.64	0.77
CVD HA	All	Windsor	2	4	0.06	-1.02	1.14
CVD HA	All	Winnipeg	2	4	1.42	0.04	2.79
CVD HA	All	Calgary	2	8	0.14	-1.09	1.37
CVD HA	All	Edmonton	2	8	-0.95	-2.29	0.38
CVD HA	All	Halifax	2	8	0.30	-1.60	2.20
CVD HA	All	Hamilton	2	8	0.02	-0.99	1.03
CVD HA	All	Montreal	2	8	-0.35	-0.97	0.27
CVD HA	All	Ottawa	2	8	0.50	-0.59	1.59
CVD HA	All	Quebec City	2	8	0.52	-0.42	1.46
CVD HA	All	St Johns	2	8	-0.87	-2.74	1.01
CVD HA	All	Toronto	2	8	-0.17	-0.66	0.32
CVD HA	All	Vancouver	2	8	-0.02	-0.77	0.73
CVD HA	All	Windsor	2	8	-0.09	-1.19	1.02
CVD HA	All	Winnipeg	2	8	0.80	-0.67	2.27

Table C-1 . City specific percent change (*β x1000*) in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Calgary	2	12	-0.01	-1.26	1.25
CVD HA	All	Edmonton	2	12	-0.82	-2.19	0.56
CVD HA	All	Halifax	2	12	0.52	-1.40	2.44
CVD HA	All	Hamilton	2	12	0.02	-1.00	1.05
CVD HA	All	Montreal	2	12	-0.30	-0.93	0.34
CVD HA	All	Ottawa	2	12	0.56	-0.54	1.67
CVD HA	All	Quebec City	2	12	0.56	-0.39	1.52
CVD HA	All	St Johns	2	12	-1.01	-2.92	0.90
CVD HA	All	Toronto	2	12	-0.15	-0.65	0.35
CVD HA	All	Vancouver	2	12	0.17	-0.61	0.94
CVD HA	All	Windsor	2	12	-0.11	-1.22	1.01
CVD HA	All	Winnipeg	2	12	0.88	-0.61	2.38
CVD HA	All	Calgary	1	4	-0.84	-2.26	0.58
CVD HA	All	Edmonton	1	4	-0.19	-1.67	1.29
CVD HA	All	Halifax	1	4	2.37	0.19	4.55
CVD HA	All	Hamilton	1	4	0.70	-0.50	1.90
CVD HA	All	Montreal	1	4	0.28	-0.42	0.99
CVD HA	All	Ottawa	1	4	1.07	-0.18	2.32
CVD HA	All	Quebec City	1	4	-0.03	-1.15	1.10
CVD HA	All	St Johns	1	4	0.66	-1.52	2.84
CVD HA	All	Toronto	1	4	0.25	-0.34	0.83
CVD HA	All	Vancouver	1	4	-0.20	-1.01	0.60
CVD HA	All	Windsor	1	4	0.61	-0.71	1.94
CVD HA	All	Winnipeg	1	4	0.66	-0.99	2.31
CVD HA	All	Calgary	1	8	-0.85	-2.36	0.66
CVD HA	All	Edmonton	1	8	-1.22	-2.85	0.40
CVD HA	All	Halifax	1	8	1.58	-0.74	3.89
CVD HA	All	Hamilton	1	8	0.61	-0.62	1.84
CVD HA	All	Montreal	1	8	-0.62	-1.36	0.13
CVD HA	All	Ottawa	1	8	0.46	-0.86	1.78
CVD HA	All	Quebec City	1	8	-0.35	-1.51	0.81
CVD HA	All	St Johns	1	8	0.51	-1.75	2.77
CVD HA	All	Toronto	1	8	0.11	-0.49	0.71
CVD HA	All	Vancouver	1	8	-0.48	-1.35	0.40
CVD HA	All	Windsor	1	8	0.53	-0.84	1.90
CVD HA	All	Winnipeg	1	8	-0.25	-2.06	1.56
CVD HA	All	Calgary	1	12	-1.18	-2.74	0.38
CVD HA	All	Edmonton	1	12	-1.02	-2.72	0.67
CVD HA	All	Halifax	1	12	1.83	-0.52	4.18
CVD HA	All	Hamilton	1	12	0.64	-0.62	1.90
CVD HA	All	Montreal	1	12	-0.54	-1.30	0.22
CVD HA	All	Ottawa	1	12	0.57	-0.77	1.92
CVD HA	All	Quebec City	1	12	-0.35	-1.54	0.83
CVD HA	All	St Johns	1	12	0.32	-1.99	2.64
CVD HA	All	Toronto	1	12	0.12	-0.49	0.74
CVD HA	All	Vancouver	1	12	-0.25	-1.16	0.67
CVD HA	All	Windsor	1	12	0.53	-0.86	1.92
CVD HA	All	Winnipeg	1	12	-0.21	-2.06	1.63

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
CVD HA	All	Calgary	2	4	-0.69	-2.28	0.91
CVD HA	All	Edmonton	2	4	-0.26	-1.90	1.38
CVD HA	All	Halifax	2	4	2.68	0.24	5.11
CVD HA	All	Hamilton	2	4	0.75	-0.62	2.12
CVD HA	All	Montreal	2	4	0.31	-0.49	1.11
CVD HA	All	Ottawa	2	4	1.39	-0.04	2.83
CVD HA	All	Quebec City	2	4	0.51	-0.77	1.80
CVD HA	All	St Johns	2	4	0.16	-2.32	2.64
CVD HA	All	Toronto	2	4	0.14	-0.53	0.82
CVD HA	All	Vancouver	2	4	-0.21	-1.09	0.67
CVD HA	All	Windsor	2	4	0.47	-1.06	2.01
CVD HA	All	Winnipeg	2	4	1.34	-0.51	3.18
CVD HA	All	Calgary	2	8	-0.70	-2.43	1.02
CVD HA	All	Edmonton	2	8	-1.72	-3.58	0.14
CVD HA	All	Halifax	2	8	1.67	-0.95	4.29
CVD HA	All	Hamilton	2	8	0.63	-0.79	2.05
CVD HA	All	Montreal	2	8	-0.76	-1.61	0.09
CVD HA	All	Ottawa	2	8	0.75	-0.78	2.28
CVD HA	All	Quebec City	2	8	0.10	-1.23	1.43
CVD HA	All	St Johns	2	8	-0.07	-2.67	2.53
CVD HA	All	Toronto	2	8	-0.02	-0.72	0.68
CVD HA	All	Vancouver	2	8	-0.44	-1.40	0.53
CVD HA	All	Windsor	2	8	0.36	-1.24	1.96
CVD HA	All	Winnipeg	2	8	0.24	-1.84	2.32
CVD HA	All	Calgary	2	12	-1.13	-2.94	0.67
CVD HA	All	Edmonton	2	12	-1.54	-3.50	0.42
CVD HA	All	Halifax	2	12	2.01	-0.68	4.69
CVD HA	All	Hamilton	2	12	0.66	-0.80	2.12
CVD HA	All	Montreal	2	12	-0.66	-1.54	0.21
CVD HA	All	Ottawa	2	12	0.92	-0.66	2.49
CVD HA	All	Quebec City	2	12	0.15	-1.22	1.53
CVD HA	All	St Johns	2	12	-0.37	-3.06	2.32
CVD HA	All	Toronto	2	12	-0.01	-0.73	0.72
CVD HA	All	Vancouver	2	12	-0.13	-1.15	0.89
CVD HA	All	Windsor	2	12	0.35	-1.28	1.98
CVD HA	All	Winnipeg	2	12	0.35	-1.79	2.49
CVD HA	All	Calgary	dist02	4	-0.49	-2.1	1.11
CVD HA	All	Edmonton	dist02	4	-0.02	-1.69	1.64
CVD HA	All	Halifax	dist02	4	2.82	0.26	5.38
CVD HA	All	Hamilton	dist02	4	1	-0.41	2.43
CVD HA	All	Montreal	dist02	4	0.18	-0.64	1.02
CVD HA	All	Ottawa	dist02	4	1.32	-0.14	2.8
CVD HA	All	Quebec City	dist02	4	0.47	-0.85	1.81
CVD HA	All	St Johns	dist02	4	-0.01	-2.54	2.51
CVD HA	All	Toronto	dist02	4	0.1	-0.61	0.81
CVD HA	All	Vancouver	dist02	4	-0.12	-1.02	0.77
CVD HA	All	Windsor	dist02	4	0.29	-1.31	1.9
CVD HA	All	Winnipeg	dist02	4	1.25	-0.63	3.15

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Calgary	dist02	8	-0.52	-2.26	1.22
CVD HA	All	Edmonton	dist02	8	-1.44	-3.33	0.44
CVD HA	All	Halifax	dist02	8	1.67	-1.06	4.41
CVD HA	All	Hamilton	dist02	8	0.83	-0.63	2.3
CVD HA	All	Montreal	dist02	8	-0.86	-1.75	0.02
CVD HA	All	Ottawa	dist02	8	0.67	-0.89	2.24
CVD HA	All	Quebec City	dist02	8	0.08	-1.29	1.46
CVD HA	All	St Johns	dist02	8	-0.33	-2.98	2.3
CVD HA	All	Toronto	dist02	8	-0.07	-0.81	0.66
CVD HA	All	Vancouver	dist02	8	-0.36	-1.35	0.61
CVD HA	All	Windsor	dist02	8	0.13	-1.54	1.81
CVD HA	All	Winnipeg	dist02	8	0.36	-1.76	2.49
CVD HA	All	Calgary	dist02	12	-0.96	-2.78	0.85
CVD HA	All	Edmonton	dist02	12	-1.28	-3.28	0.71
CVD HA	All	Halifax	dist02	12	2.05	-0.75	4.86
CVD HA	All	Hamilton	dist02	12	0.84	-0.67	2.35
CVD HA	All	Montreal	dist02	12	-0.75	-1.67	0.15
CVD HA	All	Ottawa	dist02	12	0.76	-0.85	2.38
CVD HA	All	Quebec City	dist02	12	0.19	-1.22	1.62
CVD HA	All	St Johns	dist02	12	-0.64	-3.38	2.09
CVD HA	All	Toronto	dist02	12	-0.06	-0.82	0.7
CVD HA	All	Vancouver	dist02	12	-0.03	-1.07	1
CVD HA	All	Windsor	dist02	12	0.1	-1.61	1.82
CVD HA	All	Winnipeg	dist02	12	0.41	-1.77	2.6
CVD HA	≥65	Calgary	1	4	-1.399	-2.90	0.10
CVD HA	≥65	Edmonton	1	4	-0.101	-1.65	1.45
CVD HA	≥65	Halifax	1	4	1.836	-0.44	4.11
CVD HA	≥65	Hamilton	1	4	0.425	-0.76	1.61
CVD HA	≥65	Montreal	1	4	0.310	-0.45	1.07
CVD HA	≥65	Ottawa	1	4	0.448	-0.85	1.74
CVD HA	≥65	Quebec City	1	4	0.236	-1.00	1.47
CVD HA	≥65	St Johns	1	4	0.775	-1.45	3.00
CVD HA	≥65	Toronto	1	4	-0.053	-0.62	0.52
CVD HA	≥65	Vancouver	1	4	-0.196	-1.04	0.65
CVD HA	≥65	Windsor	1	4	1.530	0.25	2.81
CVD HA	≥65	Winnipeg	1	4	1.073	-0.54	2.69
CVD HA	≥65	Calgary	1	8	-1.481	-3.04	0.08
CVD HA	≥65	Edmonton	1	8	-0.640	-2.29	1.02
CVD HA	≥65	Halifax	1	8	1.561	-0.80	3.92
CVD HA	≥65	Hamilton	1	8	0.454	-0.75	1.66
CVD HA	≥65	Montreal	1	8	-0.604	-1.40	0.19
CVD HA	≥65	Ottawa	1	8	-0.027	-1.37	1.32
CVD HA	≥65	Quebec City	1	8	-0.086	-1.34	1.17
CVD HA	≥65	St Johns	1	8	0.729	-1.55	3.01
CVD HA	≥65	Toronto	1	8	-0.174	-0.76	0.41
CVD HA	≥65	Vancouver	1	8	-0.435	-1.33	0.46
CVD HA	≥65	Windsor	1	8	1.452	0.14	2.76
CVD HA	≥65	Winnipeg	1	8	0.334	-1.39	2.05

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	≥65	Calgary	1	12	-1.808	-3.40	-0.22
CVD HA	≥65	Edmonton	1	12	-0.435	-2.14	1.27
CVD HA	≥65	Halifax	1	12	1.759	-0.63	4.15
CVD HA	≥65	Hamilton	1	12	0.523	-0.70	1.75
CVD HA	≥65	Montreal	1	12	-0.558	-1.37	0.25
CVD HA	≥65	Ottawa	1	12	-0.036	-1.40	1.33
CVD HA	≥65	Quebec City	1	12	-0.034	-1.31	1.24
CVD HA	≥65	St Johns	1	12	0.567	-1.75	2.89
CVD HA	≥65	Toronto	1	12	-0.145	-0.74	0.45
CVD HA	≥65	Vancouver	1	12	-0.108	-1.03	0.81
CVD HA	≥65	Windsor	1	12	1.457	0.13	2.78
CVD HA	≥65	Winnipeg	1	12	0.350	-1.39	2.09
CVD HA	≥65	Calgary	2	4	-0.425	-2.44	1.59
CVD HA	≥65	Edmonton	2	4	-0.112	-2.15	1.92
CVD HA	≥65	Halifax	2	4	2.601	-0.42	5.63
CVD HA	≥65	Hamilton	2	4	-0.016	-1.66	1.62
CVD HA	≥65	Montreal	2	4	0.209	-0.81	1.23
CVD HA	≥65	Ottawa	2	4	1.607	-0.16	3.38
CVD HA	≥65	Quebec City	2	4	0.824	-0.88	2.53
CVD HA	≥65	St Johns	2	4	0.146	-2.87	3.16
CVD HA	≥65	Toronto	2	4	-0.203	-1.01	0.60
CVD HA	≥65	Vancouver	2	4	-0.311	-1.37	0.74
CVD HA	≥65	Windsor	2	4	1.103	-0.71	2.92
CVD HA	≥65	Winnipeg	2	4	1.508	-0.64	3.66
CVD HA	≥65	Calgary	2	8	-0.501	-2.69	1.69
CVD HA	≥65	Edmonton	2	8	-1.241	-3.54	1.06
CVD HA	≥65	Halifax	2	8	1.857	-1.39	5.10
CVD HA	≥65	Hamilton	2	8	0.062	-1.63	1.76
CVD HA	≥65	Montreal	2	8	-1.161	-2.25	-0.07
CVD HA	≥65	Ottawa	2	8	0.954	-0.94	2.84
CVD HA	≥65	Quebec City	2	8	0.195	-1.57	1.96
CVD HA	≥65	St Johns	2	8	-0.137	-3.30	3.02
CVD HA	≥65	Toronto	2	8	-0.338	-1.17	0.49
CVD HA	≥65	Vancouver	2	8	-0.688	-1.85	0.47
CVD HA	≥65	Windsor	2	8	0.986	-0.91	2.88
CVD HA	≥65	Winnipeg	2	8	0.329	-2.10	2.76
CVD HA	≥65	Calgary	2	12	-1.163	-3.45	1.12
CVD HA	≥65	Edmonton	2	12	-0.910	-3.34	1.52
CVD HA	≥65	Halifax	2	12	2.142	-1.20	5.48
CVD HA	≥65	Hamilton	2	12	0.166	-1.58	1.91
CVD HA	≥65	Montreal	2	12	-1.085	-2.21	0.04
CVD HA	≥65	Ottawa	2	12	1.001	-0.95	2.95
CVD HA	≥65	Quebec City	2	12	0.317	-1.50	2.14
CVD HA	≥65	St Johns	2	12	-0.557	-3.82	2.71
CVD HA	≥65	Toronto	2	12	-0.308	-1.16	0.55
CVD HA	≥65	Vancouver	2	12	-0.158	-1.38	1.06
CVD HA	≥65	Windsor	2	12	0.996	-0.94	2.93
CVD HA	≥65	Winnipeg	2	12	0.398	-2.10	2.89

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	≥65	Calgary	dist02	4	-0.01	-2.05	2.02
CVD HA	≥65	Edmonton	dist02	4	0.15	-1.55	1.85
CVD HA	≥65	Halifax	dist02	4	0.55	-1.21	2.32
CVD HA	≥65	Hamilton	dist02	4	-0.2	-1.27	0.87
CVD HA	≥65	Montreal	dist02	4	-0.01	-2.05	2.02
CVD HA	≥65	Ottawa	dist02	4	0.16	-1.59	1.93
CVD HA	≥65	Quebec City	dist02	4	-0.02	-1.85	1.81
CVD HA	≥65	St Johns	dist02	4	-0.61	-1.79	0.56
CVD HA	≥65	Toronto	dist02	4	-0.02	-2.23	2.17
CVD HA	≥65	Vancouver	dist02	4	0.28	-1.53	2.09
CVD HA	≥65	Windsor	dist02	4	0.17	-1.71	2.07
CVD HA	≥65	Winnipeg	dist02	4	-0.1	-1.35	1.13
CVD HA	≥65	Calgary	dist02	8	0.13	-1.93	2.2
CVD HA	≥65	Edmonton	dist02	8	0	-1.07	1.06
CVD HA	≥65	Halifax	dist02	8	-0.02	-3.09	3.04
CVD HA	≥65	Hamilton	dist02	8	0.95	-0.95	2.86
CVD HA	≥65	Montreal	dist02	8	-1	-3.34	1.34
CVD HA	≥65	Ottawa	dist02	8	-1.36	-2.5	-0.22
CVD HA	≥65	Quebec City	dist02	8	-0.38	-3.59	2.83
CVD HA	≥65	St Johns	dist02	8	0.8	-1.18	2.8
CVD HA	≥65	Toronto	dist02	8	-1	-3.34	1.34
CVD HA	≥65	Vancouver	dist02	8	-1.27	-2.45	-0.1
CVD HA	≥65	Windsor	dist02	8	-0.8	-4.13	2.51
CVD HA	≥65	Winnipeg	dist02	8	0.8	-1.23	2.84
CVD HA	≥65	Calgary	dist02	12	2.62	-0.54	5.8
CVD HA	≥65	Edmonton	dist02	12	1.7	-0.11	3.53
CVD HA	≥65	Halifax	dist02	12	-0.36	-1.21	0.48
CVD HA	≥65	Hamilton	dist02	12	1.17	-1.03	3.38
CVD HA	≥65	Montreal	dist02	12	1.75	-1.64	5.15
CVD HA	≥65	Ottawa	dist02	12	1.05	-0.89	2.99
CVD HA	≥65	Quebec City	dist02	12	-0.5	-1.38	0.37
CVD HA	≥65	St Johns	dist02	12	0.16	-2.32	2.64
CVD HA	≥65	Toronto	dist02	12	2.18	-1.29	5.66
CVD HA	≥65	Vancouver	dist02	12	1.04	-0.96	3.05
CVD HA	≥65	Windsor	dist02	12	-0.47	-1.38	0.42
CVD HA	≥65	Winnipeg	dist02	12	0.16	-2.38	2.72
Resp HA	All	Calgary	0	4	-1.71	-3.16	-0.26
Resp HA	All	Edmonton	0	4	-1.36	-2.77	0.05
Resp HA	All	Halifax	0	4	-0.80	-3.17	1.58
Resp HA	All	Hamilton	0	4	-0.12	-1.61	1.37
Resp HA	All	Montreal	0	4	0.86	0.05	1.66
Resp HA	All	Ottawa	0	4	-0.03	-1.53	1.47
Resp HA	All	Quebec City	0	4	-1.03	-2.39	0.33
Resp HA	All	St Johns	0	4	-0.27	-2.61	2.07
Resp HA	All	Toronto	0	4	0.46	-0.22	1.13
Resp HA	All	Vancouver	0	4	-0.45	-1.37	0.47
Resp HA	All	Windsor	0	4	-0.40	-1.98	1.18
Resp HA	All	Winnipeg	0	4	0.39	-1.45	2.24

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	0	8	-0.75	-2.26	0.75
Resp HA	All	Edmonton	0	8	-1.43	-2.94	0.07
Resp HA	All	Halifax	0	8	-1.47	-3.94	1.00
Resp HA	All	Hamilton	0	8	0.43	-1.09	1.94
Resp HA	All	Montreal	0	8	-0.19	-1.03	0.65
Resp HA	All	Ottawa	0	8	0.51	-1.04	2.06
Resp HA	All	Quebec City	0	8	-0.61	-2.00	0.78
Resp HA	All	St Johns	0	8	0.23	-2.17	2.63
Resp HA	All	Toronto	0	8	0.54	-0.15	1.23
Resp HA	All	Vancouver	0	8	0.19	-0.78	1.17
Resp HA	All	Windsor	0	8	0.06	-1.55	1.66
Resp HA	All	Winnipeg	0	8	-0.22	-2.17	1.73
Resp HA	All	Calgary	0	12	0.20	-1.34	1.74
Resp HA	All	Edmonton	0	12	-1.45	-3.01	0.10
Resp HA	All	Halifax	0	12	-1.41	-3.91	1.09
Resp HA	All	Hamilton	0	12	-0.04	-1.58	1.50
Resp HA	All	Montreal	0	12	-0.47	-1.33	0.38
Resp HA	All	Ottawa	0	12	0.52	-1.06	2.09
Resp HA	All	Quebec City	0	12	-0.76	-2.17	0.65
Resp HA	All	St Johns	0	12	0.33	-2.11	2.76
Resp HA	All	Toronto	0	12	0.17	-0.53	0.86
Resp HA	All	Vancouver	0	12	0.16	-0.84	1.16
Resp HA	All	Windsor	0	12	-0.20	-1.82	1.42
Resp HA	All	Winnipeg	0	12	-0.56	-2.53	1.41
Resp HA	All	Calgary	1	4	-0.74	-2.19	0.70
Resp HA	All	Edmonton	1	4	-0.14	-1.54	1.27
Resp HA	All	Halifax	1	4	0.89	-1.47	3.25
Resp HA	All	Hamilton	1	4	0.07	-1.41	1.55
Resp HA	All	Montreal	1	4	1.39	0.59	2.20
Resp HA	All	Ottawa	1	4	-0.24	-1.74	1.26
Resp HA	All	Quebec City	1	4	-0.71	-2.07	0.65
Resp HA	All	St Johns	1	4	-0.24	-2.58	2.10
Resp HA	All	Toronto	1	4	1.45	0.78	2.11
Resp HA	All	Vancouver	1	4	-1.12	-2.04	-0.20
Resp HA	All	Windsor	1	4	1.28	-0.29	2.84
Resp HA	All	Winnipeg	1	4	1.50	-0.34	3.34
Resp HA	All	Calgary	1	8	0.33	-1.17	1.84
Resp HA	All	Edmonton	1	8	-0.08	-1.59	1.42
Resp HA	All	Halifax	1	8	0.31	-2.14	2.77
Resp HA	All	Hamilton	1	8	0.59	-0.92	2.10
Resp HA	All	Montreal	1	8	0.37	-0.47	1.21
Resp HA	All	Ottawa	1	8	0.34	-1.21	1.89
Resp HA	All	Quebec City	1	8	-0.24	-1.63	1.15
Resp HA	All	St Johns	1	8	0.21	-2.19	2.61
Resp HA	All	Toronto	1	8	1.55	0.86	2.23
Resp HA	All	Vancouver	1	8	-0.40	-1.37	0.57
Resp HA	All	Windsor	1	8	1.80	0.21	3.40
Resp HA	All	Winnipeg	1	8	0.87	-1.08	2.83

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	1	12	1.41	-0.14	2.95
Resp HA	All	Edmonton	1	12	0.06	-1.50	1.62
Resp HA	All	Halifax	1	12	0.43	-2.05	2.90
Resp HA	All	Hamilton	1	12	0.12	-1.41	1.65
Resp HA	All	Montreal	1	12	0.14	-0.72	0.99
Resp HA	All	Ottawa	1	12	0.38	-1.19	1.96
Resp HA	All	Quebec City	1	12	-0.45	-1.84	0.94
Resp HA	All	St Johns	1	12	0.31	-2.13	2.74
Resp HA	All	Toronto	1	12	1.21	0.51	1.90
Resp HA	All	Vancouver	1	12	-0.50	-1.50	0.50
Resp HA	All	Windsor	1	12	1.57	-0.04	3.18
Resp HA	All	Winnipeg	1	12	0.49	-1.48	2.47
Resp HA	All	Calgary	2	4	-1.79	-3.23	-0.34
Resp HA	All	Edmonton	2	4	0.93	-0.48	2.34
Resp HA	All	Halifax	2	4	-0.42	-2.78	1.95
Resp HA	All	Hamilton	2	4	-0.34	-1.82	1.14
Resp HA	All	Montreal	2	4	2.52	1.72	3.32
Resp HA	All	Ottawa	2	4	-0.23	-1.73	1.27
Resp HA	All	Quebec City	2	4	-0.09	-1.45	1.26
Resp HA	All	St Johns	2	4	2.36	0.05	4.67
Resp HA	All	Toronto	2	4	1.49	0.82	2.16
Resp HA	All	Vancouver	2	4	-1.61	-2.53	-0.69
Resp HA	All	Windsor	2	4	0.49	-1.08	2.05
Resp HA	All	Winnipeg	2	4	1.84	0.01	3.68
Resp HA	All	Calgary	2	8	-0.77	-2.27	0.74
Resp HA	All	Edmonton	2	8	1.29	-0.21	2.80
Resp HA	All	Halifax	2	8	-0.92	-3.38	1.54
Resp HA	All	Hamilton	2	8	0.18	-1.33	1.69
Resp HA	All	Montreal	2	8	1.67	0.83	2.50
Resp HA	All	Ottawa	2	8	0.31	-1.24	1.87
Resp HA	All	Quebec City	2	8	0.45	-0.93	1.83
Resp HA	All	St Johns	2	8	3.05	0.69	5.42
Resp HA	All	Toronto	2	8	1.63	0.95	2.31
Resp HA	All	Vancouver	2	8	-0.92	-1.89	0.05
Resp HA	All	Windsor	2	8	0.97	-0.63	2.56
Resp HA	All	Winnipeg	2	8	1.51	-0.44	3.46
Resp HA	All	Calgary	2	12	0.28	-1.26	1.83
Resp HA	All	Edmonton	2	12	1.57	0.01	3.12
Resp HA	All	Halifax	2	12	-0.77	-3.25	1.71
Resp HA	All	Hamilton	2	12	-0.25	-1.78	1.29
Resp HA	All	Montreal	2	12	1.49	0.64	2.34
Resp HA	All	Ottawa	2	12	0.38	-1.20	1.95
Resp HA	All	Quebec City	2	12	0.36	-1.05	1.76
Resp HA	All	St Johns	2	12	3.23	0.82	5.63
Resp HA	All	Toronto	2	12	1.32	0.63	2.02
Resp HA	All	Vancouver	2	12	-1.07	-2.07	-0.07
Resp HA	All	Windsor	2	12	0.75	-0.87	2.36
Resp HA	All	Winnipeg	2	12	1.15	-0.83	3.12

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	1	4	-1.71	-3.44	0.03
Resp HA	All	Edmonton	1	4	-1.04	-2.70	0.63
Resp HA	All	Halifax	1	4	0.42	-2.38	3.23
Resp HA	All	Hamilton	1	4	-0.02	-1.81	1.77
Resp HA	All	Montreal	1	4	1.50	0.54	2.45
Resp HA	All	Ottawa	1	4	-0.16	-1.96	1.63
Resp HA	All	Quebec City	1	4	-1.45	-3.10	0.21
Resp HA	All	St Johns	1	4	-0.24	-3.00	2.53
Resp HA	All	Toronto	1	4	1.45	0.63	2.27
Resp HA	All	Vancouver	1	4	-0.94	-1.98	0.11
Resp HA	All	Windsor	1	4	0.70	-1.22	2.61
Resp HA	All	Winnipeg	1	4	1.31	-0.88	3.50
Resp HA	All	Calgary	1	8	-0.36	-2.20	1.48
Resp HA	All	Edmonton	1	8	-1.14	-2.97	0.69
Resp HA	All	Halifax	1	8	-0.49	-3.47	2.49
Resp HA	All	Hamilton	1	8	0.70	-1.13	2.54
Resp HA	All	Montreal	1	8	0.16	-0.85	1.16
Resp HA	All	Ottawa	1	8	0.65	-1.23	2.53
Resp HA	All	Quebec City	1	8	-0.81	-2.51	0.88
Resp HA	All	St Johns	1	8	0.40	-2.47	3.27
Resp HA	All	Toronto	1	8	1.62	0.79	2.46
Resp HA	All	Vancouver	1	8	-0.13	-1.26	0.99
Resp HA	All	Windsor	1	8	1.46	-0.52	3.44
Resp HA	All	Winnipeg	1	8	0.38	-2.02	2.77
Resp HA	All	Calgary	1	12	1.16	-0.75	3.07
Resp HA	All	Edmonton	1	12	-1.11	-3.03	0.81
Resp HA	All	Halifax	1	12	-0.28	-3.31	2.75
Resp HA	All	Hamilton	1	12	0.00	-1.88	1.88
Resp HA	All	Montreal	1	12	-0.21	-1.23	0.82
Resp HA	All	Ottawa	1	12	0.66	-1.26	2.58
Resp HA	All	Quebec City	1	12	-1.05	-2.79	0.68
Resp HA	All	St Johns	1	12	0.53	-2.41	3.47
Resp HA	All	Toronto	1	12	1.11	0.25	1.96
Resp HA	All	Vancouver	1	12	-0.21	-1.39	0.96
Resp HA	All	Windsor	1	12	1.09	-0.92	3.09
Resp HA	All	Winnipeg	1	12	-0.12	-2.55	2.32
Resp HA	All	Calgary	2	4	-2.44	-4.38	-0.50
Resp HA	All	Edmonton	2	4	-0.30	-2.14	1.54
Resp HA	All	Halifax	2	4	0.39	-2.76	3.54
Resp HA	All	Hamilton	2	4	0.11	-1.94	2.17
Resp HA	All	Montreal	2	4	2.75	1.68	3.82
Resp HA	All	Ottawa	2	4	-0.13	-2.18	1.91
Resp HA	All	Quebec City	2	4	-1.28	-3.16	0.61
Resp HA	All	St Johns	2	4	1.26	-1.87	4.39
Resp HA	All	Toronto	2	4	2.35	1.41	3.29
Resp HA	All	Vancouver	2	4	-1.52	-2.66	-0.38
Resp HA	All	Windsor	2	4	0.93	-1.28	3.15
Resp HA	All	Winnipeg	2	4	2.36	-0.08	4.81

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	2	8	-0.81	-2.90	1.29
Resp HA	All	Edmonton	2	8	-0.14	-2.23	1.94
Resp HA	All	Halifax	2	8	-0.60	-3.99	2.79
Resp HA	All	Hamilton	2	8	1.00	-1.12	3.12
Resp HA	All	Montreal	2	8	1.33	0.19	2.48
Resp HA	All	Ottawa	2	8	0.89	-1.28	3.06
Resp HA	All	Quebec City	2	8	-0.33	-2.28	1.62
Resp HA	All	St Johns	2	8	2.39	-0.89	5.68
Resp HA	All	Toronto	2	8	2.66	1.68	3.63
Resp HA	All	Vancouver	2	8	-0.61	-1.85	0.63
Resp HA	All	Windsor	2	8	1.97	-0.33	4.28
Resp HA	All	Winnipeg	2	8	1.38	-1.37	4.13
Resp HA	All	Calgary	2	12	1.23	-0.97	3.42
Resp HA	All	Edmonton	2	12	0.07	-2.15	2.29
Resp HA	All	Halifax	2	12	-0.26	-3.73	3.21
Resp HA	All	Hamilton	2	12	0.09	-2.09	2.27
Resp HA	All	Montreal	2	12	0.93	-0.24	2.11
Resp HA	All	Ottawa	2	12	0.95	-1.29	3.18
Resp HA	All	Quebec City	2	12	-0.60	-2.61	1.42
Resp HA	All	St Johns	2	12	2.73	-0.67	6.12
Resp HA	All	Toronto	2	12	2.03	1.02	3.03
Resp HA	All	Vancouver	2	12	-0.75	-2.05	0.56
Resp HA	All	Windsor	2	12	1.48	-0.87	3.83
Resp HA	All	Winnipeg	2	12	0.74	-2.08	3.55
Resp HA	All	Calgary	dist02	4	-4.18	-8.58	0.21
Resp HA	All	Edmonton	dist02	4	0.77	-2.97	4.52
Resp HA	All	Halifax	dist02	4	-1.85	-7.38	3.68
Resp HA	All	Hamilton	dist02	4	2.6	-0.97	6.17
Resp HA	All	Montreal	dist02	4	1.13	-0.86	3.13
Resp HA	All	Ottawa	dist02	4	-2.93	-6.46	0.58
Resp HA	All	Quebec City	dist02	4	-0.13	-3.23	2.97
Resp HA	All	St Johns	dist02	4	1.53	-4.52	7.58
Resp HA	All	Toronto	dist02	4	1.15	-0.68	2.99
Resp HA	All	Vancouver	dist02	4	1.27	-0.97	3.52
Resp HA	All	Windsor	dist02	4	4.9	0.34	9.46
Resp HA	All	Winnipeg	dist02	4	0.23	-3.82	4.29
Resp HA	All	Calgary	dist02	8	-3.13	-7.94	1.67
Resp HA	All	Edmonton	dist02	8	2.22	-1.95	6.4
Resp HA	All	Halifax	dist02	8	-1.22	-7.17	4.71
Resp HA	All	Hamilton	dist02	8	2.08	-1.58	5.76
Resp HA	All	Montreal	dist02	8	1.65	-0.48	3.79
Resp HA	All	Ottawa	dist02	8	-1.41	-5.18	2.35
Resp HA	All	Quebec City	dist02	8	1.42	-1.9	4.75
Resp HA	All	St Johns	dist02	8	3.95	-2.42	10.33
Resp HA	All	Toronto	dist02	8	1.69	-0.2	3.59
Resp HA	All	Vancouver	dist02	8	1.64	-0.82	4.1
Resp HA	All	Windsor	dist02	8	6.23	1.51	10.96
Resp HA	All	Winnipeg	dist02	8	1.72	-2.83	6.28

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	dist02	12	-3.59	-8.62	1.43
Resp HA	All	Edmonton	dist02	12	1.59	-2.74	5.93
Resp HA	All	Halifax	dist02	12	-1.05	-7.27	5.16
Resp HA	All	Hamilton	dist02	12	1.7	-2.13	5.55
Resp HA	All	Montreal	dist02	12	0.87	-1.32	3.08
Resp HA	All	Ottawa	dist02	12	-0.59	-4.54	3.35
Resp HA	All	Quebec City	dist02	12	1.67	-1.82	5.18
Resp HA	All	St Johns	dist02	12	3.93	-2.7	10.57
Resp HA	All	Toronto	dist02	12	1	-0.95	2.96
Resp HA	All	Vancouver	dist02	12	3.1	0.52	5.69
Resp HA	All	Windsor	dist02	12	6.14	1.25	11.03
Resp HA	All	Winnipeg	dist02	12	1.32	-3.41	6.06
Resp HA	≥65	Calgary	1	4	0.181	-2.07	2.44
Resp HA	≥65	Edmonton	1	4	-1.634	-3.92	0.65
Resp HA	≥65	Halifax	1	4	0.984	-2.65	4.61
Resp HA	≥65	Hamilton	1	4	1.032	-1.02	3.08
Resp HA	≥65	Montreal	1	4	0.530	-0.68	1.74
Resp HA	≥65	Ottawa	1	4	-0.373	-2.53	1.79
Resp HA	≥65	Quebec City	1	4	1.617	-0.53	3.76
Resp HA	≥65	St Johns	1	4	-1.191	-4.63	2.25
Resp HA	≥65	Toronto	1	4	0.686	-0.28	1.65
Resp HA	≥65	Vancouver	1	4	-1.413	-2.76	-0.06
Resp HA	≥65	Windsor	1	4	1.007	-1.26	3.27
Resp HA	≥65	Winnipeg	1	4	1.560	-0.91	4.03
Resp HA	≥65	Calgary	1	8	1.909	-0.44	4.26
Resp HA	≥65	Edmonton	1	8	-1.165	-3.61	1.28
Resp HA	≥65	Halifax	1	8	0.779	-3.00	4.56
Resp HA	≥65	Hamilton	1	8	1.676	-0.41	3.77
Resp HA	≥65	Montreal	1	8	0.319	-0.94	1.58
Resp HA	≥65	Ottawa	1	8	0.185	-2.05	2.42
Resp HA	≥65	Quebec City	1	8	1.780	-0.41	3.97
Resp HA	≥65	St Johns	1	8	-0.955	-4.49	2.58
Resp HA	≥65	Toronto	1	8	1.018	0.04	2.00
Resp HA	≥65	Vancouver	1	8	-1.057	-2.48	0.37
Resp HA	≥65	Windsor	1	8	1.713	-0.59	4.01
Resp HA	≥65	Winnipeg	1	8	1.567	-1.06	4.20
Resp HA	≥65	Calgary	1	12	2.920	0.51	5.33
Resp HA	≥65	Edmonton	1	12	-1.227	-3.76	1.31
Resp HA	≥65	Halifax	1	12	0.785	-3.03	4.60
Resp HA	≥65	Hamilton	1	12	0.895	-1.23	3.02
Resp HA	≥65	Montreal	1	12	-0.227	-1.50	1.05
Resp HA	≥65	Ottawa	1	12	-0.231	-2.50	2.04
Resp HA	≥65	Quebec City	1	12	1.312	-0.91	3.54
Resp HA	≥65	St Johns	1	12	-1.014	-4.59	2.56
Resp HA	≥65	Toronto	1	12	0.410	-0.58	1.40
Resp HA	≥65	Vancouver	1	12	-1.063	-2.53	0.40
Resp HA	≥65	Windsor	1	12	1.696	-0.63	4.02
Resp HA	≥65	Winnipeg	1	12	1.113	-1.54	3.77

Table C-1 . City specific percent change *(β x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI Lower	95% CI Upper
Resp HA	≥65	Calgary	2	4	-1.279	-4.29	1.73
Resp HA	≥65	Edmonton	2	4	-3.492	-6.49	-0.50
Resp HA	≥65	Halifax	2	4	1.263	-3.56	6.09
Resp HA	≥65	Hamilton	2	4	1.388	-1.46	4.23
Resp HA	≥65	Montreal	2	4	2.370	0.76	3.98
Resp HA	≥65	Ottawa	2	4	-0.602	-3.56	2.36
Resp HA	≥65	Quebec City	2	4	2.686	-0.27	5.64
Resp HA	≥65	St Johns	2	4	-0.990	-5.61	3.63
Resp HA	≥65	Toronto	2	4	1.590	0.23	2.95
Resp HA	≥65	Vancouver	2	4	-1.320	-2.99	0.35
Resp HA	≥65	Windsor	2	4	0.097	-3.10	3.30
Resp HA	≥65	Winnipeg	2	4	3.653	0.37	6.94
Resp HA	≥65	Calgary	2	8	1.608	-1.65	4.87
Resp HA	≥65	Edmonton	2	8	-3.240	-6.64	0.16
Resp HA	≥65	Halifax	2	8	1.157	-4.06	6.37
Resp HA	≥65	Hamilton	2	8	2.589	-0.35	5.53
Resp HA	≥65	Montreal	2	8	2.064	0.35	3.78
Resp HA	≥65	Ottawa	2	8	0.195	-2.94	3.33
Resp HA	≥65	Quebec City	2	8	3.065	0.00	6.13
Resp HA	≥65	St Johns	2	8	-0.437	-5.29	4.42
Resp HA	≥65	Toronto	2	8	2.275	0.88	3.67
Resp HA	≥65	Vancouver	2	8	-0.971	-2.79	0.85
Resp HA	≥65	Windsor	2	8	1.489	-1.83	4.81
Resp HA	≥65	Winnipeg	2	8	4.119	0.43	7.81
Resp HA	≥65	Calgary	2	12	3.656	0.23	7.08
Resp HA	≥65	Edmonton	2	12	-3.628	-7.24	-0.02
Resp HA	≥65	Halifax	2	12	1.510	-3.84	6.86
Resp HA	≥65	Hamilton	2	12	1.114	-1.91	4.14
Resp HA	≥65	Montreal	2	12	1.128	-0.63	2.89
Resp HA	≥65	Ottawa	2	12	-0.672	-3.90	2.56
Resp HA	≥65	Quebec City	2	12	2.048	-1.12	5.21
Resp HA	≥65	St Johns	2	12	-0.651	-5.63	4.33
Resp HA	≥65	Toronto	2	12	1.114	-0.32	2.55
Resp HA	≥65	Vancouver	2	12	-0.857	-2.76	1.05
Resp HA	≥65	Windsor	2	12	1.443	-1.94	4.83
Resp HA	≥65	Winnipeg	2	12	3.387	-0.39	7.16
Resp HA	≥65	Calgary	dist02	4	-1.1	-4.15	1.93
Resp HA	≥65	Edmonton	dist02	4	1.28	-1.67	4.23
Resp HA	≥65	Halifax	dist02	4	2.2	-0.87	5.27
Resp HA	≥65	Hamilton	dist02	4	-0.9	-2.6	0.79
Resp HA	≥65	Montreal	dist02	4	-1.1	-4.15	1.93
Resp HA	≥65	Ottawa	dist02	4	2.6	-0.44	5.66
Resp HA	≥65	Quebec City	dist02	4	2.68	-0.49	5.85
Resp HA	≥65	St Johns	dist02	4	-0.66	-2.51	1.18
Resp HA	≥65	Toronto	dist02	4	1.71	-1.58	5
Resp HA	≥65	Vancouver	dist02	4	1.13	-2	4.27
Resp HA	≥65	Windsor	dist02	4	1.85	-1.42	5.14
Resp HA	≥65	Winnipeg	dist02	4	-0.62	-2.56	1.31

Table C-1 . City specific percent change (β *x1000)* in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
Resp HA	≥65	Calgary	dist02	8	-3.67	-6.71	-0.62
Resp HA	≥65	Edmonton	dist02	8	2.38	0.7	4.05
Resp HA	≥65	Halifax	dist02	8	-1.18	-5.9	3.52
Resp HA	≥65	Hamilton	dist02	8	-1.13	-4.49	2.22
Resp HA	≥65	Montreal	dist02	8	-3.37	-6.83	0.08
Resp HA	≥65	Ottawa	dist02	8	2.24	0.45	4.03
Resp HA	≥65	Quebec City	dist02	8	-0.61	-5.56	4.32
Resp HA	≥65	St Johns	dist02	8	0.22	-3.25	3.7
Resp HA	≥65	Toronto	dist02	8	-3.37	-6.83	0.08
Resp HA	≥65	Vancouver	dist02	8	1.32	-0.51	3.16
Resp HA	≥65	Windsor	dist02	8	-0.86	-5.94	4.22
Resp HA	≥65	Winnipeg	dist02	8	0.18	-3.36	3.73
Resp HA	≥65	Calgary	dist02	12	-0.89	-5.96	4.18
Resp HA	≥65	Edmonton	dist02	12	0.74	-1.57	3.06
Resp HA	≥65	Halifax	dist02	12	1.32	-0.11	2.75
Resp HA	≥65	Hamilton	dist02	12	3.71	0.34	7.09
Resp HA	≥65	Montreal	dist02	12	-0.44	-5.91	5.02
Resp HA	≥65	Ottawa	dist02	12	0.76	-2.45	3.98
Resp HA	≥65	Quebec City	dist02	12	2.05	0.58	3.53
Resp HA	≥65	St Johns	dist02	12	4.4	0.62	8.18
Resp HA	≥65	Toronto	dist02	12	-0.33	-5.92	5.26
Resp HA	≥65	Vancouver	dist02	12	-0.03	-3.35	3.28
Resp HA	≥65	Windsor	dist02	12	0.82	-0.7	2.34
Resp HA	≥65	Winnipeg	dist02	12	3.61	-0.25	7.48

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Calgary	0	4	1.72	-1.68	5.12
All mortality	All	Edmonton	0	4	1.00	-2.33	4.32
All mortality	All	Halifax	0	4	5.86	-0.12	11.84
All mortality	All	Hamilton	0	4	-1.14	-4.45	2.18
All mortality	All	Montreal	0	4	-0.15	-1.16	0.85
All mortality	All	Ottawa	0	4	0.06	-2.72	2.83
All mortality	All	Quebec City	0	4	0.60	-2.58	3.78
All mortality	All	St Johns	0	4	3.51	-3.51	10.52
All mortality	All	Toronto	0	4	0.95	0.02	1.89
All mortality	All	Vancouver	0	4	0.34	-1.67	2.36
All mortality	All	Windsor	0	4	-0.67	-3.73	2.38
All mortality	All	Winnipeg	0	4	-1.49	-5.05	2.07
All mortality	All	Calgary	0	8	0.95	-2.70	4.61
All mortality	All	Edmonton	0	8	0.67	-2.85	4.18
All mortality	All	Halifax	0	8	6.39	0.09	12.70
All mortality	All	Hamilton	0	8	-2.60	-6.06	0.87
All mortality	All	Montreal	0	8	0.04	-1.01	1.08
All mortality	All	Ottawa	0	8	-0.15	-3.07	2.76
All mortality	All	Quebec City	0	8	0.72	-2.60	4.05
All mortality	All	St Johns	0	8	2.31	-4.87	9.48
All mortality	All	Toronto	0	8	0.75	-0.20	1.70
All mortality	All	Vancouver	0	8	0.61	-1.54	2.76
All mortality	All	Windsor	0	8	-1.03	-4.19	2.13
All mortality	All	Winnipeg	0	8	-0.45	-4.34	3.45
All mortality	All	Calgary	0	12	1.29	-2.56	5.14
All mortality	All	Edmonton	0	12	-0.08	-3.81	3.65
All mortality	All	Halifax	0	12	5.26	-1.16	11.68
All mortality	All	Hamilton	0	12	-2.38	-5.93	1.17
All mortality	All	Montreal	0	12	-0.28	-1.36	0.80
All mortality	All	Ottawa	0	12	-0.10	-3.14	2.94
All mortality	All	Quebec City	0	12	1.52	-1.97	5.01
All mortality	All	St Johns	0	12	2.87	-4.30	10.04
All mortality	All	Toronto	0	12	0.75	-0.22	1.72
All mortality	All	Vancouver	0	12	0.17	-2.10	2.44
All mortality	All	Windsor	0	12	-1.07	-4.29	2.15
All mortality	All	Winnipeg	0	12	0.79	-3.45	5.04
All mortality	All	Calgary	1	4	0.46	-2.90	3.83
All mortality	All	Edmonton	1	4	-0.60	-3.94	2.74
All mortality	All	Halifax	1	4	2.54	-3.52	8.61
All mortality	All	Hamilton	1	4	5.12	2.00	8.25
All mortality	All	Montreal	1	4	1.32	0.32	2.32
All mortality	All	Ottawa	1	4	0.85	-1.89	3.59
All mortality	All	Quebec City	1	4	0.13	-3.05	3.32
All mortality	All	St Johns	1	4	4.90	-1.98	11.78
All mortality	All	Toronto	1	4	1.55	0.62	2.48
All mortality	All	Vancouver	1	4	2.18	0.17	4.18
All mortality	All	Windsor	1	4	2.52	-0.51	5.55
All mortality	All	Winnipeg	1	4	1.25	-2.20	4.70
All mortality	All	Calgary	1	8	3.12	-0.49	6.74

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI	
						Lower	*Upper*
All mortality	All	Edmonton	1	8	-0.20	-3.70	3.29
All mortality	All	Halifax	1	8	2.82	-3.57	9.20
All mortality	All	Hamilton	1	8	4.28	0.99	7.56
All mortality	All	Montreal	1	8	0.91	-0.14	1.95
All mortality	All	Ottawa	1	8	0.87	-2.02	3.76
All mortality	All	Quebec City	1	8	-0.46	-3.78	2.87
All mortality	All	St Johns	1	8	5.45	-1.58	12.49
All mortality	All	Toronto	1	8	1.44	0.48	2.39
All mortality	All	Vancouver	1	8	2.43	0.29	4.58
All mortality	All	Windsor	1	8	2.49	-0.65	5.63
All mortality	All	Winnipeg	1	8	1.55	-2.25	5.35
All mortality	All	Calgary	1	12	2.72	-1.08	6.53
All mortality	All	Edmonton	1	12	0.82	-2.90	4.55
All mortality	All	Halifax	1	12	2.29	-4.19	8.76
All mortality	All	Hamilton	1	12	3.22	-0.15	6.59
All mortality	All	Montreal	1	12	0.84	-0.23	1.92
All mortality	All	Ottawa	1	12	1.28	-1.72	4.27
All mortality	All	Quebec City	1	12	-0.39	-3.89	3.12
All mortality	All	St Johns	1	12	4.83	-2.19	11.86
All mortality	All	Toronto	1	12	1.48	0.51	2.45
All mortality	All	Vancouver	1	12	2.32	0.06	4.58
All mortality	All	Windsor	1	12	2.87	-0.32	6.05
All mortality	All	Winnipeg	1	12	1.56	-2.59	5.71
All mortality	All	Calgary	2	4	1.70	-1.68	5.09
All mortality	All	Edmonton	2	4	0.61	-2.76	3.97
All mortality	All	Halifax	2	4	-1.55	-7.59	4.50
All mortality	All	Hamilton	2	4	0.09	-3.20	3.38
All mortality	All	Montreal	2	4	1.41	0.42	2.41
All mortality	All	Ottawa	2	4	-0.39	-3.20	2.41
All mortality	All	Quebec City	2	4	2.36	-0.84	5.56
All mortality	All	St Johns	2	4	5.98	-0.85	12.82
All mortality	All	Toronto	2	4	0.72	-0.22	1.66
All mortality	All	Vancouver	2	4	0.41	-1.60	2.43
All mortality	All	Windsor	2	4	0.60	-2.43	3.62
All mortality	All	Winnipeg	2	4	3.13	-0.29	6.56
All mortality	All	Calgary	2	8	1.88	-1.77	5.53
All mortality	All	Edmonton	2	8	0.87	-2.66	4.39
All mortality	All	Halifax	2	8	-2.23	-8.55	4.09
All mortality	All	Hamilton	2	8	-0.42	-3.86	3.02
All mortality	All	Montreal	2	8	1.48	0.44	2.52
All mortality	All	Ottawa	2	8	0.08	-2.87	3.04
All mortality	All	Quebec City	2	8	2.20	-1.15	5.55
All mortality	All	St Johns	2	8	5.81	-1.18	12.81
All mortality	All	Toronto	2	8	0.64	-0.32	1.60
All mortality	All	Vancouver	2	8	0.78	-1.37	2.93
All mortality	All	Windsor	2	8	0.60	-2.54	3.73
All mortality	All	Winnipeg	2	8	1.21	-2.59	5.02
All mortality	All	Calgary	2	12	1.25	-2.64	5.14
All mortality	All	Edmonton	2	12	0.45	-3.28	4.17

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	All	Halifax	2	12	-1.76	-8.21	4.69
All mortality	All	Hamilton	2	12	-0.75	-4.28	2.78
All mortality	All	Montreal	2	12	1.42	0.34	2.49
All mortality	All	Ottawa	2	12	-0.66	-3.76	2.44
All mortality	All	Quebec City	2	12	2.69	-0.85	6.22
All mortality	All	St Johns	2	12	5.74	-1.23	12.72
All mortality	All	Toronto	2	12	0.68	-0.30	1.66
All mortality	All	Vancouver	2	12	0.28	-1.98	2.54
All mortality	All	Windsor	2	12	1.41	-1.78	4.59
All mortality	All	Winnipeg	2	12	-0.36	-4.52	3.79
All mortality	≥75	Calgary	0	4	3.25	-1.66	8.17
All mortality	≥75	Edmonton	0	4	0.16	-4.73	5.05
All mortality	≥75	Halifax	0	4	4.34	-4.67	13.34
All mortality	≥75	Hamilton	0	4	2.25	-2.44	6.95
All mortality	≥75	Montreal	0	4	-0.05	-1.51	1.41
All mortality	≥75	Ottawa	0	4	-2.62	-6.74	1.50
All mortality	≥75	Quebec City	0	4	-0.10	-4.60	4.40
All mortality	≥75	St Johns	0	4	1.56	-8.48	11.59
All mortality	≥75	Toronto	0	4	0.96	-0.36	2.27
All mortality	≥75	Vancouver	0	4	-0.61	-3.41	2.20
All mortality	≥75	Windsor	0	4	-0.24	-4.50	4.03
All mortality	≥75	Winnipeg	0	4	-3.85	-8.94	1.24
All mortality	≥75	Calgary	0	8	1.36	-3.94	6.67
All mortality	≥75	Edmonton	0	8	1.11	-4.01	6.24
All mortality	≥75	Halifax	0	8	4.57	-4.91	14.06
All mortality	≥75	Hamilton	0	8	-0.07	-5.00	4.85
All mortality	≥75	Montreal	0	8	0.39	-1.13	1.91
All mortality	≥75	Ottawa	0	8	-2.85	-7.18	1.48
All mortality	≥75	Quebec City	0	8	-0.38	-5.08	4.33
All mortality	≥75	St Johns	0	8	0.14	-10.10	10.37
All mortality	≥75	Toronto	0	8	0.44	-0.91	1.79
All mortality	≥75	Vancouver	0	8	-0.35	-3.35	2.64
All mortality	≥75	Windsor	0	8	-1.17	-5.56	3.23
All mortality	≥75	Winnipeg	0	8	-3.61	-9.18	1.96
All mortality	≥75	Calgary	0	12	0.84	-4.78	6.45
All mortality	≥75	Edmonton	0	12	-0.26	-5.72	5.20
All mortality	≥75	Halifax	0	12	3.13	-6.47	12.72
All mortality	≥75	Hamilton	0	12	0.57	-4.45	5.60
All mortality	≥75	Montreal	0	12	0.02	-1.55	1.59
All mortality	≥75	Ottawa	0	12	-2.65	-7.17	1.87
All mortality	≥75	Quebec City	0	12	0.04	-4.90	4.97
All mortality	≥75	St Johns	0	12	1.12	-9.12	11.36
All mortality	≥75	Toronto	0	12	0.44	-0.94	1.81
All mortality	≥75	Vancouver	0	12	-1.39	-4.55	1.77
All mortality	≥75	Windsor	0	12	-1.36	-5.84	3.12
All mortality	≥75	Winnipeg	0	12	-1.92	-7.98	4.14
All mortality	≥75	Calgary	1	4	1.94	-2.90	6.78
All mortality	≥75	Edmonton	1	4	0.85	-4.00	5.70
All mortality	≥75	Halifax	1	4	2.86	-6.51	12.23

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	≥75	Hamilton	1	4	6.18	1.62	10.75
All mortality	≥75	Montreal	1	4	1.97	0.54	3.40
All mortality	≥75	Ottawa	1	4	1.25	-2.75	5.26
All mortality	≥75	Quebec City	1	4	-0.86	-5.42	3.70
All mortality	≥75	St Johns	1	4	9.06	-0.45	18.56
All mortality	≥75	Toronto	1	4	2.11	0.80	3.42
All mortality	≥75	Vancouver	1	4	1.81	-0.97	4.59
All mortality	≥75	Windsor	1	4	5.43	1.26	9.59
All mortality	≥75	Winnipeg	1	4	1.45	-3.29	6.18
All mortality	≥75	Calgary	1	8	3.00	-2.21	8.21
All mortality	≥75	Edmonton	1	8	1.16	-3.95	6.27
All mortality	≥75	Halifax	1	8	5.37	-4.39	15.13
All mortality	≥75	Hamilton	1	8	4.91	0.11	9.72
All mortality	≥75	Montreal	1	8	1.40	-0.10	2.89
All mortality	≥75	Ottawa	1	8	1.35	-2.85	5.56
All mortality	≥75	Quebec City	1	8	-1.19	-5.96	3.57
All mortality	≥75	St Johns	1	8	9.93	0.18	19.68
All mortality	≥75	Toronto	1	8	1.96	0.61	3.30
All mortality	≥75	Vancouver	1	8	2.13	-0.84	5.10
All mortality	≥75	Windsor	1	8	5.45	1.12	9.78
All mortality	≥75	Winnipeg	1	8	1.64	-3.59	6.87
All mortality	≥75	Calgary	1	12	3.92	-1.55	9.39
All mortality	≥75	Edmonton	1	12	1.19	-4.25	6.62
All mortality	≥75	Halifax	1	12	4.82	-5.07	14.71
All mortality	≥75	Hamilton	1	12	4.41	-0.52	9.33
All mortality	≥75	Montreal	1	12	1.27	-0.28	2.81
All mortality	≥75	Ottawa	1	12	1.54	-2.83	5.92
All mortality	≥75	Quebec City	1	12	-0.86	-5.89	4.17
All mortality	≥75	St Johns	1	12	9.07	-0.69	18.83
All mortality	≥75	Toronto	1	12	1.94	0.57	3.31
All mortality	≥75	Vancouver	1	12	1.69	-1.44	4.83
All mortality	≥75	Windsor	1	12	5.94	1.54	10.34
All mortality	≥75	Winnipeg	1	12	1.43	-4.31	7.18
All mortality	≥75	Calgary	2	4	0.25	-4.69	5.19
All mortality	≥75	Edmonton	2	4	2.49	-2.41	7.39
All mortality	≥75	Halifax	2	4	-3.62	-12.99	5.75
All mortality	≥75	Hamilton	2	4	-0.15	-4.99	4.70
All mortality	≥75	Montreal	2	4	2.68	1.25	4.11
All mortality	≥75	Ottawa	2	4	-0.42	-4.46	3.63
All mortality	≥75	Quebec City	2	4	3.44	-1.08	7.96
All mortality	≥75	St Johns	2	4	6.26	-3.38	15.91
All mortality	≥75	Toronto	2	4	2.28	0.96	3.60
All mortality	≥75	Vancouver	2	4	0.03	-2.76	2.81
All mortality	≥75	Windsor	2	4	-0.22	-4.51	4.08
All mortality	≥75	Winnipeg	2	4	3.05	-1.67	7.78
All mortality	≥75	Calgary	2	8	0.82	-4.50	6.14
All mortality	≥75	Edmonton	2	8	2.40	-2.73	7.53
All mortality	≥75	Halifax	2	8	-4.39	-14.20	5.42
All mortality	≥75	Hamilton	2	8	-0.69	-5.76	4.38

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	≥75	Montreal	2	8	2.49	1.00	3.98
All mortality	≥75	Ottawa	2	8	-0.53	-4.78	3.73
All mortality	≥75	Quebec City	2	8	3.54	-1.19	8.27
All mortality	≥75	St Johns	2	8	6.40	-3.53	16.32
All mortality	≥75	Toronto	2	8	2.07	0.71	3.42
All mortality	≥75	Vancouver	2	8	0.92	-2.05	3.88
All mortality	≥75	Windsor	2	8	-0.11	-4.55	4.34
All mortality	≥75	Winnipeg	2	8	1.37	-3.85	6.59
All mortality	≥75	Calgary	2	12	0.26	-5.37	5.89
All mortality	≥75	Edmonton	2	12	1.23	-4.21	6.68
All mortality	≥75	Halifax	2	12	-3.23	-13.20	6.74
All mortality	≥75	Hamilton	2	12	-0.85	-6.05	4.34
All mortality	≥75	Montreal	2	12	2.53	0.99	4.07
All mortality	≥75	Ottawa	2	12	-0.99	-5.45	3.48
All mortality	≥75	Quebec City	2	12	3.69	-1.30	8.68
All mortality	≥75	St Johns	2	12	6.37	-3.54	16.29
All mortality	≥75	Toronto	2	12	2.21	0.83	3.60
All mortality	≥75	Vancouver	2	12	0.26	-2.87	3.39
All mortality	≥75	Windsor	2	12	0.54	-3.97	5.06
All mortality	≥75	Winnipeg	2	12	-1.46	-7.17	4.26
All mortality	<75	Calgary	0	4	0.41	-4.30	5.13
All mortality	<75	Edmonton	0	4	1.63	-2.91	6.17
All mortality	<75	Halifax	0	4	7.09	-0.92	15.09
All mortality	<75	Hamilton	0	4	-4.31	-8.99	0.37
All mortality	<75	Montreal	0	4	-0.27	-1.66	1.13
All mortality	<75	Ottawa	0	4	2.36	-1.40	6.11
All mortality	<75	Quebec City	0	4	1.25	-3.24	5.74
All mortality	<75	St Johns	0	4	5.50	-4.31	15.32
All mortality	<75	Toronto	0	4	0.95	-0.36	2.27
All mortality	<75	Vancouver	0	4	1.34	-1.57	4.24
All mortality	<75	Windsor	0	4	-1.14	-5.53	3.25
All mortality	<75	Winnipeg	0	4	0.76	-4.21	5.74
All mortality	<75	Calgary	0	8	0.21	-4.86	5.28
All mortality	<75	Edmonton	0	8	0.02	-4.81	4.85
All mortality	<75	Halifax	0	8	7.91	-0.54	16.36
All mortality	<75	Hamilton	0	8	-4.98	-9.87	-0.09
All mortality	<75	Montreal	0	8	-0.32	-1.77	1.13
All mortality	<75	Ottawa	0	8	2.15	-1.80	6.10
All mortality	<75	Quebec City	0	8	1.86	-2.84	6.56
All mortality	<75	St Johns	0	8	4.43	-5.63	14.48
All mortality	<75	Toronto	0	8	1.07	-0.28	2.41
All mortality	<75	Vancouver	0	8	1.62	-1.46	4.71
All mortality	<75	Windsor	0	8	-0.92	-5.46	3.63
All mortality	<75	Winnipeg	0	8	2.71	-2.75	8.17
All mortality	<75	Calgary	0	12	1.23	-4.09	6.54
All mortality	<75	Edmonton	0	12	-0.10	-5.22	5.02
All mortality	<75	Halifax	0	12	7.17	-1.48	15.82
All mortality	<75	Hamilton	0	12	-5.21	-10.23	-0.19
All mortality	<75	Montreal	0	12	-0.59	-2.09	0.91

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	<75	Ottawa	0	12	2.10	-2.01	6.21
All mortality	<75	Quebec City	0	12	2.97	-1.97	7.92
All mortality	<75	St Johns	0	12	4.63	-5.41	14.67
All mortality	<75	Toronto	0	12	1.08	-0.30	2.45
All mortality	<75	Vancouver	0	12	1.85	-1.41	5.10
All mortality	<75	Windsor	0	12	-0.76	-5.40	3.87
All mortality	<75	Winnipeg	0	12	3.41	-2.55	9.38
All mortality	<75	Calgary	1	4	-0.76	-5.43	3.92
All mortality	<75	Edmonton	1	4	-1.89	-6.48	2.71
All mortality	<75	Halifax	1	4	2.05	-5.92	10.01
All mortality	<75	Hamilton	1	4	4.13	-0.17	8.43
All mortality	<75	Montreal	1	4	0.72	-0.67	2.11
All mortality	<75	Ottawa	1	4	0.36	-3.39	4.12
All mortality	<75	Quebec City	1	4	1.00	-3.45	5.45
All mortality	<75	St Johns	1	4	0.53	-9.43	10.48
All mortality	<75	Toronto	1	4	0.99	-0.33	2.31
All mortality	<75	Vancouver	1	4	2.60	-0.30	5.50
All mortality	<75	Windsor	1	4	-0.62	-5.04	3.80
All mortality	<75	Winnipeg	1	4	1.05	-4.00	6.10
All mortality	<75	Calgary	1	8	3.33	-1.69	8.36
All mortality	<75	Edmonton	1	8	-1.45	-6.25	3.35
All mortality	<75	Halifax	1	8	0.96	-7.47	9.40
All mortality	<75	Hamilton	1	8	3.67	-0.83	8.17
All mortality	<75	Montreal	1	8	0.44	-1.01	1.90
All mortality	<75	Ottawa	1	8	0.34	-3.64	4.32
All mortality	<75	Quebec City	1	8	0.23	-4.41	4.88
All mortality	<75	St Johns	1	8	0.69	-9.45	10.84
All mortality	<75	Toronto	1	8	0.93	-0.42	2.28
All mortality	<75	Vancouver	1	8	2.79	-0.30	5.88
All mortality	<75	Windsor	1	8	-0.73	-5.28	3.83
All mortality	<75	Winnipeg	1	8	1.61	-3.93	7.16
All mortality	<75	Calgary	1	12	1.54	-3.76	6.85
All mortality	<75	Edmonton	1	12	0.44	-4.68	5.57
All mortality	<75	Halifax	1	12	0.19	-8.38	8.75
All mortality	<75	Hamilton	1	12	2.16	-2.47	6.78
All mortality	<75	Montreal	1	12	0.43	-1.07	1.94
All mortality	<75	Ottawa	1	12	1.01	-3.12	5.13
All mortality	<75	Quebec City	1	12	0.10	-4.79	4.99
All mortality	<75	St Johns	1	12	0.37	-9.75	10.49
All mortality	<75	Toronto	1	12	1.02	-0.35	2.40
All mortality	<75	Vancouver	1	12	3.06	-0.20	6.33
All mortality	<75	Windsor	1	12	-0.50	-5.12	4.13
All mortality	<75	Winnipeg	1	12	1.90	-4.12	7.91
All mortality	<75	Calgary	2	4	3.18	-1.47	7.83
All mortality	<75	Edmonton	2	4	-0.93	-5.56	3.70
All mortality	<75	Halifax	2	4	-0.09	-8.00	7.82
All mortality	<75	Hamilton	2	4	0.29	-4.19	4.78
All mortality	<75	Montreal	2	4	0.22	-1.17	1.62
All mortality	<75	Ottawa	2	4	-0.37	-4.26	3.53

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
All mortality	<75	Quebec City	2	4	1.17	-3.37	5.71
All mortality	<75	St Johns	2	4	5.55	-4.13	15.24
All mortality	<75	Toronto	2	4	-0.84	-2.17	0.49
All mortality	<75	Vancouver	2	4	0.86	-2.07	3.78
All mortality	<75	Windsor	2	4	1.46	-2.80	5.72
All mortality	<75	Winnipeg	2	4	3.27	-1.70	8.23
All mortality	<75	Calgary	2	8	2.96	-2.06	7.98
All mortality	<75	Edmonton	2	8	-0.43	-5.28	4.42
All mortality	<75	Halifax	2	8	-0.60	-8.87	7.67
All mortality	<75	Hamilton	2	8	-0.21	-4.90	4.48
All mortality	<75	Montreal	2	8	0.53	-0.92	1.99
All mortality	<75	Ottawa	2	8	0.65	-3.45	4.75
All mortality	<75	Quebec City	2	8	0.82	-3.93	5.57
All mortality	<75	St Johns	2	8	5.29	-4.56	15.15
All mortality	<75	Toronto	2	8	-0.78	-2.14	0.58
All mortality	<75	Vancouver	2	8	0.64	-2.46	3.75
All mortality	<75	Windsor	2	8	1.42	-3.00	5.84
All mortality	<75	Winnipeg	2	8	0.98	-4.57	6.53
All mortality	<75	Calgary	2	12	2.11	-3.28	7.50
All mortality	<75	Edmonton	2	12	-0.10	-5.21	5.01
All mortality	<75	Halifax	2	12	-0.65	-9.12	7.81
All mortality	<75	Hamilton	2	12	-0.71	-5.53	4.11
All mortality	<75	Montreal	2	12	0.38	-1.12	1.89
All mortality	<75	Ottawa	2	12	-0.57	-4.88	3.75
All mortality	<75	Quebec City	2	12	1.64	-3.37	6.66
All mortality	<75	St Johns	2	12	5.21	-4.62	15.03
All mortality	<75	Toronto	2	12	-0.83	-2.22	0.55
All mortality	<75	Vancouver	2	12	0.37	-2.91	3.65
All mortality	<75	Windsor	2	12	2.43	-2.06	6.93
All mortality	<75	Winnipeg	2	12	0.91	-5.14	6.96
CVD mortality	All	Calgary	0	4	1.81	-3.50	7.11
CVD mortality	All	Edmonton	0	4	0.63	-4.56	5.82
CVD mortality	All	Halifax	0	4	8.23	-1.42	17.89
CVD mortality	All	Hamilton	0	4	2.27	-2.98	7.52
CVD mortality	All	Montreal	0	4	-1.17	-2.79	0.46
CVD mortality	All	Ottawa	0	4	-0.35	-4.63	3.93
CVD mortality	All	Quebec City	0	4	-1.50	-6.64	3.65
CVD mortality	All	St Johns	0	4	2.83	-8.08	13.74
CVD mortality	All	Toronto	0	4	0.71	-0.83	2.24
CVD mortality	All	Vancouver	0	4	2.20	-0.88	5.28
CVD mortality	All	Windsor	0	4	-3.67	-8.33	0.99
CVD mortality	All	Winnipeg	0	4	-2.71	-8.33	2.90
CVD mortality	All	Calgary	0	8	0.76	-4.90	6.41
CVD mortality	All	Edmonton	0	8	0.68	-4.79	6.15
CVD mortality	All	Halifax	0	8	8.35	-1.89	18.58
CVD mortality	All	Hamilton	0	8	0.31	-5.18	5.80
CVD mortality	All	Montreal	0	8	-1.11	-2.80	0.58
CVD mortality	All	Ottawa	0	8	-0.66	-5.15	3.83
CVD mortality	All	Quebec City	0	8	-2.89	-8.30	2.51

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m[3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	All	St Johns	0	8	1.89	-9.24	13.02
CVD mortality	All	Toronto	0	8	0.48	-1.10	2.06
CVD mortality	All	Vancouver	0	8	1.96	-1.34	5.25
CVD mortality	All	Windsor	0	8	-4.47	-9.26	0.33
CVD mortality	All	Winnipeg	0	8	-2.59	-8.73	3.55
CVD mortality	All	Calgary	0	12	-0.06	-6.03	5.91
CVD mortality	All	Edmonton	0	12	0.89	-4.95	6.73
CVD mortality	All	Halifax	0	12	8.32	-2.08	18.72
CVD mortality	All	Hamilton	0	12	0.77	-4.84	6.39
CVD mortality	All	Montreal	0	12	-1.61	-3.36	0.15
CVD mortality	All	Ottawa	0	12	-2.03	-6.72	2.65
CVD mortality	All	Quebec City	0	12	0.05	-5.63	5.73
CVD mortality	All	St Johns	0	12	2.33	-8.80	13.45
CVD mortality	All	Toronto	0	12	0.47	-1.13	2.08
CVD mortality	All	Vancouver	0	12	0.87	-2.60	4.35
CVD mortality	All	Windsor	0	12	-4.99	-9.90	-0.08
CVD mortality	All	Winnipeg	0	12	-1.39	-8.08	5.30
CVD mortality	All	Calgary	1	4	-5.32	-10.70	0.05
CVD mortality	All	Edmonton	1	4	-0.67	-5.96	4.62
CVD mortality	All	Halifax	1	4	1.56	-8.43	11.55
CVD mortality	All	Hamilton	1	4	7.10	2.03	12.18
CVD mortality	All	Montreal	1	4	1.22	-0.39	2.82
CVD mortality	All	Ottawa	1	4	0.47	-3.84	4.78
CVD mortality	All	Quebec City	1	4	0.84	-4.19	5.87
CVD mortality	All	St Johns	1	4	6.60	-3.90	17.11
CVD mortality	All	Toronto	1	4	1.14	-0.39	2.67
CVD mortality	All	Vancouver	1	4	-0.07	-3.16	3.02
CVD mortality	All	Windsor	1	4	4.58	0.12	9.03
CVD mortality	All	Winnipeg	1	4	-0.30	-5.62	5.02
CVD mortality	All	Calgary	1	8	-1.66	-7.39	4.07
CVD mortality	All	Edmonton	1	8	1.45	-4.10	7.01
CVD mortality	All	Halifax	1	8	1.97	-8.58	12.53
CVD mortality	All	Hamilton	1	8	5.41	0.08	10.75
CVD mortality	All	Montreal	1	8	0.70	-0.99	2.38
CVD mortality	All	Ottawa	1	8	0.35	-4.18	4.88
CVD mortality	All	Quebec City	1	8	0.13	-5.11	5.38
CVD mortality	All	St Johns	1	8	8.02	-2.69	18.73
CVD mortality	All	Toronto	1	8	1.09	-0.48	2.65
CVD mortality	All	Vancouver	1	8	0.30	-3.00	3.61
CVD mortality	All	Windsor	1	8	4.37	-0.25	8.99
CVD mortality	All	Winnipeg	1	8	-1.85	-7.66	3.96
CVD mortality	All	Calgary	1	12	-0.81	-6.85	5.22
CVD mortality	All	Edmonton	1	12	2.57	-3.35	8.49
CVD mortality	All	Halifax	1	12	1.04	-9.68	11.76
CVD mortality	All	Hamilton	1	12	5.66	0.22	11.10
CVD mortality	All	Montreal	1	12	0.34	-1.41	2.09
CVD mortality	All	Ottawa	1	12	0.85	-3.86	5.55
CVD mortality	All	Quebec City	1	12	0.91	-4.65	6.46
CVD mortality	All	St Johns	1	12	7.17	-3.54	17.88

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI Lower	95% CI Upper
CVD mortality	All	Toronto	1	12	1.08	-0.52	2.67
CVD mortality	All	Vancouver	1	12	0.67	-2.80	4.15
CVD mortality	All	Windsor	1	12	4.72	0.01	9.43
CVD mortality	All	Winnipeg	1	12	-0.88	-7.24	5.47
CVD mortality	All	Calgary	2	4	1.66	-3.61	6.94
CVD mortality	All	Edmonton	2	4	-0.80	-6.15	4.56
CVD mortality	All	Halifax	2	4	-0.76	-10.60	9.08
CVD mortality	All	Hamilton	2	4	0.68	-4.71	6.06
CVD mortality	All	Montreal	2	4	2.06	0.47	3.65
CVD mortality	All	Ottawa	2	4	-0.08	-4.41	4.26
CVD mortality	All	Quebec City	2	4	3.67	-1.43	8.76
CVD mortality	All	St Johns	2	4	4.33	-6.43	15.09
CVD mortality	All	Toronto	2	4	2.06	0.52	3.59
CVD mortality	All	Vancouver	2	4	0.28	-2.81	3.37
CVD mortality	All	Windsor	2	4	-2.10	-6.66	2.46
CVD mortality	All	Winnipeg	2	4	4.71	-0.50	9.93
CVD mortality	All	Calgary	2	8	1.83	-3.83	7.49
CVD mortality	All	Edmonton	2	8	0.50	-5.07	6.08
CVD mortality	All	Halifax	2	8	0.31	-9.89	10.51
CVD mortality	All	Hamilton	2	8	1.12	-4.49	6.73
CVD mortality	All	Montreal	2	8	2.14	0.48	3.80
CVD mortality	All	Ottawa	2	8	-0.20	-4.77	4.38
CVD mortality	All	Quebec City	2	8	3.27	-2.07	8.62
CVD mortality	All	St Johns	2	8	4.46	-6.52	15.45
CVD mortality	All	Toronto	2	8	2.08	0.50	3.65
CVD mortality	All	Vancouver	2	8	1.21	-2.07	4.49
CVD mortality	All	Windsor	2	8	-1.52	-6.24	3.21
CVD mortality	All	Winnipeg	2	8	2.94	-2.87	8.75
CVD mortality	All	Calgary	2	12	0.42	-5.61	6.45
CVD mortality	All	Edmonton	2	12	-0.44	-6.34	5.47
CVD mortality	All	Halifax	2	12	0.79	-9.65	11.22
CVD mortality	All	Hamilton	2	12	1.34	-4.41	7.09
CVD mortality	All	Montreal	2	12	2.26	0.54	3.98
CVD mortality	All	Ottawa	2	12	-2.08	-6.87	2.72
CVD mortality	All	Quebec City	2	12	2.56	-3.06	8.17
CVD mortality	All	St Johns	2	12	3.98	-6.98	14.94
CVD mortality	All	Toronto	2	12	2.33	0.72	3.94
CVD mortality	All	Vancouver	2	12	0.77	-2.68	4.23
CVD mortality	All	Windsor	2	12	-0.96	-5.77	3.85
CVD mortality	All	Winnipeg	2	12	0.61	-5.78	7.00
CVD mortality	≥75	Calgary	0	4	2.07	-4.83	8.97
CVD mortality	≥75	Edmonton	0	4	-2.43	-9.55	4.69
CVD mortality	≥75	Halifax	0	4	5.54	-8.01	19.09
CVD mortality	≥75	Hamilton	0	4	6.33	-0.35	13.02
CVD mortality	≥75	Montreal	0	4	-1.08	-3.24	1.08
CVD mortality	≥75	Ottawa	0	4	-4.12	-9.88	1.63
CVD mortality	≥75	Quebec City	0	4	1.94	-4.74	8.62
CVD mortality	≥75	St Johns	0	4	0.23	-14.48	14.95
CVD mortality	≥75	Toronto	0	4	1.03	-0.93	3.00

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
CVD mortality	≥75	Vancouver	0	4	1.19	-2.67	5.05
CVD mortality	≥75	Windsor	0	4	-4.16	-10.02	1.70
CVD mortality	≥75	Winnipeg	0	4	-5.17	-12.39	2.06
CVD mortality	≥75	Calgary	0	8	0.82	-6.57	8.20
CVD mortality	≥75	Edmonton	0	8	-1.77	-9.25	5.72
CVD mortality	≥75	Halifax	0	8	5.55	-8.67	19.77
CVD mortality	≥75	Hamilton	0	8	3.68	-3.36	10.72
CVD mortality	≥75	Montreal	0	8	-0.97	-3.21	1.27
CVD mortality	≥75	Ottawa	0	8	-4.62	-10.69	1.46
CVD mortality	≥75	Quebec City	0	8	0.27	-6.77	7.31
CVD mortality	≥75	St Johns	0	8	-0.99	-15.95	13.98
CVD mortality	≥75	Toronto	0	8	0.50	-1.52	2.52
CVD mortality	≥75	Vancouver	0	8	1.00	-3.12	5.13
CVD mortality	≥75	Windsor	0	8	-5.28	-11.29	0.73
CVD mortality	≥75	Winnipeg	0	8	-6.23	-14.18	1.72
CVD mortality	≥75	Calgary	0	12	-0.31	-8.18	7.56
CVD mortality	≥75	Edmonton	0	12	-2.02	-10.02	5.99
CVD mortality	≥75	Halifax	0	12	5.62	-8.74	19.98
CVD mortality	≥75	Hamilton	0	12	4.17	-3.03	11.37
CVD mortality	≥75	Montreal	0	12	-1.47	-3.79	0.86
CVD mortality	≥75	Ottawa	0	12	-6.08	-12.43	0.28
CVD mortality	≥75	Quebec City	0	12	3.02	-4.41	10.44
CVD mortality	≥75	St Johns	0	12	-0.06	-15.01	14.88
CVD mortality	≥75	Toronto	0	12	0.34	-1.71	2.40
CVD mortality	≥75	Vancouver	0	12	-0.30	-4.65	4.05
CVD mortality	≥75	Windsor	0	12	-5.54	-11.71	0.63
CVD mortality	≥75	Winnipeg	0	12	-6.69	-15.40	2.03
CVD mortality	≥75	Calgary	1	4	-5.45	-12.43	1.53
CVD mortality	≥75	Edmonton	1	4	0.76	-6.22	7.75
CVD mortality	≥75	Halifax	1	4	-0.02	-14.38	14.33
CVD mortality	≥75	Hamilton	1	4	8.45	1.72	15.17
CVD mortality	≥75	Montreal	1	4	2.23	0.13	4.33
CVD mortality	≥75	Ottawa	1	4	2.28	-3.38	7.95
CVD mortality	≥75	Quebec City	1	4	1.19	-5.36	7.73
CVD mortality	≥75	St Johns	1	4	4.03	-10.04	18.09
CVD mortality	≥75	Toronto	1	4	2.79	0.84	4.74
CVD mortality	≥75	Vancouver	1	4	-0.64	-4.54	3.27
CVD mortality	≥75	Windsor	1	4	6.75	1.23	12.28
CVD mortality	≥75	Winnipeg	1	4	0.96	-5.69	7.61
CVD mortality	≥75	Calgary	1	8	-3.02	-10.46	4.43
CVD mortality	≥75	Edmonton	1	8	2.61	-4.78	10.00
CVD mortality	≥75	Halifax	1	8	2.23	-12.90	17.36
CVD mortality	≥75	Hamilton	1	8	7.16	0.05	14.26
CVD mortality	≥75	Montreal	1	8	1.69	-0.52	3.89
CVD mortality	≥75	Ottawa	1	8	2.16	-3.78	8.09
CVD mortality	≥75	Quebec City	1	8	-0.16	-7.03	6.72
CVD mortality	≥75	St Johns	1	8	6.09	-8.23	20.42
CVD mortality	≥75	Toronto	1	8	2.77	0.78	4.77
CVD mortality	≥75	Vancouver	1	8	-0.47	-4.65	3.70

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	≥75	Windsor	1	8	6.55	0.80	12.29
CVD mortality	≥75	Winnipeg	1	8	0.13	-7.11	7.37
CVD mortality	≥75	Calgary	1	12	-2.05	-9.89	5.79
CVD mortality	≥75	Edmonton	1	12	2.42	-5.48	10.32
CVD mortality	≥75	Halifax	1	12	1.67	-13.82	17.15
CVD mortality	≥75	Hamilton	1	12	7.68	0.41	14.94
CVD mortality	≥75	Montreal	1	12	1.30	-0.99	3.60
CVD mortality	≥75	Ottawa	1	12	2.61	-3.55	8.76
CVD mortality	≥75	Quebec City	1	12	0.78	-6.51	8.06
CVD mortality	≥75	St Johns	1	12	4.89	-9.44	19.22
CVD mortality	≥75	Toronto	1	12	2.60	0.57	4.63
CVD mortality	≥75	Vancouver	1	12	-0.75	-5.13	3.64
CVD mortality	≥75	Windsor	1	12	7.52	1.65	13.38
CVD mortality	≥75	Winnipeg	1	12	1.08	-6.92	9.07
CVD mortality	≥75	Calgary	2	4	-0.28	-7.21	6.65
CVD mortality	≥75	Edmonton	2	4	1.24	-5.77	8.25
CVD mortality	≥75	Halifax	2	4	-9.80	-24.33	4.73
CVD mortality	≥75	Hamilton	2	4	2.52	-4.57	9.61
CVD mortality	≥75	Montreal	2	4	3.04	0.95	5.13
CVD mortality	≥75	Ottawa	2	4	-1.08	-6.78	4.62
CVD mortality	≥75	Quebec City	2	4	3.92	-2.80	10.63
CVD mortality	≥75	St Johns	2	4	0.77	-13.81	15.35
CVD mortality	≥75	Toronto	2	4	3.89	1.93	5.84
CVD mortality	≥75	Vancouver	2	4	-0.21	-4.09	3.66
CVD mortality	≥75	Windsor	2	4	-1.96	-7.69	3.77
CVD mortality	≥75	Winnipeg	2	4	2.78	-3.93	9.48
CVD mortality	≥75	Calgary	2	8	-0.27	-7.71	7.16
CVD mortality	≥75	Edmonton	2	8	0.53	-6.77	7.84
CVD mortality	≥75	Halifax	2	8	-9.22	-24.40	5.96
CVD mortality	≥75	Hamilton	2	8	3.76	-3.65	11.16
CVD mortality	≥75	Montreal	2	8	2.86	0.68	5.05
CVD mortality	≥75	Ottawa	2	8	-2.49	-8.49	3.52
CVD mortality	≥75	Quebec City	2	8	3.14	-3.93	10.21
CVD mortality	≥75	St Johns	2	8	2.15	-12.74	17.03
CVD mortality	≥75	Toronto	2	8	3.79	1.78	5.80
CVD mortality	≥75	Vancouver	2	8	1.07	-3.04	5.19
CVD mortality	≥75	Windsor	2	8	-1.53	-7.46	4.41
CVD mortality	≥75	Winnipeg	2	8	0.87	-6.57	8.30
CVD mortality	≥75	Calgary	2	12	-2.25	-10.11	5.62
CVD mortality	≥75	Edmonton	2	12	-0.39	-8.17	7.39
CVD mortality	≥75	Halifax	2	12	-8.57	-24.05	6.92
CVD mortality	≥75	Hamilton	2	12	3.67	-3.94	11.27
CVD mortality	≥75	Montreal	2	12	2.72	0.46	4.98
CVD mortality	≥75	Ottawa	2	12	-4.44	-10.70	1.83
CVD mortality	≥75	Quebec City	2	12	1.66	-5.74	9.06
CVD mortality	≥75	St Johns	2	12	1.76	-13.07	16.58
CVD mortality	≥75	Toronto	2	12	4.20	2.14	6.25
CVD mortality	≥75	Vancouver	2	12	0.72	-3.61	5.06
CVD mortality	≥75	Windsor	2	12	-0.59	-6.64	5.45

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI	
						Lower	*Upper*
CVD mortality	≥75	Winnipeg	2	12	-3.45	-11.60	4.70
CVD mortality	<75	Calgary	0	4	1.31	-7.00	9.63
CVD mortality	<75	Edmonton	0	4	4.21	-3.38	11.81
CVD mortality	<75	Halifax	0	4	11.49	-2.38	25.36
CVD mortality	<75	Hamilton	0	4	-3.87	-12.36	4.62
CVD mortality	<75	Montreal	0	4	-1.33	-3.79	1.14
CVD mortality	<75	Ottawa	0	4	4.70	-1.69	11.10
CVD mortality	<75	Quebec City	0	4	-6.30	-14.37	1.77
CVD mortality	<75	St Johns	0	4	6.50	-9.77	22.77
CVD mortality	<75	Toronto	0	4	0.20	-2.27	2.67
CVD mortality	<75	Vancouver	0	4	3.97	-1.16	9.09
CVD mortality	<75	Windsor	0	4	-2.77	-10.48	4.93
CVD mortality	<75	Winnipeg	0	4	0.97	-7.98	9.92
CVD mortality	<75	Calgary	0	8	0.30	-8.56	9.16
CVD mortality	<75	Edmonton	0	8	3.53	-4.55	11.61
CVD mortality	<75	Halifax	0	8	12.30	-2.52	27.12
CVD mortality	<75	Hamilton	0	8	-4.84	-13.63	3.95
CVD mortality	<75	Montreal	0	8	-1.34	-3.92	1.24
CVD mortality	<75	Ottawa	0	8	4.36	-2.34	11.05
CVD mortality	<75	Quebec City	0	8	-7.06	-15.55	1.43
CVD mortality	<75	St Johns	0	8	5.66	-11.00	22.32
CVD mortality	<75	Toronto	0	8	0.47	-2.06	2.99
CVD mortality	<75	Vancouver	0	8	3.69	-1.80	9.18
CVD mortality	<75	Windsor	0	8	-3.00	-10.94	4.94
CVD mortality	<75	Winnipeg	0	8	2.99	-6.67	12.65
CVD mortality	<75	Calgary	0	12	-0.36	-9.66	8.93
CVD mortality	<75	Edmonton	0	12	4.12	-4.49	12.72
CVD mortality	<75	Halifax	0	12	11.60	-3.57	26.77
CVD mortality	<75	Hamilton	0	12	-4.49	-13.52	4.53
CVD mortality	<75	Montreal	0	12	-1.80	-4.47	0.87
CVD mortality	<75	Ottawa	0	12	2.90	-4.06	9.86
CVD mortality	<75	Quebec City	0	12	-3.79	-12.66	5.07
CVD mortality	<75	St Johns	0	12	5.55	-11.12	22.22
CVD mortality	<75	Toronto	0	12	0.69	-1.88	3.27
CVD mortality	<75	Vancouver	0	12	3.11	-2.68	8.89
CVD mortality	<75	Windsor	0	12	-4.07	-12.20	4.05
CVD mortality	<75	Winnipeg	0	12	5.83	-4.63	16.29
CVD mortality	<75	Calgary	1	4	1.91	-17.31	21.12
CVD mortality	<75	Edmonton	1	4	3.79	-12.31	19.89
CVD mortality	<75	Halifax	1	4	-6.22	-36.42	23.98
CVD mortality	<75	Hamilton	1	4	-2.80	-21.45	15.86
CVD mortality	<75	Montreal	1	4	3.92	-1.46	9.30
CVD mortality	<75	Ottawa	1	4	-4.49	-19.48	10.49
CVD mortality	<75	Quebec City	1	4	-9.83	-27.85	8.20
CVD mortality	<75	St Johns	1	4	-5.23	-42.26	31.79
CVD mortality	<75	Toronto	1	4	-2.75	-8.60	3.10
CVD mortality	<75	Vancouver	1	4	1.77	-9.49	13.02
CVD mortality	<75	Windsor	1	4	-13.70	-33.81	6.41
CVD mortality	<75	Winnipeg	1	4	-15.16	-39.09	8.77

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD mortality	<75	Calgary	1	8	-2.77	-24.04	18.49
CVD mortality	<75	Edmonton	1	8	6.28	-10.87	23.44
CVD mortality	<75	Halifax	1	8	-5.71	-37.91	26.49
CVD mortality	<75	Hamilton	1	8	-4.11	-23.43	15.22
CVD mortality	<75	Montreal	1	8	2.22	-3.40	7.85
CVD mortality	<75	Ottawa	1	8	-6.71	-22.38	8.97
CVD mortality	<75	Quebec City	1	8	-6.88	-25.67	11.91
CVD mortality	<75	St Johns	1	8	-10.45	-50.96	30.06
CVD mortality	<75	Toronto	1	8	-2.48	-8.49	3.53
CVD mortality	<75	Vancouver	1	8	-1.05	-13.14	11.05
CVD mortality	<75	Windsor	1	8	-17.03	-38.00	3.94
CVD mortality	<75	Winnipeg	1	8	-19.00	-46.26	8.26
CVD mortality	<75	Calgary	1	12	-4.08	-28.40	20.25
CVD mortality	<75	Edmonton	1	12	2.31	-6.65	11.28
CVD mortality	<75	Halifax	1	12	0.58	-14.30	15.46
CVD mortality	<75	Hamilton	1	12	-5.88	-25.87	14.11
CVD mortality	<75	Montreal	1	12	2.37	-3.48	8.23
CVD mortality	<75	Ottawa	1	12	-5.32	-21.86	11.22
CVD mortality	<75	Quebec City	1	12	-8.03	-27.91	11.84
CVD mortality	<75	St Johns	1	12	9.45	-6.78	25.68
CVD mortality	<75	Toronto	1	12	-2.18	-8.30	3.93
CVD mortality	<75	Vancouver	1	12	-0.35	-13.25	12.54
CVD mortality	<75	Windsor	1	12	-14.31	-36.07	7.45
CVD mortality	<75	Winnipeg	1	12	-4.11	-14.63	6.41
CVD mortality	<75	Calgary	2	4	4.65	-3.52	12.81
CVD mortality	<75	Edmonton	2	4	-3.48	-11.76	4.81
CVD mortality	<75	Halifax	2	4	6.99	-6.41	20.38
CVD mortality	<75	Hamilton	2	4	-1.77	-10.05	6.51
CVD mortality	<75	Montreal	2	4	0.76	-1.68	3.20
CVD mortality	<75	Ottawa	2	4	1.25	-5.42	7.92
CVD mortality	<75	Quebec City	2	4	3.06	-4.78	10.89
CVD mortality	<75	St Johns	2	4	8.19	-7.84	24.23
CVD mortality	<75	Toronto	2	4	-0.80	-3.28	1.67
CVD mortality	<75	Vancouver	2	4	1.12	-3.99	6.22
CVD mortality	<75	Windsor	2	4	-2.06	-9.59	5.48
CVD mortality	<75	Winnipeg	2	4	7.85	-0.46	16.16
CVD mortality	<75	Calgary	2	8	4.85	-3.93	13.62
CVD mortality	<75	Edmonton	2	8	0.31	-8.35	8.97
CVD mortality	<75	Halifax	2	8	9.05	-4.74	22.83
CVD mortality	<75	Hamilton	2	8	-2.54	-11.15	6.07
CVD mortality	<75	Montreal	2	8	1.17	-1.38	3.72
CVD mortality	<75	Ottawa	2	8	2.70	-4.39	9.78
CVD mortality	<75	Quebec City	2	8	3.23	-4.96	11.42
CVD mortality	<75	St Johns	2	8	6.93	-9.41	23.27
CVD mortality	<75	Toronto	2	8	-0.58	-3.11	1.96
CVD mortality	<75	Vancouver	2	8	1.41	-4.04	6.85
CVD mortality	<75	Windsor	2	8	-1.39	-9.25	6.46
CVD mortality	<75	Winnipeg	2	8	6.55	-2.80	15.89
CVD mortality	<75	Calgary	2	12	4.22	-5.28	13.72

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI Lower	Upper
CVD mortality	<75	Edmonton	2	12	-0.63	-9.72	8.46
CVD mortality	<75	Halifax	2	12	8.96	-5.21	23.13
CVD mortality	<75	Hamilton	2	12	-1.95	-10.76	6.86
CVD mortality	<75	Montreal	2	12	1.63	-1.01	4.27
CVD mortality	<75	Ottawa	2	12	1.30	-6.18	8.78
CVD mortality	<75	Quebec City	2	12	3.29	-5.35	11.94
CVD mortality	<75	St Johns	2	12	6.59	-9.77	22.96
CVD mortality	<75	Toronto	2	12	-0.58	-3.17	2.02
CVD mortality	<75	Vancouver	2	12	1.01	-4.74	6.75
CVD mortality	<75	Windsor	2	12	-1.34	-9.30	6.62
CVD mortality	<75	Winnipeg	2	12	7.53	-2.82	17.87
Resp mortality	All	Calgary	0	4	-0.62	-11.77	10.53
Resp mortality	All	Edmonton	0	4		0.00	0.00
Resp mortality	All	Halifax	0	4		0.00	0.00
Resp mortality	All	Hamilton	0	4	-9.89	-22.03	2.24
Resp mortality	All	Montreal	0	4	1.61	-1.80	5.02
Resp mortality	All	Ottawa	0	4	-9.81	-19.87	0.25
Resp mortality	All	Quebec City	0	4	-13.70	-24.35	-3.05
Resp mortality	All	St Johns	0	4	3.59	-19.64	26.82
Resp mortality	All	Toronto	0	4	-0.75	-4.03	2.53
Resp mortality	All	Vancouver	0	4	-0.37	-6.72	5.97
Resp mortality	All	Windsor	0	4	10.48	-0.77	21.72
Resp mortality	All	Winnipeg	0	4	1.68	-10.16	13.52
Resp mortality	All	Calgary	0	8	-2.40	-14.81	10.01
Resp mortality	All	Edmonton	0	8		0.00	0.00
Resp mortality	All	Halifax	0	8		0.00	0.00
Resp mortality	All	Hamilton	0	8	-11.62	-24.14	0.91
Resp mortality	All	Montreal	0	8	1.65	-1.89	5.19
Resp mortality	All	Ottawa	0	8	-12.54	-23.03	-2.05
Resp mortality	All	Quebec City	0	8	-14.26	-25.43	-3.09
Resp mortality	All	St Johns	0	8		0.00	0.00
Resp mortality	All	Toronto	0	8	-1.65	-5.01	1.72
Resp mortality	All	Vancouver	0	8	-0.92	-7.67	5.83
Resp mortality	All	Windsor	0	8	8.28	-3.47	20.03
Resp mortality	All	Winnipeg	0	8	5.38	-7.71	18.48
Resp mortality	All	Calgary	0	12	-0.21	-13.18	12.76
Resp mortality	All	Edmonton	0	12		0.00	0.00
Resp mortality	All	Halifax	0	12		0.00	0.00
Resp mortality	All	Hamilton	0	12	-12.02	-24.87	0.84
Resp mortality	All	Montreal	0	12	1.33	-2.33	4.99
Resp mortality	All	Ottawa	0	12	-8.75	-19.59	2.09
Resp mortality	All	Quebec City	0	12	-14.00	-25.77	-2.23
Resp mortality	All	St Johns	0	12		0.00	0.00
Resp mortality	All	Toronto	0	12	-1.67	-5.09	1.75
Resp mortality	All	Vancouver	0	12	-0.61	-7.77	6.56
Resp mortality	All	Windsor	0	12	9.46	-2.59	21.51
Resp mortality	All	Winnipeg	0	12	8.12	-6.13	22.36
Resp mortality	All	Calgary	1	4	-0.51	-12.01	10.98
Resp mortality	All	Edmonton	1	4	-0.05	-10.72	10.61

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Halifax	1	4	1.88	-17.30	21.07
Resp mortality	All	Hamilton	1	4	6.05	-4.38	16.47
Resp mortality	All	Montreal	1	4	2.35	-0.96	5.65
Resp mortality	All	Ottawa	1	4	3.31	-5.87	12.49
Resp mortality	All	Quebec City	1	4	-8.01	-18.65	2.62
Resp mortality	All	St Johns	1	4	6.37	-15.40	28.15
Resp mortality	All	Toronto	1	4	0.19	-3.08	3.46
Resp mortality	All	Vancouver	1	4	2.65	-3.54	8.83
Resp mortality	All	Windsor	1	4	-10.56	-22.95	1.84
Resp mortality	All	Winnipeg	1	4	-7.89	-20.34	4.55
Resp mortality	All	Calgary	1	8	-1.80	-14.27	10.67
Resp mortality	All	Edmonton	1	8	0.27	-10.84	11.38
Resp mortality	All	Halifax	1	8		0.00	0.00
Resp mortality	All	Hamilton	1	8	5.27	-5.63	16.17
Resp mortality	All	Montreal	1	8	0.96	-2.49	4.41
Resp mortality	All	Ottawa	1	8	4.34	-5.32	14.01
Resp mortality	All	Quebec City	1	8	-8.82	-19.88	2.23
Resp mortality	All	St Johns	1	8		0.00	0.00
Resp mortality	All	Toronto	1	8	0.16	-3.18	3.51
Resp mortality	All	Vancouver	1	8	1.84	-4.78	8.46
Resp mortality	All	Windsor	1	8		0.00	0.00
Resp mortality	All	Winnipeg	1	8	-14.19	-28.12	-0.26
Resp mortality	All	Calgary	1	12	-3.68	-17.03	9.67
Resp mortality	All	Edmonton	1	12	-1.61	-13.29	10.08
Resp mortality	All	Halifax	1	12	6.41	-13.74	26.55
Resp mortality	All	Hamilton	1	12	3.40	-7.84	14.64
Resp mortality	All	Montreal	1	12	0.97	-2.60	4.54
Resp mortality	All	Ottawa	1	12	3.37	-6.83	13.57
Resp mortality	All	Quebec City	1	12	-8.56	-20.30	3.17
Resp mortality	All	St Johns	1	12	1.89	-20.72	24.50
Resp mortality	All	Toronto	1	12	0.10	-3.31	3.50
Resp mortality	All	Vancouver	1	12	3.57	-3.50	10.63
Resp mortality	All	Windsor	1	12		0.00	0.00
Resp mortality	All	Winnipeg	1	12	-14.73	-30.01	0.55
Resp mortality	All	Calgary	2	4	-3.81	-15.17	7.56
Resp mortality	All	Edmonton	2	4	6.08	-3.92	16.08
Resp mortality	All	Halifax	2	4	-1.67	-22.48	19.15
Resp mortality	All	Hamilton	2	4	-4.06	-15.86	7.74
Resp mortality	All	Montreal	2	4	3.59	0.22	6.96
Resp mortality	All	Ottawa	2	4		0.00	0.00
Resp mortality	All	Quebec City	2	4	2.86	-7.43	13.14
Resp mortality	All	St Johns	2	4	22.74	1.91	43.57
Resp mortality	All	Toronto	2	4	1.14	-2.13	4.42
Resp mortality	All	Vancouver	2	4	-0.35	-6.64	5.95
Resp mortality	All	Windsor	2	4	6.08	-5.26	17.42
Resp mortality	All	Winnipeg	2	4	0.31	-11.58	12.21
Resp mortality	All	Calgary	2	8	-2.71	-15.08	9.66
Resp mortality	All	Edmonton	2	8	5.07	-5.63	15.77
Resp mortality	All	Halifax	2	8	-7.53	-29.91	14.86

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	All	Hamilton	2	8	-7.40	-19.74	4.93
Resp mortality	All	Montreal	2	8	2.94	-0.56	6.43
Resp mortality	All	Ottawa	2	8		0.00	0.00
Resp mortality	All	Quebec City	2	8	3.15	-7.74	14.04
Resp mortality	All	St Johns	2	8		0.00	0.00
Resp mortality	All	Toronto	2	8	0.95	-2.40	4.30
Resp mortality	All	Vancouver	2	8	-0.78	-7.51	5.95
Resp mortality	All	Windsor	2	8	4.89	-6.95	16.73
Resp mortality	All	Winnipeg	2	8	-3.75	-17.13	9.63
Resp mortality	All	Calgary	2	12	-3.17	-16.32	9.99
Resp mortality	All	Edmonton	2	12	2.82	-8.56	14.19
Resp mortality	All	Halifax	2	12	-7.63	-30.27	15.00
Resp mortality	All	Hamilton	2	12	-10.36	-23.27	2.55
Resp mortality	All	Montreal	2	12	3.89	0.28	7.50
Resp mortality	All	Ottawa	2	12		0.00	0.00
Resp mortality	All	Quebec City	2	12	4.18	-7.49	15.84
Resp mortality	All	St Johns	2	12	21.07	-0.37	42.51
Resp mortality	All	Toronto	2	12	0.75	-2.70	4.19
Resp mortality	All	Vancouver	2	12	-2.76	-9.88	4.36
Resp mortality	All	Windsor	2	12	6.25	-5.91	18.42
Resp mortality	All	Winnipeg	2	12	-8.82	-23.28	5.64
Resp mortality	≥75	Calgary	0	4	2.31	-11.58	16.20
Resp mortality	≥75	Edmonton	0	4		0.00	0.00
Resp mortality	≥75	Halifax	0	4		0.00	0.00
Resp mortality	≥75	Hamilton	0	4	-14.07	-29.56	1.41
Resp mortality	≥75	Montreal	0	4	1.80	-2.45	6.04
Resp mortality	≥75	Ottawa	0	4	-12.62	-25.74	0.50
Resp mortality	≥75	Quebec City	0	4	-16.90	-30.27	-3.53
Resp mortality	≥75	St Johns	0	4	-2.08	-32.87	28.72
Resp mortality	≥75	Toronto	0	4	-0.85	-4.82	3.12
Resp mortality	≥75	Vancouver	0	4	-0.26	-7.81	7.30
Resp mortality	≥75	Windsor	0	4	9.15	-5.28	23.58
Resp mortality	≥75	Winnipeg	0	4	1.18	-13.13	15.49
Resp mortality	≥75	Calgary	0	8	-0.62	-16.03	14.79
Resp mortality	≥75	Edmonton	0	8		0.00	0.00
Resp mortality	≥75	Halifax	0	8		0.00	0.00
Resp mortality	≥75	Hamilton	0	8	-14.49	-30.47	1.50
Resp mortality	≥75	Montreal	0	8	1.61	-2.80	6.02
Resp mortality	≥75	Ottawa	0	8	-14.00	-27.60	-0.40
Resp mortality	≥75	Quebec City	0	8		0.00	0.00
Resp mortality	≥75	St Johns	0	8		0.00	0.00
Resp mortality	≥75	Toronto	0	8	-2.11	-6.18	1.96
Resp mortality	≥75	Vancouver	0	8	-0.46	-8.53	7.61
Resp mortality	≥75	Windsor	0	8	4.89	-10.17	19.95
Resp mortality	≥75	Winnipeg	0	8	5.57	-10.05	21.20
Resp mortality	≥75	Calgary	0	12	1.08	-15.11	17.28
Resp mortality	≥75	Edmonton	0	12		0.00	0.00
Resp mortality	≥75	Halifax	0	12		0.00	0.00
Resp mortality	≥75	Hamilton	0	12	-15.07	-31.44	1.31

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
Resp mortality	≥75	Montreal	0	12	1.55	-3.01	6.12
Resp mortality	≥75	Ottawa	0	12		0.00	0.00
Resp mortality	≥75	Quebec City	0	12	-12.61	-27.38	2.16
Resp mortality	≥75	St Johns	0	12		0.00	0.00
Resp mortality	≥75	Toronto	0	12	-1.84	-5.97	2.30
Resp mortality	≥75	Vancouver	0	12	-0.33	-8.89	8.23
Resp mortality	≥75	Windsor	0	12	5.29	-10.32	20.90
Resp mortality	≥75	Winnipeg	0	12	7.84	-9.41	25.08
Resp mortality	≥75	Calgary	1	4	-1.60	-16.02	12.82
Resp mortality	≥75	Edmonton	1	4	-2.48	-16.70	11.75
Resp mortality	≥75	Halifax	1	4		0.00	0.00
Resp mortality	≥75	Hamilton	1	4	10.86	-1.74	23.46
Resp mortality	≥75	Montreal	1	4	1.37	-2.82	5.57
Resp mortality	≥75	Ottawa	1	4	7.22	-4.42	18.85
Resp mortality	≥75	Quebec City	1	4	-7.11	-20.31	6.09
Resp mortality	≥75	St Johns	1	4	11.73	-15.22	38.68
Resp mortality	≥75	Toronto	1	4	1.53	-2.42	5.48
Resp mortality	≥75	Vancouver	1	4	3.18	-4.22	10.58
Resp mortality	≥75	Windsor	1	4	-9.15	-24.96	6.65
Resp mortality	≥75	Winnipeg	1	4	-4.86	-19.41	9.69
Resp mortality	≥75	Calgary	1	8	-2.84	-18.58	12.90
Resp mortality	≥75	Edmonton	1	8	-2.33	-17.07	12.41
Resp mortality	≥75	Halifax	1	8		0.00	0.00
Resp mortality	≥75	Hamilton	1	8	10.53	-2.75	23.81
Resp mortality	≥75	Montreal	1	8	0.15	-4.22	4.53
Resp mortality	≥75	Ottawa	1	8	10.80	-1.62	23.22
Resp mortality	≥75	Quebec City	1	8	-9.49	-23.27	4.29
Resp mortality	≥75	St Johns	1	8		0.00	0.00
Resp mortality	≥75	Toronto	1	8	1.41	-2.61	5.44
Resp mortality	≥75	Vancouver	1	8	3.19	-4.73	11.11
Resp mortality	≥75	Windsor	1	8	-8.61	-24.93	7.72
Resp mortality	≥75	Winnipeg	1	8	-13.83	-30.19	2.53
Resp mortality	≥75	Calgary	1	12		0.00	0.00
Resp mortality	≥75	Edmonton	1	12	-3.85	-19.15	11.44
Resp mortality	≥75	Halifax	1	12		0.00	0.00
Resp mortality	≥75	Hamilton	1	12	8.72	-5.01	22.45
Resp mortality	≥75	Montreal	1	12	0.10	-4.41	4.61
Resp mortality	≥75	Ottawa	1	12	9.93	-3.32	23.19
Resp mortality	≥75	Quebec City	1	12	-10.08	-24.77	4.61
Resp mortality	≥75	St Johns	1	12	8.61	-19.26	36.49
Resp mortality	≥75	Toronto	1	12		0.00	0.00
Resp mortality	≥75	Vancouver	1	12	5.20	-3.25	13.66
Resp mortality	≥75	Windsor	1	12		0.00	0.00
Resp mortality	≥75	Winnipeg	1	12	-14.28	-32.29	3.73
Resp mortality	≥75	Calgary	2	4	-1.35	-15.39	12.69
Resp mortality	≥75	Edmonton	2	4		0.00	0.00
Resp mortality	≥75	Halifax	2	4		0.00	0.00
Resp mortality	≥75	Hamilton	2	4	-2.94	-17.57	11.69
Resp mortality	≥75	Montreal	2	4	7.57	3.47	11.67

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	≥75	Ottawa	2	4		0.00	0.00
Resp mortality	≥75	Quebec City	2	4	8.78	-3.75	21.31
Resp mortality	≥75	St Johns	2	4	20.81	-6.28	47.90
Resp mortality	≥75	Toronto	2	4	1.48	-2.49	5.44
Resp mortality	≥75	Vancouver	2	4	0.10	-7.45	7.65
Resp mortality	≥75	Windsor	2	4	8.94	-5.77	23.64
Resp mortality	≥75	Winnipeg	2	4	-1.37	-15.58	12.85
Resp mortality	≥75	Calgary	2	8	-0.99	-16.38	14.40
Resp mortality	≥75	Edmonton	2	8		0.00	0.00
Resp mortality	≥75	Halifax	2	8		0.00	0.00
Resp mortality	≥75	Hamilton	2	8	-5.97	-21.29	9.35
Resp mortality	≥75	Montreal	2	8	6.87	2.61	11.13
Resp mortality	≥75	Ottawa	2	8		0.00	0.00
Resp mortality	≥75	Quebec City	2	8	9.07	-4.11	22.25
Resp mortality	≥75	St Johns	2	8		0.00	0.00
Resp mortality	≥75	Toronto	2	8	1.25	-2.81	5.32
Resp mortality	≥75	Vancouver	2	8	0.35	-7.74	8.44
Resp mortality	≥75	Windsor	2	8	8.51	-6.89	23.90
Resp mortality	≥75	Winnipeg	2	8	-8.37	-24.34	7.60
Resp mortality	≥75	Calgary	2	12	-1.75	-17.96	14.45
Resp mortality	≥75	Edmonton	2	12		0.00	0.00
Resp mortality	≥75	Halifax	2	12		0.00	0.00
Resp mortality	≥75	Hamilton	2	12	-7.05	-22.84	8.75
Resp mortality	≥75	Montreal	2	12	8.77	4.38	13.16
Resp mortality	≥75	Ottawa	2	12		0.00	0.00
Resp mortality	≥75	Quebec City	2	12	11.23	-3.15	25.61
Resp mortality	≥75	St Johns	2	12	21.36	-6.63	49.35
Resp mortality	≥75	Toronto	2	12	1.15	-3.02	5.32
Resp mortality	≥75	Vancouver	2	12	-2.48	-11.06	6.10
Resp mortality	≥75	Windsor	2	12	7.94	-8.18	24.06
Resp mortality	≥75	Winnipeg	2	12	-12.89	-30.25	4.47
Resp mortality	<75	Calgary	0	4	-4.33	-23.38	14.72
Resp mortality	<75	Edmonton	0	4		0.00	0.00
Resp mortality	<75	Halifax	0	4		0.00	0.00
Resp mortality	<75	Hamilton	0	4	-3.10	-22.67	16.47
Resp mortality	<75	Montreal	0	4	1.54	-4.17	7.25
Resp mortality	<75	Ottawa	0	4		0.00	0.00
Resp mortality	<75	Quebec City	0	4	-9.23	-27.02	8.57
Resp mortality	<75	St Johns	0	4		0.00	0.00
Resp mortality	<75	Toronto	0	4	-0.51	-6.33	5.32
Resp mortality	<75	Vancouver	0	4	-0.97	-12.68	10.74
Resp mortality	<75	Windsor	0	4		0.00	0.00
Resp mortality	<75	Winnipeg	0	4		0.00	0.00
Resp mortality	<75	Calgary	0	8	-3.71	-24.98	17.57
Resp mortality	<75	Edmonton	0	8		0.00	0.00
Resp mortality	<75	Halifax	0	8		0.00	0.00
Resp mortality	<75	Hamilton	0	8	-7.32	-27.52	12.89
Resp mortality	<75	Montreal	0	8	2.06	-3.90	8.01
Resp mortality	<75	Ottawa	0	8		0.00	0.00

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	<75	Quebec City	0	8	0.00	0.00	0.00
Resp mortality	<75	St Johns	0	8		0.00	0.00
Resp mortality	<75	Toronto	0	8	-0.58	-6.55	5.39
Resp mortality	<75	Vancouver	0	8	-1.95	-14.33	10.43
Resp mortality	<75	Windsor	0	8		0.00	0.00
Resp mortality	<75	Winnipeg	0	8		0.00	0.00
Resp mortality	<75	Edmonton	0	12		0.00	0.00
Resp mortality	<75	Halifax	0	12		0.00	0.00
Resp mortality	<75	Hamilton	0	12	-6.93	-27.67	13.80
Resp mortality	<75	Montreal	0	12	1.16	-4.99	7.31
Resp mortality	<75	Ottawa	0	12		0.00	0.00
Resp mortality	<75	Quebec City	0	12		0.00	0.00
Resp mortality	<75	St Johns	0	12		0.00	0.00
Resp mortality	<75	Toronto	0	12	-1.24	-7.33	4.86
Resp mortality	<75	Vancouver	0	12	-1.15	-14.30	12.00
Resp mortality	<75	Windsor	0	12		0.00	0.00
Resp mortality	<75	Winnipeg	0	12	8.34	-18.26	34.94
Resp mortality	<75	Calgary	0	12	-0.84	-23.12	21.45
Resp mortality	<75	Calgary	1	4	1.91	-17.31	21.12
Resp mortality	<75	Edmonton	1	4	3.79	-12.31	19.89
Resp mortality	<75	Halifax	1	4		0.00	0.00
Resp mortality	<75	Hamilton	1	4	-2.80	-21.45	15.86
Resp mortality	<75	Montreal	1	4	3.92	-1.46	9.30
Resp mortality	<75	Ottawa	1	4	-4.49	-19.48	10.49
Resp mortality	<75	Quebec City	1	4	-9.83	-27.85	8.20
Resp mortality	<75	St Johns	1	4		0.00	0.00
Resp mortality	<75	Toronto	1	4	-2.75	-8.60	3.10
Resp mortality	<75	Vancouver	1	4	1.77	-9.49	13.02
Resp mortality	<75	Windsor	1	4	-13.70	-33.81	6.41
Resp mortality	<75	Winnipeg	1	4	-15.16	-39.09	8.77
Resp mortality	<75	Calgary	1	8	-2.77	-24.04	18.49
Resp mortality	<75	Edmonton	1	8	6.28	-10.87	23.44
Resp mortality	<75	Halifax	1	8		0.00	0.00
Resp mortality	<75	Hamilton	1	8	-4.11	-23.43	15.22
Resp mortality	<75	Montreal	1	8	2.22	-3.40	7.85
Resp mortality	<75	Ottawa	1	8		0.00	0.00
Resp mortality	<75	Quebec City	1	8	-6.88	-25.67	11.91
Resp mortality	<75	St Johns	1	8		0.00	0.00
Resp mortality	<75	Toronto	1	8	-2.48	-8.49	3.53
Resp mortality	<75	Vancouver	1	8	-1.05	-13.14	11.05
Resp mortality	<75	Windsor	1	8		0.00	0.00
Resp mortality	<75	Winnipeg	1	8		0.00	0.00
Resp mortality	<75	Calgary	1	12	-4.08	-28.40	20.25
Resp mortality	<75	Edmonton	1	12		0.00	0.00
Resp mortality	<75	Halifax	1	12		0.00	0.00
Resp mortality	<75	Hamilton	1	12	-5.88	-25.87	14.11
Resp mortality	<75	Montreal	1	12	2.37	-3.48	8.23
Resp mortality	<75	Ottawa	1	12		0.00	0.00
Resp mortality	<75	Quebec City	1	12	-8.03	-27.91	11.84

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp mortality	<75	St Johns	1	12	0.00	0.00	0.00
Resp mortality	<75	Toronto	1	12	-2.18	-8.30	3.93
Resp mortality	<75	Vancouver	1	12	-0.35	-13.25	12.54
Resp mortality	<75	Windsor	1	12		0.00	0.00
Resp mortality	<75	Winnipeg	1	12		0.00	0.00
Resp mortality	<75	Calgary	2	4	-8.58	-28.20	11.04
Resp mortality	<75	Edmonton	2	4	12.63	-2.72	27.97
Resp mortality	<75	Halifax	2	4	-13.41	-46.18	19.36
Resp mortality	<75	Hamilton	2	4	-5.82	-25.75	14.12
Resp mortality	<75	Montreal	2	4	-3.99	-9.89	1.91
Resp mortality	<75	Ottawa	2	4	-4.66	-21.17	11.86
Resp mortality	<75	Quebec City	2	4	-9.13	-27.21	8.95
Resp mortality	<75	St Johns	2	4		0.00	0.00
Resp mortality	<75	Toronto	2	4	0.36	-5.46	6.17
Resp mortality	<75	Vancouver	2	4	-1.25	-12.65	10.15
Resp mortality	<75	Windsor	2	4	3.27	-14.68	21.22
Resp mortality	<75	Winnipeg	2	4	4.06	-17.98	26.10
Resp mortality	<75	Calgary	2	8		0.00	0.00
Resp mortality	<75	Edmonton	2	8	9.56	-7.30	26.43
Resp mortality	<75	Halifax	2	8		0.00	0.00
Resp mortality	<75	Hamilton	2	8	-9.21	-29.93	11.50
Resp mortality	<75	Montreal	2	8	-4.86	-11.01	1.30
Resp mortality	<75	Ottawa	2	8		0.00	0.00
Resp mortality	<75	Quebec City	2	8		0.00	0.00
Resp mortality	<75	St Johns	2	8		0.00	0.00
Resp mortality	<75	Toronto	2	8	0.21	-5.73	6.14
Resp mortality	<75	Vancouver	2	8	-2.87	-15.00	9.25
Resp mortality	<75	Windsor	2	8	1.82	-16.77	20.41
Resp mortality	<75	Winnipeg	2	8		0.00	0.00
Resp mortality	<75	Calgary	2	12		0.00	0.00
Resp mortality	<75	Edmonton	2	12		0.00	0.00
Resp mortality	<75	Halifax	2	12		0.00	0.00
Resp mortality	<75	Hamilton	2	12	-16.28	-38.88	6.32
Resp mortality	<75	Montreal	2	12	-5.46	-11.84	0.92
Resp mortality	<75	Ottawa	2	12		0.00	0.00
Resp mortality	<75	Quebec City	2	12		0.00	0.00
Resp mortality	<75	St Johns	2	12		0.00	0.00
Resp mortality	<75	Toronto	2	12	-0.27	-6.38	5.83
Resp mortality	<75	Vancouver	2	12	-2.59	-15.39	10.22
Resp mortality	<75	Windsor	2	12		0.00	0.00
Resp mortality	<75	Winnipeg	2	12		0.00	0.00
CVD HA	All	Calgary	0	4	1.72	-2.30	5.75
CVD HA	All	Edmonton	0	4	1.04	-3.32	5.39
CVD HA	All	Halifax	0	4	-0.21	-8.30	7.88
CVD HA	All	Hamilton	0	4	-0.03	-1.29	1.23
CVD HA	All	Montreal	0	4	1.00	-0.25	2.26
CVD HA	All	Ottawa	0	4	-0.33	-4.12	3.46
CVD HA	All	Quebec City	0	4	1.01	-2.72	4.73
CVD HA	All	St Johns	0	4	-0.47	-5.05	4.12

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m[3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Toronto	0	4	0.93	-0.01	1.87
CVD HA	All	Vancouver	0	4	2.51	-0.88	5.89
CVD HA	All	Windsor	0	4	1.72	-2.30	5.75
CVD HA	All	Winnipeg	0	4	1.04	-3.32	5.39
CVD HA	All	Calgary	0	8	-0.21	-8.30	7.88
CVD HA	All	Edmonton	0	8	-0.03	-1.29	1.23
CVD HA	All	Halifax	0	8	1.00	-0.25	2.26
CVD HA	All	Hamilton	0	8	-0.33	-4.12	3.46
CVD HA	All	Montreal	0	8	1.01	-2.72	4.73
CVD HA	All	Ottawa	0	8	-0.47	-5.05	4.12
CVD HA	All	Quebec City	0	8	0.93	-0.01	1.87
CVD HA	All	St Johns	0	8	-1.31	-5.96	3.34
CVD HA	All	Toronto	0	8	0.69	-0.27	1.65
CVD HA	All	Vancouver	0	8	2.36	-1.31	6.02
CVD HA	All	Windsor	0	8	-0.72	-3.64	2.21
CVD HA	All	Winnipeg	0	8	0.59	-6.19	7.36
CVD HA	All	Calgary	0	12	0.80	-3.82	5.42
CVD HA	All	Edmonton	0	12	2.56	-2.48	7.60
CVD HA	All	Halifax	0	12	-0.22	-8.56	8.12
CVD HA	All	Hamilton	0	12	0.17	-1.32	1.66
CVD HA	All	Montreal	0	12	1.31	-0.06	2.67
CVD HA	All	Ottawa	0	12	-0.95	-5.24	3.34
CVD HA	All	Quebec City	0	12	1.27	-2.78	5.31
CVD HA	All	St Johns	0	12	-1.41	-6.08	3.26
CVD HA	All	Toronto	0	12	0.74	-0.24	1.71
CVD HA	All	Vancouver	0	12	1.75	-2.11	5.60
CVD HA	All	Windsor	0	12	-0.35	-3.34	2.64
CVD HA	All	Winnipeg	0	12	-0.35	-7.45	6.75
CVD HA	All	Calgary	1	4	2.24	-1.73	6.22
CVD HA	All	Edmonton	1	4	-1.55	-6.00	2.91
CVD HA	All	Halifax	1	4	-3.87	-12.02	4.28
CVD HA	All	Hamilton	1	4	0.73	-2.15	3.61
CVD HA	All	Montreal	1	4	0.77	-0.50	2.03
CVD HA	All	Ottawa	1	4	0.97	-2.80	4.74
CVD HA	All	Quebec City	1	4	-1.43	-5.12	2.26
CVD HA	All	St Johns	1	4	-1.06	-5.73	3.60
CVD HA	All	Toronto	1	4	0.81	-0.14	1.75
CVD HA	All	Vancouver	1	4	-1.37	-4.76	2.02
CVD HA	All	Windsor	1	4	0.81	-2.02	3.64
CVD HA	All	Winnipeg	1	4	0.54	-5.69	6.78
CVD HA	All	Calgary	1	8	3.33	-1.01	7.67
CVD HA	All	Edmonton	1	8	-1.85	-6.66	2.96
CVD HA	All	Halifax	1	8	-3.51	-11.81	4.79
CVD HA	All	Hamilton	1	8	1.24	-1.69	4.17
CVD HA	All	Montreal	1	8	0.63	-0.71	1.97
CVD HA	All	Ottawa	1	8	0.94	-3.03	4.90
CVD HA	All	Quebec City	1	8	-0.66	-4.53	3.21
CVD HA	All	St Johns	1	8	-1.69	-6.40	3.02
CVD HA	All	Toronto	1	8	0.74	-0.22	1.71

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Vancouver	1	8	-2.89	-6.55	0.76
CVD HA	All	Windsor	1	8	0.68	-2.23	3.60
CVD HA	All	Winnipeg	1	8	0.85	-6.05	7.75
CVD HA	All	Calgary	1	12	2.78	-1.85	7.40
CVD HA	All	Edmonton	1	12	-0.26	-5.37	4.85
CVD HA	All	Halifax	1	12	-3.93	-12.40	4.54
CVD HA	All	Hamilton	1	12	1.01	-2.00	4.02
CVD HA	All	Montreal	1	12	0.61	-0.78	1.99
CVD HA	All	Ottawa	1	12	1.05	-3.20	5.30
CVD HA	All	Quebec City	1	12	0.29	-3.72	4.29
CVD HA	All	St Johns	1	12	-2.00	-6.73	2.74
CVD HA	All	Toronto	1	12	0.67	-0.31	1.66
CVD HA	All	Vancouver	1	12	-2.88	-6.73	0.97
CVD HA	All	Windsor	1	12	0.59	-2.39	3.56
CVD HA	All	Winnipeg	1	12	3.37	-3.83	10.56
CVD HA	All	Calgary	2	4	-1.69	-5.82	2.43
CVD HA	All	Edmonton	2	4	3.62	-0.91	8.16
CVD HA	All	Halifax	2	4	3.55	-4.22	11.32
CVD HA	All	Hamilton	2	4	-0.78	-3.68	2.12
CVD HA	All	Montreal	2	4	-0.17	-1.46	1.12
CVD HA	All	Ottawa	2	4	-1.96	-5.72	1.80
CVD HA	All	Quebec City	2	4	1.54	-1.99	5.08
CVD HA	All	St Johns	2	4	-1.61	-6.26	3.05
CVD HA	All	Toronto	2	4	1.16	0.21	2.11
CVD HA	All	Vancouver	2	4	-0.51	-3.94	2.93
CVD HA	All	Windsor	2	4	0.61	-2.26	3.48
CVD HA	All	Winnipeg	2	4	1.42	-4.96	7.80
CVD HA	All	Calgary	2	4	-5.47	-10.91	-0.02
CVD HA	All	Calgary	2	8	-1.50	-5.96	2.96
CVD HA	All	Edmonton	2	8	3.80	-1.13	8.72
CVD HA	All	Halifax	2	8	3.74	-4.17	11.65
CVD HA	All	Hamilton	2	8	-0.74	-3.71	2.23
CVD HA	All	Montreal	2	8	-0.07	-1.43	1.29
CVD HA	All	Ottawa	2	8	-2.12	-6.08	1.84
CVD HA	All	Quebec City	2	8	1.94	-1.75	5.64
CVD HA	All	St Johns	2	8	-2.55	-7.24	2.15
CVD HA	All	Toronto	2	8	1.09	0.12	2.06
CVD HA	All	Vancouver	2	8	-1.75	-5.46	1.96
CVD HA	All	Windsor	2	8	0.59	-2.35	3.54
CVD HA	All	Winnipeg	2	8	2.91	-4.11	9.93
CVD HA	All	Calgary	2	12	-0.89	-5.68	3.90
CVD HA	All	Edmonton	2	12	3.81	-1.46	9.07
CVD HA	All	Halifax	2	12	3.28	-4.79	11.34
CVD HA	All	Hamilton	2	12	-1.31	-4.36	1.75
CVD HA	All	Montreal	2	12	0.02	-1.39	1.42
CVD HA	All	Ottawa	2	12	-1.60	-5.81	2.62
CVD HA	All	Quebec City	2	12	3.10	-0.74	6.95
CVD HA	All	St Johns	2	12	-2.80	-7.52	1.92
CVD HA	All	Toronto	2	12	1.05	0.06	2.04

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	All	Vancouver	2	12	-2.52	-6.43	1.39
CVD HA	All	Windsor	2	12	0.73	-2.28	3.74
CVD HA	All	Winnipeg	2	12	2.54	-4.80	9.87
CVD HA	≥65	Calgary	0	4	3.06	-1.94	8.07
CVD HA	≥65	Edmonton	0	4	2.53	-2.89	7.95
CVD HA	≥65	Halifax	0	4	5.51	-4.33	15.35
CVD HA	≥65	Hamilton	0	4	0.21	-1.30	1.72
CVD HA	≥65	Montreal	0	4	0.91	-0.70	2.52
CVD HA	≥65	Ottawa	0	4	0.53	-4.10	5.16
CVD HA	≥65	Quebec City	0	4	3.44	-1.48	8.36
CVD HA	≥65	St Johns	0	4	-1.22	-6.81	4.36
CVD HA	≥65	Toronto	0	4	0.70	-0.42	1.82
CVD HA	≥65	Vancouver	0	4	3.76	-0.28	7.80
CVD HA	≥65	Windsor	0	4	-2.45	-5.87	0.98
CVD HA	≥65	Winnipeg	0	4	0.37	-6.75	7.49
CVD HA	≥65	Calgary	0	8	3.78	-1.69	9.24
CVD HA	≥65	Edmonton	0	8	4.33	-1.42	10.09
CVD HA	≥65	Halifax	0	8	6.07	-3.92	16.06
CVD HA	≥65	Hamilton	0	8	0.16	-1.49	1.81
CVD HA	≥65	Montreal	0	8	1.50	-0.20	3.20
CVD HA	≥65	Ottawa	0	8	-0.55	-5.41	4.31
CVD HA	≥65	Quebec City	0	8	2.98	-2.19	8.14
CVD HA	≥65	St Johns	0	8	-2.34	-7.99	3.31
CVD HA	≥65	Toronto	0	8	0.42	-0.73	1.56
CVD HA	≥65	Vancouver	0	8	3.76	-0.61	8.14
CVD HA	≥65	Windsor	0	8	-2.22	-5.74	1.31
CVD HA	≥65	Winnipeg	0	8	2.31	-5.57	10.18
CVD HA	≥65	Calgary	1	4	3.06	-2.01	8.13
CVD HA	≥65	Edmonton	1	4	-1.94	-7.47	3.60
CVD HA	≥65	Halifax	1	4	-0.82	-10.92	9.27
CVD HA	≥65	Hamilton	1	4	0.50	-2.95	3.95
CVD HA	≥65	Montreal	1	4	-0.18	-1.83	1.47
CVD HA	≥65	Ottawa	1	4	1.30	-3.33	5.94
CVD HA	≥65	Quebec City	1	4	-3.28	-8.22	1.66
CVD HA	≥65	St Johns	1	4	-3.93	-9.68	1.82
CVD HA	≥65	Toronto	1	4	0.91	-0.21	2.03
CVD HA	≥65	Vancouver	1	4	-3.05	-7.12	1.03
CVD HA	≥65	Windsor	1	4	1.15	-2.24	4.55
CVD HA	≥65	Winnipeg	1	4	-1.01	-8.38	6.36
CVD HA	≥65	Calgary	1	8	4.35	-1.17	9.87
CVD HA	≥65	Edmonton	1	8	-3.06	-9.03	2.91
CVD HA	≥65	Halifax	1	8	-0.62	-10.88	9.64
CVD HA	≥65	Hamilton	1	8	0.96	-2.56	4.48
CVD HA	≥65	Montreal	1	8	0.01	-1.73	1.75
CVD HA	≥65	Ottawa	1	8	1.53	-3.35	6.41
CVD HA	≥65	Quebec City	1	8	-2.97	-8.15	2.20
CVD HA	≥65	St Johns	1	8	-4.68	-10.47	1.11
CVD HA	≥65	Toronto	1	8	0.82	-0.33	1.96
CVD HA	≥65	Vancouver	1	8	-3.85	-8.24	0.54

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
CVD HA	≥65	Windsor	1	8	1.02	-2.48	4.51
CVD HA	≥65	Winnipeg	1	8	-1.82	-9.96	6.33
CVD HA	≥65	Edmonton	2	4	4.27	-1.25	9.78
CVD HA	≥65	Halifax	2	4	2.57	-7.26	12.40
CVD HA	≥65	Hamilton	2	4	-0.64	-4.11	2.83
CVD HA	≥65	Montreal	2	4	-0.76	-2.41	0.90
CVD HA	≥65	Ottawa	2	4	-1.26	-5.86	3.35
CVD HA	≥65	Quebec City	2	4	0.85	-3.82	5.51
CVD HA	≥65	St Johns	2	4	-1.98	-7.64	3.68
CVD HA	≥65	Toronto	2	4	1.17	0.04	2.30
CVD HA	≥65	Vancouver	2	4	0.06	-4.04	4.15
CVD HA	≥65	Windsor	2	4	0.57	-2.87	4.00
CVD HA	≥65	Winnipeg	2	4	-1.28	-8.88	6.31
CVD HA	≥65	Calgary	2	8	-5.12	-10.96	0.73
CVD HA	≥65	Edmonton	2	8	3.84	-2.13	9.80
CVD HA	≥65	Halifax	2	8	3.15	-6.82	13.13
CVD HA	≥65	Hamilton	2	8	-0.68	-4.24	2.87
CVD HA	≥65	Montreal	2	8	-0.51	-2.26	1.24
CVD HA	≥65	Ottawa	2	8	-1.83	-6.68	3.03
CVD HA	≥65	Quebec City	2	8	1.05	-3.82	5.92
CVD HA	≥65	St Johns	2	8	-2.96	-8.68	2.76
CVD HA	≥65	Toronto	2	8	1.11	-0.05	2.26
CVD HA	≥65	Vancouver	2	8	-0.65	-5.08	3.78
CVD HA	≥65	Windsor	2	8	0.67	-2.86	4.20
CVD HA	≥65	Winnipeg	2	8	0.74	-7.58	9.05
CVD HA	≥65	Calgary	2	12	-5.21	-11.49	1.07
Resp HA	All	Calgary	0	4	-2.87	-7.87	2.13
Resp HA	All	Edmonton	0	4	1.26	-3.38	5.90
Resp HA	All	Halifax	0	4	-0.41	-11.98	11.16
Resp HA	All	Hamilton	0	4	1.60	-0.04	3.24
Resp HA	All	Montreal	0	4	0.55	-1.03	2.12
Resp HA	All	Ottawa	0	4	4.61	-0.13	9.35
Resp HA	All	Quebec City	0	4	0.31	-4.64	5.26
Resp HA	All	St Johns	0	4	1.33	-4.35	7.01
Resp HA	All	Toronto	0	4	0.44	-0.85	1.74
Resp HA	All	Vancouver	0	4	4.07	-0.23	8.38
Resp HA	All	Windsor	0	4	-2.08	-6.26	2.11
Resp HA	All	Winnipeg	0	4	-5.68	-14.10	2.74
Resp HA	All	Calgary	0	8	-2.16	-7.59	3.28
Resp HA	All	Edmonton	0	8	1.10	-3.88	6.08
Resp HA	All	Halifax	0	8	-2.91	-14.82	9.01
Resp HA	All	Hamilton	0	8	1.80	-0.11	3.70
Resp HA	All	Montreal	0	8	0.85	-0.81	2.51
Resp HA	All	Ottawa	0	8	3.09	-1.92	8.09
Resp HA	All	Quebec City	0	8	-0.03	-5.26	5.20
Resp HA	All	St Johns	0	8	-0.22	-5.97	5.53
Resp HA	All	Toronto	0	8	-0.19	-1.52	1.13
Resp HA	All	Vancouver	0	8	4.52	-0.14	9.18
Resp HA	All	Windsor	0	8	-1.56	-5.87	2.75

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m[3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Winnipeg	0	8	-5.79	-15.06	3.48
Resp HA	All	Calgary	0	12	1.87	-3.85	7.60
Resp HA	All	Edmonton	0	12	4.50	-1.77	10.78
Resp HA	All	Halifax	0	12	5.14	-5.05	15.34
Resp HA	All	Hamilton	0	12	0.27	-1.53	2.06
Resp HA	All	Montreal	0	12	1.86	0.11	3.61
Resp HA	All	Ottawa	0	12	-1.04	-6.27	4.20
Resp HA	All	Quebec City	0	12	3.79	-1.55	9.12
Resp HA	All	St Johns	0	12	-2.32	-8.00	3.36
Resp HA	All	Toronto	0	12	0.41	-0.75	1.58
Resp HA	All	Vancouver	0	12	3.32	-1.28	7.92
Resp HA	All	Windsor	0	12	-1.91	-5.51	1.69
Resp HA	All	Winnipeg	0	12	1.73	-6.53	9.99
Resp HA	All	Calgary	0	12	-3.85	-9.57	1.87
Resp HA	All	Edmonton	0	12	-0.35	-5.67	4.97
Resp HA	All	Halifax	0	12	-5.86	-18.17	6.45
Resp HA	All	Hamilton	0	12	0.82	-1.20	2.85
Resp HA	All	Montreal	0	12	1.09	-0.62	2.79
Resp HA	All	Ottawa	0	12	2.27	-3.10	7.64
Resp HA	All	Quebec City	0	12	0.05	-5.36	5.46
Resp HA	All	St Johns	0	12	0.48	-5.31	6.26
Resp HA	All	Toronto	0	12	-0.61	-1.96	0.73
Resp HA	All	Vancouver	0	12	6.46	1.54	11.38
Resp HA	All	Windsor	0	12	-0.94	-5.33	3.46
Resp HA	All	Winnipeg	0	12	-6.82	-16.43	2.80
Resp HA	All	Calgary	1	4	0.54	-4.25	5.33
Resp HA	All	Edmonton	1	4	-0.37	-5.17	4.44
Resp HA	All	Halifax	1	4	-0.61	-11.99	10.77
Resp HA	All	Hamilton	1	4	3.98	-0.16	8.13
Resp HA	All	Montreal	1	4	1.26	-0.32	2.84
Resp HA	All	Ottawa	1	4	2.53	-2.47	7.53
Resp HA	All	Quebec City	1	4	2.50	-2.47	7.47
Resp HA	All	St Johns	1	4	-1.00	-6.69	4.70
Resp HA	All	Toronto	1	4	1.52	0.23	2.81
Resp HA	All	Vancouver	1	4	2.52	-1.78	6.83
Resp HA	All	Windsor	1	4	1.19	-2.94	5.33
Resp HA	All	Winnipeg	1	4	-1.58	-9.36	6.20
Resp HA	All	Calgary	1	8	0.10	-5.17	5.37
Resp HA	All	Edmonton	1	8	0.07	-5.02	5.16
Resp HA	All	Halifax	1	8	-3.63	-15.37	8.10
Resp HA	All	Hamilton	1	8	4.34	0.10	8.58
Resp HA	All	Montreal	1	8	1.59	-0.08	3.26
Resp HA	All	Ottawa	1	8	0.33	-4.89	5.55
Resp HA	All	Quebec City	1	8	2.32	-2.90	7.54
Resp HA	All	St Johns	1	8	-2.55	-8.31	3.21
Resp HA	All	Toronto	1	8	0.82	-0.50	2.15
Resp HA	All	Vancouver	1	8	4.19	-0.44	8.82
Resp HA	All	Windsor	1	8	2.11	-2.16	6.37
Resp HA	All	Winnipeg	1	8	0.52	-8.17	9.20

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	All	Calgary	1	12	4.71	-1.20	10.62
Resp HA	All	Edmonton	1	12	-2.01	-8.35	4.34
Resp HA	All	Halifax	1	12	0.50	-9.96	10.96
Resp HA	All	Hamilton	1	12	0.58	-3.04	4.21
Resp HA	All	Montreal	1	12	0.09	-1.70	1.89
Resp HA	All	Ottawa	1	12	1.58	-3.65	6.82
Resp HA	All	Quebec City	1	12	-2.62	-7.96	2.72
Resp HA	All	St Johns	1	12	-5.06	-10.89	0.77
Resp HA	All	Toronto	1	12	0.69	-0.48	1.86
Resp HA	All	Vancouver	1	12	-3.40	-8.02	1.23
Resp HA	All	Windsor	1	12	1.05	-2.52	4.62
Resp HA	All	Winnipeg	1	12	1.17	-7.31	9.66
Resp HA	All	Calgary	1	12	-0.69	-6.25	4.87
Resp HA	All	Edmonton	1	12	0.45	-4.98	5.88
Resp HA	All	Halifax	1	12	-5.83	-17.96	6.31
Resp HA	All	Hamilton	1	12	3.35	-1.07	7.77
Resp HA	All	Montreal	1	12	1.36	-0.36	3.08
Resp HA	All	Ottawa	1	12	-0.19	-5.82	5.44
Resp HA	All	Quebec City	1	12	1.69	-3.70	7.09
Resp HA	All	St Johns	1	12	-2.07	-7.87	3.73
Resp HA	All	Toronto	1	12	0.62	-0.72	1.97
Resp HA	All	Vancouver	1	12	5.15	0.22	10.07
Resp HA	All	Windsor	1	12	2.03	-2.30	6.35
Resp HA	All	Winnipeg	1	12	1.99	-6.85	10.83
Resp HA	All	Calgary	2	4	-3.86	-8.81	1.10
Resp HA	All	Edmonton	2	4	-1.62	-6.47	3.24
Resp HA	All	Halifax	2	4	1.70	-9.73	13.13
Resp HA	All	Hamilton	2	4	3.91	-0.22	8.05
Resp HA	All	Montreal	2	4	-0.16	-1.77	1.44
Resp HA	All	Ottawa	2	4	0.63	-4.47	5.73
Resp HA	All	Quebec City	2	4	1.57	-3.23	6.37
Resp HA	All	St Johns	2	4	1.86	-3.85	7.56
Resp HA	All	Toronto	2	4	4.01	2.73	5.29
Resp HA	All	Vancouver	2	4	0.11	-4.22	4.45
Resp HA	All	Windsor	2	4	0.85	-3.25	4.95
Resp HA	All	Winnipeg	2	4	-5.39	-13.59	2.81
Resp HA	All	Calgary	2	4	-10.43	-18.52	-2.34
Resp HA	All	Calgary	2	8	-2.87	-8.24	2.50
Resp HA	All	Edmonton	2	8	0.96	-4.08	6.00
Resp HA	All	Halifax	2	8	0.04	-11.70	11.79
Resp HA	All	Hamilton	2	8	3.19	-1.05	7.44
Resp HA	All	Montreal	2	8	-0.05	-1.75	1.64
Resp HA	All	Ottawa	2	8	-0.70	-6.09	4.70
Resp HA	All	Quebec City	2	8	-1.50	-6.55	3.56
Resp HA	All	St Johns	2	8	0.92	-4.85	6.68
Resp HA	All	Toronto	2	8	3.49	2.17	4.80
Resp HA	All	Vancouver	2	8	0.96	-3.70	5.61
Resp HA	All	Windsor	2	8	1.93	-2.31	6.16
Resp HA	All	Winnipeg	2	8	-3.67	-12.78	5.45

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m^3 increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	*Upper*
Resp HA	All	Edmonton	2	12	3.68	-2.70	10.07
Resp HA	All	Halifax	2	12	3.53	-6.63	13.69
Resp HA	All	Hamilton	2	12	-1.37	-5.02	2.29
Resp HA	All	Montreal	2	12	-0.45	-2.26	1.35
Resp HA	All	Ottawa	2	12	-1.75	-6.93	3.43
Resp HA	All	Quebec City	2	12	1.53	-3.56	6.61
Resp HA	All	St Johns	2	12	-3.42	-9.17	2.33
Resp HA	All	Toronto	2	12	0.99	-0.18	2.17
Resp HA	All	Vancouver	2	12	-1.22	-5.89	3.46
Resp HA	All	Windsor	2	12	0.91	-2.69	4.50
Resp HA	All	Winnipeg	2	12	-0.59	-9.27	8.10
Resp HA	All	Calgary	2	12	-3.70	-9.43	2.03
Resp HA	All	Edmonton	2	12	0.95	-4.45	6.34
Resp HA	All	Halifax	2	12	-0.69	-12.68	11.31
Resp HA	All	Hamilton	2	12	0.30	-4.15	4.75
Resp HA	All	Montreal	2	12	-0.18	-1.93	1.57
Resp HA	All	Ottawa	2	12	0.11	-5.65	5.87
Resp HA	All	Quebec City	2	12	-3.09	-8.38	2.20
Resp HA	All	St Johns	2	12	1.39	-4.41	7.18
Resp HA	All	Toronto	2	12	3.09	1.75	4.44
Resp HA	All	Vancouver	2	12	0.79	-4.11	5.69
Resp HA	All	Windsor	2	12	2.34	-1.99	6.67
Resp HA	All	Winnipeg	2	12	-1.10	-10.54	8.34
Resp HA	≥65	Calgary	0	4	-1.67	-9.39	6.05
Resp HA	≥65	Edmonton	0	4	1.58	-5.84	9.00
Resp HA	≥65	Halifax	0	4	-3.87	-23.00	15.25
Resp HA	≥65	Hamilton	0	4	0.96	-1.31	3.24
Resp HA	≥65	Montreal	0	4	1.08	-1.27	3.43
Resp HA	≥65	Ottawa	0	4	7.88	1.01	14.74
Resp HA	≥65	Quebec City	0	4	-5.38	-13.58	2.82
Resp HA	≥65	St Johns	0	4	-0.06	-8.75	8.64
Resp HA	≥65	Toronto	0	4	0.58	-1.28	2.44
Resp HA	≥65	Vancouver	0	4	4.49	-1.95	10.92
Resp HA	≥65	Windsor	0	4	-2.24	-8.41	3.93
Resp HA	≥65	Winnipeg	0	4	-1.70	-12.95	9.55
Resp HA	≥65	Calgary	0	8	-0.52	-8.97	7.93
Resp HA	≥65	Edmonton	0	8	2.06	-5.84	9.95
Resp HA	≥65	Halifax	0	8	-6.40	-26.27	13.47
Resp HA	≥65	Hamilton	0	8	0.69	-1.83	3.21
Resp HA	≥65	Montreal	0	8	1.16	-1.29	3.62
Resp HA	≥65	Ottawa	0	8	6.68	-0.59	13.95
Resp HA	≥65	Quebec City	0	8	-7.71	-16.29	0.87
Resp HA	≥65	St Johns	0	8	-1.33	-10.18	7.52
Resp HA	≥65	Toronto	0	8	-0.15	-2.06	1.76
Resp HA	≥65	Vancouver	0	8	4.23	-2.71	11.18
Resp HA	≥65	Windsor	0	8	-1.59	-7.90	4.73
Resp HA	≥65	Winnipeg	0	8	-1.23	-13.60	11.14
Resp HA	≥65	Calgary	0	12	-1.54	-10.51	7.44
Resp HA	≥65	Edmonton	0	12	2.29	-6.07	10.64

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m[3] increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI	
						Lower	*Upper*
Resp HA	≥65	Halifax	0	12	-11.18	-31.74	9.38
Resp HA	≥65	Hamilton	0	12	-1.03	-3.57	1.51
Resp HA	≥65	Montreal	0	12	1.61	-0.90	4.13
Resp HA	≥65	Ottawa	0	12	4.96	-2.88	12.81
Resp HA	≥65	Quebec City	0	12	-8.23	-17.10	0.65
Resp HA	≥65	St Johns	0	12	-0.05	-8.94	8.85
Resp HA	≥65	Toronto	0	12	-0.67	-2.61	1.27
Resp HA	≥65	Vancouver	0	12	7.17	-0.18	14.51
Resp HA	≥65	Windsor	0	12	-1.61	-8.08	4.85
Resp HA	≥65	Winnipeg	0	12	-1.88	-14.66	10.90
Resp HA	≥65	Calgary	1	4	-2.90	-10.54	4.73
Resp HA	≥65	Edmonton	1	4	2.67	-4.60	9.94
Resp HA	≥65	Halifax	1	4	-2.58	-21.35	16.19
Resp HA	≥65	Hamilton	1	4	7.71	2.21	13.21
Resp HA	≥65	Montreal	1	4	1.13	-1.23	3.49
Resp HA	≥65	Ottawa	1	4	2.68	-4.51	9.88
Resp HA	≥65	Quebec City	1	4	1.06	-6.84	8.97
Resp HA	≥65	St Johns	1	4	-5.98	-14.91	2.96
Resp HA	≥65	Toronto	1	4	1.38	-0.48	3.25
Resp HA	≥65	Vancouver	1	4	4.31	-2.13	10.74
Resp HA	≥65	Windsor	1	4	1.30	-4.84	7.43
Resp HA	≥65	Winnipeg	1	4	2.38	-8.02	12.77
Resp HA	≥65	Calgary	1	8	-4.30	-12.66	4.06
Resp HA	≥65	Edmonton	1	8	1.18	-6.64	9.00
Resp HA	≥65	Halifax	1	8	-7.17	-26.76	12.42
Resp HA	≥65	Hamilton	1	8	7.95	2.32	13.58
Resp HA	≥65	Montreal	1	8	1.27	-1.23	3.77
Resp HA	≥65	Ottawa	1	8	-0.44	-7.87	7.00
Resp HA	≥65	Quebec City	1	8	2.76	-5.61	11.13
Resp HA	≥65	St Johns	1	8	-6.86	-15.90	2.18
Resp HA	≥65	Toronto	1	8	0.90	-1.01	2.80
Resp HA	≥65	Vancouver	1	8	7.69	0.79	14.58
Resp HA	≥65	Windsor	1	8	3.05	-3.26	9.36
Resp HA	≥65	Winnipeg	1	8	4.33	-7.36	16.02
Resp HA	≥65	Calgary	1	12	-6.76	-15.50	1.97
Resp HA	≥65	Edmonton	1	12	2.12	-6.14	10.37
Resp HA	≥65	Halifax	1	12	-8.74	-28.84	11.37
Resp HA	≥65	Hamilton	1	12	7.94	2.10	13.78
Resp HA	≥65	Montreal	1	12	1.30	-1.27	3.87
Resp HA	≥65	Ottawa	1	12	0.60	-7.41	8.61
Resp HA	≥65	Quebec City	1	12	2.44	-6.26	11.14
Resp HA	≥65	St Johns	1	12	-5.85	-14.95	3.25
Resp HA	≥65	Toronto	1	12	0.49	-1.45	2.43
Resp HA	≥65	Vancouver	1	12	7.15	-0.17	14.47
Resp HA	≥65	Windsor	1	12	3.25	-3.18	9.69
Resp HA	≥65	Winnipeg	1	12	7.27	-4.76	19.31
Resp HA	≥65	Edmonton	2	4	-0.10	-7.99	7.79
Resp HA	≥65	Halifax	2	4	-5.23	-24.24	13.78
Resp HA	≥65	Hamilton	2	4	5.20	-0.44	10.84

Table C-2. City specific percent change (βx1000) in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$ for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	City	Lag period	df/yr (time)	Effect (% change)	95% CI *Lower*	95% CI *Upper*
Resp HA	≥65	Montreal	2	4	1.31	-1.06	3.67
Resp HA	≥65	Ottawa	2	4	3.39	-3.97	10.74
Resp HA	≥65	Quebec City	2	4	3.08	-4.43	10.58
Resp HA	≥65	St Johns	2	4	0.65	-8.19	9.48
Resp HA	≥65	Toronto	2	4	3.65	1.79	5.50
Resp HA	≥65	Vancouver	2	4	-1.12	-7.64	5.40
Resp HA	≥65	Windsor	2	4	-1.03	-7.15	5.09
Resp HA	≥65	Winnipeg	2	4	0.78	-10.25	11.81
Resp HA	≥65	Calgary	2	8	-8.49	-17.26	0.28
Resp HA	≥65	Edmonton	2	8	1.16	-7.08	9.40
Resp HA	≥65	Halifax	2	8	-6.93	-26.76	12.91
Resp HA	≥65	Hamilton	2	8	4.60	-1.19	10.39
Resp HA	≥65	Montreal	2	8	1.07	-1.41	3.56
Resp HA	≥65	Ottawa	2	8	1.73	-6.00	9.46
Resp HA	≥65	Quebec City	2	8	1.57	-6.29	9.42
Resp HA	≥65	St Johns	2	8	0.29	-8.66	9.25
Resp HA	≥65	Toronto	2	8	3.07	1.17	4.97
Resp HA	≥65	Vancouver	2	8	0.33	-6.64	7.29
Resp HA	≥65	Windsor	2	8	0.16	-6.15	6.47
Resp HA	≥65	Winnipeg	2	8	2.12	-10.19	14.44
Resp HA	≥65	Calgary	2	12	-12.09	-21.48	-2.70
Resp HA	≥65	Edmonton	2	12	1.61	-7.06	10.29
Resp HA	≥65	Halifax	2	12	-5.97	-25.97	14.03
Resp HA	≥65	Hamilton	2	12	1.65	-4.43	7.72
Resp HA	≥65	Montreal	2	12	1.21	-1.35	3.77
Resp HA	≥65	Ottawa	2	12	2.07	-6.24	10.38
Resp HA	≥65	Quebec City	2	12	-0.61	-8.79	7.58
Resp HA	≥65	St Johns	2	12	0.92	-8.08	9.92
Resp HA	≥65	Toronto	2	12	2.84	0.91	4.77
Resp HA	≥65	Vancouver	2	12	0.12	-7.23	7.47
Resp HA	≥65	Windsor	2	12	1.37	-5.13	7.87
Resp HA	≥65	Winnipeg	2	12	3.44	-9.42	16.30

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI Lower	95% CI Upper
PM ctrl Ozone	All mortality	All	Calgary	2.42	-1.42	6.26
PM ctrl Ozone	All mortality	All	Edmonton	0.39	-3.37	4.15
PM ctrl Ozone	All mortality	All	Halifax	1.55	-5.62	8.71
PM ctrl Ozone	All mortality	All	Hamilton	2.96	-0.59	6.50
PM ctrl Ozone	All mortality	All	Montreal	0.83	-0.24	1.90
PM ctrl Ozone	All mortality	All	Ottawa	0.96	-1.98	3.91
PM ctrl Ozone	All mortality	All	Quebec City	-1.09	-4.62	2.44
PM ctrl Ozone	All mortality	All	St Johns	3.98	-3.89	11.84
PM ctrl Ozone	All mortality	All	Toronto	1.21	0.21	2.21
PM ctrl Ozone	All mortality	All	Vancouver	2.15	-0.07	4.37
PM ctrl Ozone	All mortality	All	Windsor	2.17	-1.16	5.50
PM ctrl Ozone	All mortality	All	Winnipeg	2.22	-1.82	6.25
PM ctrl Ozone	All mortality	≥75	Calgary	2.63	-2.92	8.18
PM ctrl Ozone	All mortality	≥75	Edmonton	1.66	-3.84	7.17
PM ctrl Ozone	All mortality	≥75	Halifax	4.24	-6.68	15.16
PM ctrl Ozone	All mortality	≥75	Hamilton	3.49	-1.76	8.73
PM ctrl Ozone	All mortality	≥75	Montreal	1.34	-0.19	2.87
PM ctrl Ozone	All mortality	≥75	Ottawa	0.94	-3.35	5.22
PM ctrl Ozone	All mortality	≥75	Quebec City	-1.83	-6.88	3.22
PM ctrl Ozone	All mortality	≥75	St Johns	11.17	0.39	21.95
PM ctrl Ozone	All mortality	≥75	Toronto	1.95	0.55	3.35
PM ctrl Ozone	All mortality	≥75	Vancouver	1.62	-1.47	4.71
PM ctrl Ozone	All mortality	≥75	Windsor	5.42	0.82	10.03
PM ctrl Ozone	All mortality	≥75	Winnipeg	2.38	-3.21	7.97
PM ctrl Ozone	All mortality	<75	Calgary	2.15	-3.17	7.48
PM ctrl Ozone	All mortality	<75	Edmonton	-0.91	-6.08	4.25
PM ctrl Ozone	All mortality	<75	Halifax	-0.73	-10.24	8.77
PM ctrl Ozone	All mortality	<75	Hamilton	2.55	-2.26	7.36
PM ctrl Ozone	All mortality	<75	Montreal	0.34	-1.15	1.83
PM ctrl Ozone	All mortality	<75	Ottawa	0.91	-3.15	4.96
PM ctrl Ozone	All mortality	<75	Quebec City	-0.31	-5.25	4.63
PM ctrl Ozone	All mortality	<75	St Johns	-3.71	-15.16	7.73
PM ctrl Ozone	All mortality	<75	Toronto	0.45	-0.97	1.87
PM ctrl Ozone	All mortality	<75	Vancouver	2.75	-0.45	5.94
PM ctrl Ozone	All mortality	<75	Windsor	-1.31	-6.13	3.52
PM ctrl Ozone	All mortality	<75	Winnipeg	2.13	-3.72	7.98
PM ctrl Ozone	CVD HA	All	Calgary	3.44	-1.10	7.97
PM ctrl Ozone	CVD HA	All	Edmonton	-1.79	-6.76	3.19
PM ctrl Ozone	CVD HA	All	Halifax	-9.69	-19.43	0.05
PM ctrl Ozone	CVD HA	All	Hamilton	0.85	-2.16	3.86
PM ctrl Ozone	CVD HA	All	Montreal	0.68	-0.68	2.04
PM ctrl Ozone	CVD HA	All	Ottawa	0.65	-3.37	4.67
PM ctrl Ozone	CVD HA	All	Quebec City	-0.52	-4.62	3.58
PM ctrl Ozone	CVD HA	All	St Johns	-2.14	-7.31	3.03
PM ctrl Ozone	CVD HA	All	Toronto	0.64	-0.36	1.65
PM ctrl Ozone	CVD HA	All	Vancouver	-3.15	-6.89	0.58
PM ctrl Ozone	CVD HA	All	Windsor	0.38	-2.74	3.50
PM ctrl Ozone	CVD HA	All	Winnipeg	2.10	-4.87	9.08

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI	
					Lower	*Upper*
PM ctrl Ozone	CVD HA	≥65	Calgary	3.58	-2.21	9.37
PM ctrl Ozone	CVD HA	≥65	Edmonton	-3.41	-9.60	2.78
PM ctrl Ozone	CVD HA	≥65	Halifax	-5.83	-18.00	6.33
PM ctrl Ozone	CVD HA	≥65	Hamilton	0.50	-3.11	4.12
PM ctrl Ozone	CVD HA	≥65	Montreal	-0.02	-1.79	1.74
PM ctrl Ozone	CVD HA	≥65	Ottawa	1.10	-3.84	6.04
PM ctrl Ozone	CVD HA	≥65	Quebec City	-3.79	-9.26	1.69
PM ctrl Ozone	CVD HA	≥65	St Johns	-5.73	-12.10	0.64
PM ctrl Ozone	CVD HA	≥65	Toronto	0.70	-0.50	1.90
PM ctrl Ozone	CVD HA	≥65	Vancouver	-4.06	-8.54	0.42
PM ctrl Ozone	CVD HA	≥65	Windsor	0.32	-3.42	4.07
PM ctrl Ozone	CVD HA	≥65	Winnipeg	0.15	-8.08	8.38
PM ctrl Ozone	CVD mortality	All	Calgary	-1.64	0.99	7.56
PM ctrl Ozone	CVD mortality	All	Edmonton	2.45	-0.39	1.77
PM ctrl Ozone	CVD mortality	All	Halifax	-2.60	-4.21	5.44
PM ctrl Ozone	CVD mortality	All	Hamilton	4.15	-7.11	7.15
PM ctrl Ozone	CVD mortality	All	Montreal	0.47	0.11	9.72
PM ctrl Ozone	CVD mortality	All	Ottawa	-0.15	-0.99	1.95
PM ctrl Ozone	CVD mortality	All	Quebec City	-0.61	-6.23	6.76
PM ctrl Ozone	CVD mortality	All	St Johns	8.97		
PM ctrl Ozone	CVD mortality	All	Toronto	1.10	-0.83	8.17
PM ctrl Ozone	CVD mortality	All	Vancouver	0.13	-0.63	2.55
PM ctrl Ozone	CVD mortality	All	Windsor	3.72	-6.16	8.34
PM ctrl Ozone	CVD mortality	All	Winnipeg	0.18		
PM ctrl Ozone	CVD mortality	≥75	Calgary	-2.37	-0.14	1.95
PM ctrl Ozone	CVD mortality	≥75	Edmonton	2.62	0.07	1.37
PM ctrl Ozone	CVD mortality	≥75	Halifax	1.32	-14.53	9.32
PM ctrl Ozone	CVD mortality	≥75	Hamilton	5.80	-0.54	2.73
PM ctrl Ozone	CVD mortality	≥75	Montreal	1.52	-0.10	2.89
PM ctrl Ozone	CVD mortality	≥75	Ottawa	1.10	0.78	2.55
PM ctrl Ozone	CVD mortality	≥75	Quebec City	-0.67	-15.82	18.46
PM ctrl Ozone	CVD mortality	≥75	St Johns		0.67	4.83
PM ctrl Ozone	CVD mortality	≥75	Toronto	2.75	-1.01	1.90
PM ctrl Ozone	CVD mortality	≥75	Vancouver	-0.56	-1.29	0.60
PM ctrl Ozone	CVD mortality	≥75	Windsor	6.02		
PM ctrl Ozone	CVD mortality	≥75	Winnipeg	2.62	-4.26	1.07
PM ctrl Ozone	CVD mortality	<75	Calgary	-0.27	-2.02	3.76
PM ctrl Ozone	CVD mortality	<75	Edmonton	1.95	-0.63	1.59
PM ctrl Ozone	CVD mortality	<75	Halifax		-1.89	12.62
PM ctrl Ozone	CVD mortality	<75	Hamilton	1.87	-1.57	1.21
PM ctrl Ozone	CVD mortality	<75	Montreal	-0.97	-2.85	5.56
PM ctrl Ozone	CVD mortality	<75	Ottawa	-1.84	-1.03	1.98
PM ctrl Ozone	CVD mortality	<75	Quebec City	-0.28	-13.45	7.93
PM ctrl Ozone	CVD mortality	<75	St Johns		-2.09	1.44
PM ctrl Ozone	CVD mortality	<75	Toronto	-1.60	-3.64	4.32
PM ctrl Ozone	CVD mortality	<75	Vancouver	1.39	-1.17	2.10
PM ctrl Ozone	CVD mortality	<75	Windsor	-0.23		
PM ctrl Ozone	CVD mortality	<75	Winnipeg	-4.08	-2.18	2.33

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI Lower	95% CI Upper
PM ctrl Ozone	Resp HA	All	Calgary	0.10	-12.78	-16.59
PM ctrl Ozone	Resp HA	All	Edmonton	-0.11	-7.71	-7.14
PM ctrl Ozone	Resp HA	All	Halifax	-1.72	-19.88	-17.32
PM ctrl Ozone	Resp HA	All	Hamilton	3.55	2.32	10.46
PM ctrl Ozone	Resp HA	All	Montreal	1.45	-1.25	0.01
PM ctrl Ozone	Resp HA	All	Ottawa	0.42	-7.76	-8.04
PM ctrl Ozone	Resp HA	All	Quebec City	1.41	-6.58	-4.36
PM ctrl Ozone	Resp HA	All	St Johns	-0.69	-14.67	-19.52
PM ctrl Ozone	Resp HA	All	Toronto	0.38	-1.36	-0.75
PM ctrl Ozone	Resp HA	All	Vancouver	4.57	0.40	7.97
PM ctrl Ozone	Resp HA	All	Windsor	1.95	-5.16	-3.63
PM ctrl Ozone	Resp HA	All	Winnipeg	1.66	-6.20	-0.60
PM ctrl Ozone	Resp HA	≥65	Calgary	-3.81	-1.17	-0.84
PM ctrl Ozone	Resp HA	≥65	Edmonton	0.56	-1.59	-1.67
PM ctrl Ozone	Resp HA	≥65	Halifax	2.56	-2.14	-1.83
PM ctrl Ozone	Resp HA	≥65	Hamilton	8.15	-0.92	-0.33
PM ctrl Ozone	Resp HA	≥65	Montreal	1.26	-0.47	-0.11
PM ctrl Ozone	Resp HA	≥65	Ottawa	-0.29	-1.21	-0.87
PM ctrl Ozone	Resp HA	≥65	Quebec City	2.22	-1.63	-1.86
PM ctrl Ozone	Resp HA	≥65	St Johns	-4.84	-2.19	-1.98
PM ctrl Ozone	Resp HA	≥65	Toronto	0.61	0.86	2.41
PM ctrl Ozone	Resp HA	≥65	Vancouver	7.57	-1.37	-1.77
PM ctrl Ozone	Resp HA	≥65	Windsor	1.53	0.21	2.02
PM ctrl Ozone	Resp HA	≥65	Winnipeg	5.60	-1.08	-0.21
PM ctrl Ozone	Resp mortality	All	Calgary	-5.63	-19.25	7.99
PM ctrl Ozone	Resp mortality	All	Edmonton	4.82	-7.06	16.69
PM ctrl Ozone	Resp mortality	All	Halifax	4.53	-17.78	26.83
PM ctrl Ozone	Resp mortality	All	Hamilton	0.56	-11.67	12.79
PM ctrl Ozone	Resp mortality	All	Montreal	1.02	-2.50	4.53
PM ctrl Ozone	Resp mortality	All	Ottawa	4.25	-5.64	14.14
PM ctrl Ozone	Resp mortality	All	Quebec City	-9.26	-20.87	2.36
PM ctrl Ozone	Resp mortality	All	St Johns	-0.37	-25.46	24.72
PM ctrl Ozone	Resp mortality	All	Toronto	0.06	-3.43	3.54
PM ctrl Ozone	Resp mortality	All	Vancouver	2.08	-4.86	9.02
PM ctrl Ozone	Resp mortality	All	Windsor			
PM ctrl Ozone	Resp mortality	All	Winnipeg	-14.94	-29.75	-0.13
PM ctrl Ozone	Resp mortality	≥75	Calgary	-6.34	-23.50	10.81
PM ctrl Ozone	Resp mortality	≥75	Edmonton	2.28	-13.55	18.12
PM ctrl Ozone	Resp mortality	≥75	Halifax			
PM ctrl Ozone	Resp mortality	≥75	Hamilton	3.14	-12.22	18.50
PM ctrl Ozone	Resp mortality	≥75	Montreal	0.13	-4.33	4.58
PM ctrl Ozone	Resp mortality	≥75	Ottawa	10.53	-2.28	23.34
PM ctrl Ozone	Resp mortality	≥75	Quebec City	-10.95	-25.47	3.57
PM ctrl Ozone	Resp mortality	≥75	St Johns			
PM ctrl Ozone	Resp mortality	≥75	Toronto	1.55	-2.65	5.75
PM ctrl Ozone	Resp mortality	≥75	Vancouver	3.17	-5.13	11.47
PM ctrl Ozone	Resp mortality	≥75	Windsor			
PM ctrl Ozone	Resp mortality	≥75	Winnipeg	-14.23	-31.61	3.15

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI	
					Lower	*Upper*
PM ctrl Ozone	Resp mortality	<75	Calgary	-8.48	-32.35	15.39
PM ctrl Ozone	Resp mortality	<75	Edmonton			
PM ctrl Ozone	Resp mortality	<75	Halifax			
PM ctrl Ozone	Resp mortality	<75	Hamilton	-2.20	-22.99	18.60
PM ctrl Ozone	Resp mortality	<75	Montreal	2.38	-3.35	8.11
PM ctrl Ozone	Resp mortality	<75	Ottawa			
PM ctrl Ozone	Resp mortality	<75	Quebec City			
PM ctrl Ozone	Resp mortality	<75	St Johns			
PM ctrl Ozone	Resp mortality	<75	Toronto	-3.41	-9.69	2.87
PM ctrl Ozone	Resp mortality	<75	Vancouver	-0.25	-12.92	12.41
PM ctrl Ozone	Resp mortality	<75	Windsor			
PM ctrl Ozone	Resp mortality	<75	Winnipeg			
Ozone ctrl PM	All mortality	All	Calgary	0.17	-3.28	3.62
Ozone ctrl PM	All mortality	All	Edmonton	-0.19	-3.25	2.87
Ozone ctrl PM	All mortality	All	Halifax	2.09	-2.25	6.43
Ozone ctrl PM	All mortality	All	Hamilton	1.29	-1.82	4.39
Ozone ctrl PM	All mortality	All	Montreal	0.78	-0.27	1.82
Ozone ctrl PM	All mortality	All	Ottawa	-0.61	-3.01	1.78
Ozone ctrl PM	All mortality	All	Quebec City	0.17	-2.57	2.90
Ozone ctrl PM	All mortality	All	St Johns	2.68	-1.90	7.27
Ozone ctrl PM	All mortality	All	Toronto	0.40	-0.43	1.24
Ozone ctrl PM	All mortality	All	Vancouver	0.10	-1.46	1.67
Ozone ctrl PM	All mortality	All	Windsor	1.71	-0.69	4.12
Ozone ctrl PM	All mortality	All	Winnipeg	0.61	-2.43	3.66
Ozone ctrl PM	All mortality	≥75	Calgary	-1.62	-6.64	3.41
Ozone ctrl PM	All mortality	≥75	Edmonton	0.50	-4.05	5.06
Ozone ctrl PM	All mortality	≥75	Halifax	0.88	-5.82	7.58
Ozone ctrl PM	All mortality	≥75	Hamilton	1.89	-2.67	6.44
Ozone ctrl PM	All mortality	≥75	Montreal	0.43	-1.08	1.94
Ozone ctrl PM	All mortality	≥75	Ottawa	-1.14	-4.69	2.41
Ozone ctrl PM	All mortality	≥75	Quebec City	-1.58	-5.50	2.34
Ozone ctrl PM	All mortality	≥75	St Johns	0.20	-6.31	6.72
Ozone ctrl PM	All mortality	≥75	Toronto	-0.27	-1.45	0.90
Ozone ctrl PM	All mortality	≥75	Vancouver	-1.41	-3.56	0.75
Ozone ctrl PM	All mortality	≥75	Windsor	2.18	-1.18	5.54
Ozone ctrl PM	All mortality	≥75	Winnipeg	-1.55	-5.79	2.68
Ozone ctrl PM	All mortality	<75	Calgary	1.77	-2.97	6.52
Ozone ctrl PM	All mortality	<75	Edmonton	-0.77	-4.91	3.38
Ozone ctrl PM	All mortality	<75	Halifax	3.02	-2.68	8.72
Ozone ctrl PM	All mortality	<75	Hamilton	0.82	-3.43	5.07
Ozone ctrl PM	All mortality	<75	Montreal	1.12	-0.33	2.57
Ozone ctrl PM	All mortality	<75	Ottawa	-0.05	-3.30	3.20
Ozone ctrl PM	All mortality	<75	Quebec City	1.79	-2.03	5.61
Ozone ctrl PM	All mortality	<75	St Johns	5.32	-1.13	11.77
Ozone ctrl PM	All mortality	<75	Toronto	1.11	-0.08	2.30
Ozone ctrl PM	All mortality	<75	Vancouver	1.86	-0.42	4.15
Ozone ctrl PM	All mortality	<75	Windsor	1.24	-2.21	4.69
Ozone ctrl PM	All mortality	<75	Winnipeg	3.00	-1.38	7.38

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI	
					Lower	Upper
Ozone ctrl PM	CVD HA	All	Calgary	0.29	-3.42	3.99
Ozone ctrl PM	CVD HA	All	Edmonton	0.20	-3.86	4.25
Ozone ctrl PM	CVD HA	All	Halifax	4.92	0.02	9.82
Ozone ctrl PM	CVD HA	All	Hamilton	-0.35	-2.90	2.19
Ozone ctrl PM	CVD HA	All	Montreal	-0.23	-1.40	0.93
Ozone ctrl PM	CVD HA	All	Ottawa	1.43	-1.72	4.58
Ozone ctrl PM	CVD HA	All	Quebec City	0.25	-2.74	3.25
Ozone ctrl PM	CVD HA	All	St Johns	0.19	-2.77	3.15
Ozone ctrl PM	CVD HA	All	Toronto	0.27	-0.50	1.04
Ozone ctrl PM	CVD HA	All	Vancouver	-0.62	-2.41	1.17
Ozone ctrl PM	CVD HA	All	Windsor	0.63	-1.64	2.90
Ozone ctrl PM	CVD HA	All	Winnipeg	0.31	-4.07	4.68
Ozone ctrl PM	CVD HA	≥65	Calgary	-2.18	-6.88	2.53
Ozone ctrl PM	CVD HA	≥65	Edmonton	-1.10	-6.08	3.87
Ozone ctrl PM	CVD HA	≥65	Halifax	4.82	-1.33	10.96
Ozone ctrl PM	CVD HA	≥65	Hamilton	-0.40	-3.47	2.68
Ozone ctrl PM	CVD HA	≥65	Montreal	0.15	-1.35	1.66
Ozone ctrl PM	CVD HA	≥65	Ottawa	2.23	-1.68	6.14
Ozone ctrl PM	CVD HA	≥65	Quebec City	2.60	-1.40	6.60
Ozone ctrl PM	CVD HA	≥65	St Johns	0.82	-2.79	4.42
Ozone ctrl PM	CVD HA	≥65	Toronto	0.31	-0.60	1.23
Ozone ctrl PM	CVD HA	≥65	Vancouver	-0.50	-2.64	1.65
Ozone ctrl PM	CVD HA	≥65	Windsor	1.42	-1.30	4.14
Ozone ctrl PM	CVD HA	≥65	Winnipeg	0.18	-4.93	5.28
Ozone ctrl PM	CVD mortality	All	Calgary	-0.88	0.29	4.58
Ozone ctrl PM	CVD mortality	All	Edmonton	0.62	0.31	2.07
Ozone ctrl PM	CVD mortality	All	Halifax	5.36	-0.67	2.73
Ozone ctrl PM	CVD mortality	All	Hamilton	0.20	-1.49	5.70
Ozone ctrl PM	CVD mortality	All	Montreal	1.03	-0.84	5.10
Ozone ctrl PM	CVD mortality	All	Ottawa	-0.53	0.40	2.61
Ozone ctrl PM	CVD mortality	All	Quebec City	0.49	-1.06	3.42
Ozone ctrl PM	CVD mortality	All	St Johns	0.02	-1.17	7.86
Ozone ctrl PM	CVD mortality	All	Toronto	-0.18	-0.30	5.88
Ozone ctrl PM	CVD mortality	All	Vancouver	-0.58	-0.81	2.08
Ozone ctrl PM	CVD mortality	All	Windsor	2.11	-1.74	3.46
Ozone ctrl PM	CVD mortality	All	Winnipeg	-0.07	-5.91	6.05
Ozone ctrl PM	CVD mortality	≥75	Calgary	-0.05	-0.65	5.63
Ozone ctrl PM	CVD mortality	≥75	Edmonton	0.27	-0.85	1.49
Ozone ctrl PM	CVD mortality	≥75	Halifax	-2.76	-4.75	4.45
Ozone ctrl PM	CVD mortality	≥75	Hamilton	1.82	-5.99	6.35
Ozone ctrl PM	CVD mortality	≥75	Montreal	1.18	1.12	9.78
Ozone ctrl PM	CVD mortality	≥75	Ottawa	-0.62	-1.17	1.82
Ozone ctrl PM	CVD mortality	≥75	Quebec City	-0.45	-4.90	7.11
Ozone ctrl PM	CVD mortality	≥75	St Johns		-5.15	10.40
Ozone ctrl PM	CVD mortality	≥75	Toronto	-0.32	-5.28	3.83
Ozone ctrl PM	CVD mortality	≥75	Vancouver	-0.49	-1.59	2.18
Ozone ctrl PM	CVD mortality	≥75	Windsor	3.35	-8.99	5.32
Ozone ctrl PM	CVD mortality	≥75	Winnipeg	-1.40	-14.29	6.12

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI Lower	95% CI Upper
Ozone ctrl PM	CVD mortality	<75	Calgary	-2.07	-2.25	5.35
Ozone ctrl PM	CVD mortality	<75	Edmonton	1.09	-1.04	1.73
Ozone ctrl PM	CVD mortality	<75	Halifax		-4.26	3.20
Ozone ctrl PM	CVD mortality	<75	Hamilton	-1.60	-4.82	4.67
Ozone ctrl PM	CVD mortality	<75	Montreal	0.86	-3.59	6.87
Ozone ctrl PM	CVD mortality	<75	Ottawa	-0.23	-2.15	1.45
Ozone ctrl PM	CVD mortality	<75	Quebec City	2.09	-5.63	4.38
Ozone ctrl PM	CVD mortality	<75	St Johns		-7.49	4.70
Ozone ctrl PM	CVD mortality	<75	Toronto	0.07	-3.93	7.16
Ozone ctrl PM	CVD mortality	<75	Vancouver	-0.57	-0.81	3.51
Ozone ctrl PM	CVD mortality	<75	Windsor	0.07	-5.84	5.39
Ozone ctrl PM	CVD mortality	<75	Winnipeg	2.24	-5.37	9.85
Ozone ctrl PM	Resp HA	All	Calgary	0.01	-6.18	-5.09
Ozone ctrl PM	Resp HA	All	Edmonton	-0.50	-9.51	-11.31
Ozone ctrl PM	Resp HA	All	Halifax	-1.13	-19.22	-26.71
Ozone ctrl PM	Resp HA	All	Hamilton	0.01	-3.89	-2.49
Ozone ctrl PM	Resp HA	All	Montreal	1.14	-2.37	-2.32
Ozone ctrl PM	Resp HA	All	Ottawa	-0.87	-7.83	-9.21
Ozone ctrl PM	Resp HA	All	Quebec City	-0.25	-7.45	-7.84
Ozone ctrl PM	Resp HA	All	St Johns	-2.17	-7.37	-9.07
Ozone ctrl PM	Resp HA	All	Toronto	1.46	-0.61	0.32
Ozone ctrl PM	Resp HA	All	Vancouver	0.64	-3.70	-3.90
Ozone ctrl PM	Resp HA	All	Windsor	0.37	-1.39	2.07
Ozone ctrl PM	Resp HA	All	Winnipeg	2.02	-3.27	1.27
Ozone ctrl PM	Resp HA	≥65	Calgary	1.08	-5.02	-4.95
Ozone ctrl PM	Resp HA	≥65	Edmonton	-1.80	-15.37	-19.00
Ozone ctrl PM	Resp HA	≥65	Halifax	-7.49	0.10	4.43
Ozone ctrl PM	Resp HA	≥65	Hamilton	1.39	-0.08	1.51
Ozone ctrl PM	Resp HA	≥65	Montreal	0.05	-4.89	-4.56
Ozone ctrl PM	Resp HA	≥65	Ottawa	-1.38	-2.90	-0.58
Ozone ctrl PM	Resp HA	≥65	Quebec City	-0.40	-8.31	-10.85
Ozone ctrl PM	Resp HA	≥65	St Johns	-1.70	-0.50	0.32
Ozone ctrl PM	Resp HA	≥65	Toronto	0.94	-0.44	3.75
Ozone ctrl PM	Resp HA	≥65	Vancouver	-0.20	-2.16	-0.05
Ozone ctrl PM	Resp HA	≥65	Windsor	3.45	-8.17	-7.66
Ozone ctrl PM	Resp HA	≥65	Winnipeg	4.54		
Ozone ctrl PM	Resp mortality	All	Calgary	-4.53	-16.04	6.98
Ozone ctrl PM	Resp mortality	All	Edmonton	13.65	3.17	24.13
Ozone ctrl PM	Resp mortality	All	Halifax	1.76	-12.35	15.87
Ozone ctrl PM	Resp mortality	All	Hamilton	1.73	-8.89	12.36
Ozone ctrl PM	Resp mortality	All	Montreal	-2.37	-6.05	1.32
Ozone ctrl PM	Resp mortality	All	Ottawa	-0.82	-9.31	7.68
Ozone ctrl PM	Resp mortality	All	Quebec City	1.64	-8.07	11.35
Ozone ctrl PM	Resp mortality	All	St Johns	2.74	-11.82	17.31
Ozone ctrl PM	Resp mortality	All	Toronto	0.31	-2.64	3.25
Ozone ctrl PM	Resp mortality	All	Vancouver	4.93	-0.05	9.91
Ozone ctrl PM	Resp mortality	All	Windsor			
Ozone ctrl PM	Resp mortality	All	Winnipeg	6.63	-3.94	17.19

Table C-3. City specific percent change in mortality/hospital admissions in two pollutant models for a lag period of 1-day and 8 degrees of freedom for seasonality control. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$.

Pollutant	Outcome	Age group	City	Effect (%)	95% CI Lower	95% CI Upper
Ozone ctrl PM	Resp mortality	≥75	Calgary	-11.89	-26.48	2.70
Ozone ctrl PM	Resp mortality	≥75	Edmonton	10.44	-3.20	24.08
Ozone ctrl PM	Resp mortality	≥75	Halifax			
Ozone ctrl PM	Resp mortality	≥75	Hamilton	1.16	-12.13	14.45
Ozone ctrl PM	Resp mortality	≥75	Montreal	-2.70	-7.31	1.91
Ozone ctrl PM	Resp mortality	≥75	Ottawa	6.88	-4.32	18.07
Ozone ctrl PM	Resp mortality	≥75	Quebec City	5.50	-6.53	17.53
Ozone ctrl PM	Resp mortality	≥75	St Johns			
Ozone ctrl PM	Resp mortality	≥75	Toronto	-0.99	-4.54	2.55
Ozone ctrl PM	Resp mortality	≥75	Vancouver	3.99	-1.90	9.88
Ozone ctrl PM	Resp mortality	≥75	Windsor			
Ozone ctrl PM	Resp mortality	≥75	Winnipeg	0.99	-12.18	14.16
Ozone ctrl PM	Resp mortality	<75	Calgary	7.44	-11.47	26.35
Ozone ctrl PM	Resp mortality	<75	Edmonton			
Ozone ctrl PM	Resp mortality	<75	Halifax			
Ozone ctrl PM	Resp mortality	<75	Hamilton	4.70	-13.76	23.16
Ozone ctrl PM	Resp mortality	<75	Montreal	-1.66	-7.80	4.48
Ozone ctrl PM	Resp mortality	<75	Ottawa			
Ozone ctrl PM	Resp mortality	<75	Quebec City			
Ozone ctrl PM	Resp mortality	<75	St Johns			
Ozone ctrl PM	Resp mortality	<75	Toronto	3.46	-1.85	8.78
Ozone ctrl PM	Resp mortality	<75	Vancouver	7.13	-2.19	16.45
Ozone ctrl PM	Resp mortality	<75	Windsor			
Ozone ctrl PM	Resp mortality	<75	Winnipeg			

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI Lower	95% CI Upper	Effect	95% CI Lower	95% CI Upper
All mortality	All	0	4	0.68	0.50	0.86	0.69	0.50	0.89
All mortality	All	0	8	0.62	0.43	0.80	0.62	0.43	0.80
All mortality	All	0	12	0.57	0.38	0.76	0.57	0.38	0.76
All mortality	All	1	1	0.75	0.62	0.90	0.76	0.45	1.06
All mortality	All	1	2	1.36	1.22	1.52	1.33	1.07	1.58
All mortality	All	1	3	0.69	0.51	0.86	0.69	0.51	0.86
All mortality	All	1	4	0.67	0.49	0.85	0.67	0.47	0.86
All mortality	All	1	5	0.60	0.42	0.78	0.60	0.40	0.81
All mortality	All	1	6	0.67	0.49	0.85	0.67	0.45	0.89
All mortality	All	1	7	0.61	0.43	0.80	0.62	0.42	0.81
All mortality	All	1	8	0.64	0.45	0.82	0.64	0.45	0.82
All mortality	All	1	9	0.62	0.42	0.79	0.61	0.40	0.81
All mortality	All	1	10	0.61	0.42	0.79	0.61	0.42	0.80
All mortality	All	1	11	0.59	0.40	0.78	0.59	0.39	0.79
All mortality	All	1	12	0.60	0.41	0.79	0.60	0.39	0.81
All mortality	All	1	13	0.59	0.40	0.77	0.59	0.38	0.79
All mortality	All	1	14	0.58	0.39	0.77	0.59	0.37	0.81
All mortality	All	1	15	0.60	0.41	0.79	0.61	0.37	0.83
All mortality	All	1	16	0.57	0.38	0.76	0.58	0.36	0.79
All mortality	All	1	17	0.57	0.38	0.76	0.57	0.37	0.77
All mortality	All	1	18	0.54	0.35	0.74	0.55	0.34	0.76
All mortality	All	1	19	0.58	0.38	0.77	0.58	0.37	0.79
All mortality	All	1	20	0.55	0.35	0.74	0.55	0.35	0.75
All mortality	All	2	4	0.45	0.27	0.62	0.45	0.27	0.62
All mortality	All	2	8	0.45	0.26	0.63	0.45	0.26	0.63
All mortality	All	2	12	0.41	0.23	0.61	0.41	0.23	0.61
All mortality	All	01	4	1.01	0.79	1.22	1.01	0.75	1.26
All mortality	All	01	8	0.93	0.72	1.15	0.93	0.72	1.15
All mortality	All	01	12	0.88	0.65	1.11	0.89	0.64	1.14
All mortality	All	02	4	1.19	0.95	1.43	1.18	0.92	1.43
All mortality	All	02	8	1.12	0.87	1.38	1.12	0.87	1.38
All mortality	All	02	12	1.07	0.81	1.34	1.07	0.81	1.34
All mortality	All	dist02	4	1.09	0.84	1.34	1.09	0.84	1.34
All mortality	All	dist02	8	1.03	0.76	1.29	1.03	0.76	1.29
All mortality	All	dist02	12	0.97	0.7	1.25	0.97	0.7	1.25
All mortality	≥75	1	4	0.69	0.43	0.95	0.69	0.43	0.95
All mortality	≥75	1	8	0.69	0.42	0.96	0.69	0.41	0.97
All mortality	≥75	1	12	0.62	0.34	0.89	0.61	0.27	0.96
All mortality	≥75	02	4	1.30	0.94	1.65	1.30	0.94	1.65
All mortality	≥75	02	8	1.25	0.87	1.62	1.25	0.87	1.62
All mortality	≥75	02	12	1.14	0.75	1.53	1.14	0.75	1.53
All mortality	≥75	dist02	4	1.31	0.91	1.71	1.31	0.91	1.71
All mortality	≥75	dist02	8	1.05	0.65	1.45	1.05	0.65	1.45
All mortality	≥75	dist02	12	0.99	0.63	1.35	0.99	0.63	1.35
All mortality	<75	1	4	-0.08	-0.33	0.16	0.03	-0.37	0.43
All mortality	<75	1	8	0.59	0.33	0.84	0.59	0.33	0.84
All mortality	<75	1	12	0.57	0.32	0.83	0.57	0.32	0.83
All mortality	<75	02	4	-0.19	-0.52	0.14	-0.04	-0.53	0.45

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
All mortality	<75	02	8	1.10	0.66	1.36	1.10	0.66	1.36
All mortality	<75	02	12	1.12	0.65	1.38	1.12	0.65	1.38
All mortality	<75	dist02	4	1.17	0.78	1.56	1.17	0.78	1.56
All mortality	<75	dist02	8	0.94	0.58	1.31	0.92	0.34	1.49
All mortality	<75	dist02	12	0.82	0.49	1.16	0.82	0.49	1.16
CVD mortality	All	0	4	0.70	0.43	0.98	0.72	0.37	1.07
CVD mortality	All	0	8	0.56	0.28	0.85	0.59	0.24	0.94
CVD mortality	All	0	12	0.48	0.19	0.77	0.51	0.16	0.85
CVD mortality	All	1	4	0.68	0.40	0.95	0.68	0.40	0.95
CVD mortality	All	1	8	0.56	0.27	0.84	0.56	0.27	0.84
CVD mortality	All	1	12	0.48	0.19	0.78	0.48	0.19	0.78
CVD mortality	All	2	4	0.79	0.51	1.06	0.72	0.38	1.05
CVD mortality	All	2	8	0.72	0.42	0.98	0.66	0.34	0.97
CVD mortality	All	2	12	0.71	0.42	1.00	0.64	0.28	1.01
CVD mortality	All	01	4	1.10	0.68	1.35	1.11	0.66	1.37
CVD mortality	All	01	8	0.82	0.47	1.17	0.82	0.47	1.17
CVD mortality	All	01	12	0.71	0.36	1.07	0.71	0.36	1.07
CVD mortality	All	02	4	1.42	1.05	1.80	1.42	1.03	1.80
CVD mortality	All	02	8	1.25	0.85	1.65	1.25	0.85	1.65
CVD mortality	All	02	12	1.14	0.73	1.55	1.14	0.73	1.55
CVD mortality	All	dist02	4	1.36	0.97	1.75	1.33	0.88	1.78
CVD mortality	All	dist02	8	1.19	0.78	1.61	1.19	0.78	1.61
CVD mortality	All	dist02	12	1.08	0.66	1.51	1.08	0.66	1.51
CVD mortality	All	1	1	0.74	0.51	0.97	0.71	0.34	1.08
CVD mortality	All	1	2	1.47	1.22	1.72	1.39	1.21	1.76
CVD mortality	All	1	3	0.64	0.37	0.91	0.64	0.37	0.91
CVD mortality	All	1	5	0.50	0.22	0.78	0.50	0.22	0.78
CVD mortality	All	1	6	0.58	0.30	0.87	0.58	0.30	0.87
CVD mortality	All	1	7	0.52	0.23	0.80	0.52	0.23	0.80
CVD mortality	All	1	9	0.52	0.23	0.81	0.52	0.23	0.81
CVD mortality	All	1	10	0.51	0.22	0.80	0.51	0.22	0.80
CVD mortality	All	1	11	0.51	0.22	0.82	0.51	0.22	0.82
CVD mortality	All	1	13	0.48	0.19	0.77	0.48	0.19	0.77
CVD mortality	All	1	14	0.47	0.18	0.77	0.47	0.18	0.77
CVD mortality	All	1	15	0.48	0.16	0.79	0.48	0.16	0.79
CVD mortality	All	1	16	0.43	0.14	0.73	0.43	0.14	0.73
CVD mortality	All	1	17	0.44	0.15	0.74	0.44	0.15	0.74
CVD mortality	All	1	18	0.41	0.11	0.71	0.41	0.11	0.71
CVD mortality	All	1	19	0.44	0.14	0.74	0.44	0.14	0.74
CVD mortality	All	1	20	0.41	0.11	0.71	0.41	0.11	0.71
CVD mortality	≥75	1	4	0.94	0.57	1.30	0.87	0.41	1.32
CVD mortality	≥75	1	8	0.93	0.55	1.31	0.91	0.51	1.32
CVD mortality	≥75	1	12	0.87	0.48	1.26	0.83	0.38	1.28
CVD mortality	≥75	02	4	1.64	1.14	2.13	1.59	1.05	2.13
CVD mortality	≥75	02	8	1.62	1.09	2.15	1.62	1.09	2.15
CVD mortality	≥75	02	12	1.54	0.99	2.09	1.54	0.99	2.09
CVD mortality	≥75	dist02	4	1.64	1.07	2.2	1.64	1.07	2.2
CVD mortality	≥75	dist02	8	1.39	0.83	1.95	1.25	0.55	1.95

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
CVD mortality	≥75	dist02	12	1.27	0.76	1.79	1.27	0.76	1.79
CVD mortality	<75	1	4	0.34	-0.08	0.76	0.34	-0.08	0.76
CVD mortality	<75	1	8	0.07	-0.36	0.51	0.07	-0.36	0.51
CVD mortality	<75	1	12	-0.11	-0.46	0.42	-0.11	-0.46	0.42
CVD mortality	<75	02	4	1.15	0.58	1.72	1.18	0.54	1.83
CVD mortality	<75	02	8	0.76	0.16	1.37	0.85	0.12	1.58
CVD mortality	<75	02	12	0.61	-0.10	1.24	0.66	-0.03	1.35
CVD mortality	<75	dist02	4	0.89	0.23	1.56	0.89	0.23	1.56
CVD mortality	<75	dist02	8	0.62	0	1.25	0.62	0	1.25
CVD mortality	<75	dist02	12	1.26	0.68	1.84	1.73	0.78	2.69
Resp mortality	All	0	4	0.10	-0.62	0.64	0.03	-0.63	0.69
Resp mortality	All	0	8	0.49	-0.16	1.15	0.49	-0.16	1.15
Resp mortality	All	0	12	0.37	-0.29	1.04	0.46	-0.28	1.20
Resp mortality	All	1	4	0.37	-0.26	1.00	0.27	-0.51	1.05
Resp mortality	All	1	8	0.86	0.21	1.51	0.83	0.11	1.56
Resp mortality	All	1	12	0.78	0.11	1.44	0.75	-0.04	1.55
Resp mortality	All	2	4	0.19	-0.44	0.82	-0.01	-0.84	0.83
Resp mortality	All	2	8	0.72	0.05	1.36	0.66	-0.03	1.35
Resp mortality	All	2	12	0.65	-0.20	1.31	0.65	-0.20	1.31
Resp mortality	All	01	4	0.40	-0.35	1.15	0.38	-0.57	1.33
Resp mortality	All	01	8	1.03	0.24	1.82	1.06	0.16	1.95
Resp mortality	All	01	12	0.89	0.08	1.72	0.97	-0.06	2.01
Resp mortality	All	02	4	0.62	-0.23	1.47	0.43	-0.75	1.60
Resp mortality	All	02	8	1.34	0.44	2.25	1.29	0.23	2.35
Resp mortality	All	02	12	1.18	0.24	2.12	1.16	0.07	2.26
Resp mortality	All	dist02	4	0.69	-0.18	1.56	0.57	-0.51	1.67
Resp mortality	All	dist02	8	1.49	0.55	2.42	1.48	0.52	2.44
Resp mortality	All	dist02	12	1.36	0.39	2.33	1.37	0.35	2.39
Resp mortality	All	1	1	2.56	2.04	3.08	2.58	1.93	3.23
Resp mortality	All	1	2	3.68	3.11	4.24	3.68	3.11	4.24
Resp mortality	All	1	3	0.60	-0.11	1.21	0.60	-0.11	1.21
Resp mortality	All	1	5	0.73	0.09	1.37	0.67	-0.08	1.43
Resp mortality	All	1	6	0.94	0.29	1.59	0.89	0.15	1.64
Resp mortality	All	1	7	0.85	0.21	1.50	0.82	0.11	1.54
Resp mortality	All	1	9	0.75	0.10	1.41	0.74	-0.11	1.49
Resp mortality	All	1	10	0.76	0.10	1.42	0.72	-0.06	1.50
Resp mortality	All	1	11	0.74	0.08	1.42	0.70	-0.13	1.53
Resp mortality	All	1	13	0.77	0.10	1.44	0.75	-0.07	1.58
Resp mortality	All	1	14	0.72	0.05	1.39	0.70	-0.12	1.52
Resp mortality	All	1	15	0.77	0.09	1.44	0.73	-0.14	1.61
Resp mortality	All	1	16	0.71	0.04	1.39	0.68	-0.19	1.55
Resp mortality	All	1	17	0.72	0.04	1.40	0.71	-0.14	1.56
Resp mortality	All	1	18	0.74	0.06	1.42	0.73	-0.11	1.57
Resp mortality	All	1	19	0.71	0.20	1.39	0.70	-0.16	1.56
Resp mortality	All	1	20	0.63	-0.06	1.32	0.63	-0.20	1.45
Resp mortality	≥75	1	4	0.35	-0.45	1.15	0.34	-0.51	1.20
Resp mortality	≥75	1	8	0.79	-0.04	1.62	0.79	-0.04	1.62
Resp mortality	≥75	1	12	0.61	-0.24	1.45	0.61	-0.28	1.50

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
Resp mortality	≥75	02	4	0.33	-0.75	1.41	0.23	-1.10	1.55
Resp mortality	≥75	02	8	0.86	-0.29	2.01	0.86	-0.29	2.01
Resp mortality	≥75	02	12	0.46	-0.74	1.65	0.43	-0.86	1.73
Resp mortality	≥75	dist02	4	0.24	-0.92	1.4	-0.01	-1.38	1.34
Resp mortality	≥75	dist02	8	1.58	0.32	2.83	1.58	0.32	2.83
Resp mortality	≥75	dist02	12	-0.16	-1.27	0.94	-0.16	-1.27	0.94
Resp mortality	<75	1	4	0.41	-0.62	1.43	0.19	-1.10	1.49
Resp mortality	<75	1	8	0.98	-0.08	2.04	0.94	-0.19	2.06
Resp mortality	<75	1	12	1.03	-0.05	2.12	1.03	-0.05	2.12
Resp mortality	<75	02	4	1.13	-0.26	2.51	1.10	-0.57	2.59
Resp mortality	<75	02	8	2.14	0.67	3.62	2.14	0.67	3.62
Resp mortality	<75	02	12	2.32	0.79	3.85	2.32	0.79	3.85
Resp mortality	<75	dist02	4	2.56	0.99	4.13	2.56	0.7	4.43
Resp mortality	<75	dist02	8	2.46	0.94	3.98	2.46	0.94	3.98
Resp mortality	<75	dist02	12	1.76	0.31	3.2	1.76	0.31	3.2
CVD HA	All	0	4	0.14	-0.12	0.39	0.14	-0.12	0.39
CVD HA	All	0	8	-0.15	-0.41	0.11	-0.15	-0.41	0.11
CVD HA	All	0	12	-0.12	-0.38	0.15	-0.12	-0.38	0.15
CVD HA	All	1	1	0.68	0.47	0.88	0.70	0.45	0.95
CVD HA	All	1	2	0.90	0.68	1.12	0.92	0.66	1.18
CVD HA	All	1	3	0.31	0.07	0.56	0.31	0.06	0.57
CVD HA	All	1	4	0.25	-0.02	0.50	0.29	-0.03	0.61
CVD HA	All	1	5	0.04	-0.22	0.29	0.09	-0.27	0.45
CVD HA	All	1	6	0.10	-0.25	0.27	0.05	-0.31	0.41
CVD HA	All	1	7	-0.20	-0.29	0.24	0.20	-0.34	0.38
CVD HA	All	1	8	-0.04	-0.30	0.22	0.01	-0.36	0.38
CVD HA	All	1	9	-0.01	-0.27	0.26	0.04	-0.32	0.39
CVD HA	All	1	10	0.10	-0.25	0.28	0.05	-0.30	0.40
CVD HA	All	1	11	-0.01	-0.27	0.26	0.03	-0.33	0.40
CVD HA	All	1	12	0.01	-0.26	0.27	0.05	-0.32	0.43
CVD HA	All	1	13	-0.01	-0.27	0.26	0.03	-0.34	0.40
CVD HA	All	1	14	0.03	-0.24	0.30	0.07	-0.32	0.47
CVD HA	All	1	15	0.10	-0.26	0.28	0.05	-0.34	0.45
CVD HA	All	1	16	0.11	-0.25	0.29	0.05	-0.32	0.43
CVD HA	All	1	17	-0.11	-0.29	0.25	0.11	-0.37	0.40
CVD HA	All	1	18	0.00	-0.27	0.28	0.04	-0.35	0.44
CVD HA	All	1	19	0.01	-0.27	0.27	0.03	-0.37	0.43
CVD HA	All	1	20	-0.11	-0.29	0.26	0.20	-0.38	0.43
CVD HA	All	2	4	0.24	-0.10	0.49	0.24	-0.10	0.49
CVD HA	All	2	8	-0.06	-0.33	0.20	-0.06	-0.33	0.20
CVD HA	All	2	12	-0.11	-0.28	0.25	-0.11	-0.28	0.25
CVD HA	All	01	4	0.26	-0.04	0.56	0.26	-0.04	0.56
CVD HA	All	01	8	-0.13	-0.44	0.19	-0.13	-0.45	0.19
CVD HA	All	01	12	-0.07	-0.40	0.25	-0.07	-0.40	0.25
CVD HA	All	02	4	0.31	-0.03	0.65	0.31	-0.03	0.66
CVD HA	All	02	8	-0.16	-0.52	0.21	-0.16	-0.52	0.21
CVD HA	All	02	12	-0.08	-0.46	0.30	-0.08	-0.46	0.30
CVD HA	All	dist02	4	0.3	-0.05	0.66	0.3	-0.05	0.66

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	Upper		Lower	Upper
CVD HA	All	dist02	8	-0.16	-0.54	0.2	-0.16	-0.54	0.2
CVD HA	All	dist02	12	-0.09	-0.48	0.29	-0.09	-0.48	0.29
CVD HA	≥65	1	4	0.19	-0.12	0.50	0.24	-0.14	0.61
CVD HA	≥65	1	8	-0.13	-0.45	0.19	-0.08	-0.48	0.31
CVD HA	≥65	1	12	-0.06	-0.39	0.26	-0.11	-0.43	0.40
CVD HA	≥65	02	4	0.22	-0.20	0.64	0.22	-0.20	0.64
CVD HA	≥65	02	8	-0.29	-0.74	0.15	-0.29	-0.74	0.15
CVD HA	≥65	02	12	-0.19	-0.65	0.27	-0.19	-0.65	0.27
CVD HA	≥65	dist02	4	-0.06	-0.51	0.39	-0.06	-0.51	0.39
CVD HA	≥65	dist02	8	-0.43	-0.93	0.05	-0.43	-0.93	0.05
CVD HA	≥65	dist02	12	0.03	-0.39	0.46	0.25	-0.3	0.81
Resp HA	All	0	4	-0.07	-0.41	0.28	-0.24	-0.74	0.25
Resp HA	All	0	8	-0.01	-0.36	0.35	-0.01	-0.36	0.35
Resp HA	All	0	12	-0.17	-0.53	0.20	-0.17	-0.53	0.20
Resp HA	All	1	1	1.04	0.76	1.31	1.59	0.73	2.46
Resp HA	All	1	2	4.21	3.90	4.51	4.28	3.60	4.96
Resp HA	All	1	3	1.57	1.23	1.91	1.46	1.11	1.92
Resp HA	All	1	4	0.52	0.16	0.85	0.29	-0.38	0.96
Resp HA	All	1	5	0.65	0.30	1.00	0.45	-0.18	1.09
Resp HA	All	1	6	0.81	0.46	1.16	0.58	-0.20	1.19
Resp HA	All	1	7	0.46	0.10	0.81	0.34	-0.16	0.84
Resp HA	All	1	8	0.61	0.26	0.97	0.52	0.04	0.99
Resp HA	All	1	9	0.52	0.16	0.88	0.45	-0.01	0.90
Resp HA	All	1	10	0.67	0.31	1.21	0.64	0.24	1.03
Resp HA	All	1	11	0.56	0.20	0.92	0.51	0.05	0.96
Resp HA	All	1	12	0.48	0.12	0.84	0.44	0.00	0.87
Resp HA	All	1	13	0.55	0.19	0.91	0.51	0.08	0.93
Resp HA	All	1	14	0.53	0.17	0.90	0.50	0.07	0.93
Resp HA	All	1	15	0.53	0.16	0.89	0.51	0.12	0.90
Resp HA	All	1	16	0.49	0.12	0.86	0.48	0.11	0.86
Resp HA	All	1	17	0.46	0.09	0.83	0.43	0.03	0.84
Resp HA	All	1	18	0.48	0.11	0.85	0.48	0.11	0.85
Resp HA	All	1	19	0.42	0.05	0.80	0.42	0.05	0.80
Resp HA	All	1	20	0.44	0.07	0.82	0.44	0.07	0.82
Resp HA	≥65	1	4	0.26	-0.25	0.76	0.24	-0.38	0.85
Resp HA	≥65	1	8	0.61	0.09	1.13	0.61	-0.10	1.24
Resp HA	≥65	1	12	0.27	-0.26	0.81	0.31	-0.32	0.95
Resp HA	All	2	4	0.68	0.34	1.20	0.42	-0.51	1.35
Resp HA	All	2	8	0.86	0.51	1.21	0.70	0.11	1.38
Resp HA	All	2	12	0.76	0.39	1.12	0.67	0.04	1.30
Resp HA	All	01	4	0.32	-0.09	0.73	0.21	-0.74	0.80
Resp HA	All	01	8	0.46	0.21	0.89	0.32	-0.25	0.89
Resp HA	All	01	12	0.25	-0.19	0.69	0.24	-0.21	0.70
Resp HA	All	02	4	0.75	0.29	1.22	0.37	-0.78	1.53
Resp HA	All	02	8	1.03	0.54	1.53	0.80	-0.03	1.63
Resp HA	All	02	12	0.82	0.31	1.33	0.72	0.06	1.39
Resp HA	≥65	02	4	0.72	0.04	1.40	0.52	-0.66	1.70
Resp HA	≥65	02	8	1.34	0.62	2.07	1.24	0.14	2.33

Table C-4. Pooled percent change in mortality/hospital admissions associated with a 10 ppb increase in the 1-hr ozone levels for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
Resp HA	≥65	02	12	0.76	0.10	1.51	0.76	-0.20	1.73
Resp HA	All	dist02	4	0.7	0.22	1.18	0.31	-0.82	1.46
Resp HA	All	dist02	8	1.03	0.52	1.54	0.8	-0.04	1.65
Resp HA	All	dist02	12	0.82	0.29	1.35	0.73	0.03	1.42
Resp HA	≥65	dist02	4	0.25	-0.48	0.98	0.37	-0.47	1.21
Resp HA	≥65	dist02	8	0.49	-0.29	1.28	-0.31	-1.68	1.05
Resp HA	≥65	dist02	12	1.42	0.73	2.12	1.42	0.73	2.12

Table C-5 . Pooled percent change in mortality/hospital admissions associated with a 10 ug/m ^{3} increase in $PM_{2.5}$, combined for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI *Lower*	95% CI *Upper*	Effect	95% CI *Lower*	95% CI *Upper*
All mortality	All	0	4	0.41	-0.16	0.98	0.41	-0.16	0.98
All mortality	All	0	8	0.35	-0.23	0.94	0.35	-0.23	0.94
All mortality	All	0	12	0.27	-0.34	0.87	0.27	-0.34	0.87
All mortality	All	1	4	1.53	0.97	2.09	1.53	0.97	2.09
All mortality	All	1	8	1.43	0.84	2.10	1.43	0.84	2.10
All mortality	All	1	12	1.43	0.82	2.03	1.43	0.82	2.03
All mortality	All	2	4	1.01	0.44	1.57	1.01	0.44	1.57
All mortality	All	2	8	0.98	0.39	1.57	0.98	0.39	1.57
All mortality	All	2	12	0.88	0.27	1.49	0.88	0.27	1.49
All mortality	≥75	0	4	0.56	-0.25	1.37	-0.15	-2.38	2.08
All mortality	≥75	0	8	0.12	-0.72	0.96	0.12	-0.72	0.96
All mortality	≥75	0	12	-0.05	-0.92	0.82	-0.05	-0.92	0.82
All mortality	≥75	1	4	1.61	0.82	2.41	1.85	-0.25	3.96
All mortality	≥75	1	8	1.98	1.14	2.81	1.98	1.14	2.81
All mortality	≥75	1	12	1.94	1.08	2.80	1.94	1.08	2.80
All mortality	≥75	2	4	1.39	0.58	2.19	0.28	-1.58	2.15
All mortality	≥75	2	8	1.85	1.10	2.68	1.85	1.10	2.68
All mortality	≥75	2	12	1.78	0.92	2.64	1.78	0.92	2.64
All mortality	<75	0	4	0.53	-0.26	1.32	0.54	-0.32	1.39
All mortality	<75	0	8	0.57	-0.26	1.39	0.61	-0.41	1.62
All mortality	<75	0	12	0.55	-0.30	1.40	0.67	-0.49	1.84
All mortality	<75	1	4	0.92	0.13	1.71	0.92	0.13	1.71
All mortality	<75	1	8	0.91	0.08	1.73	0.91	0.08	1.73
All mortality	<75	1	12	0.93	0.08	1.78	0.93	0.08	1.78
All mortality	<75	2	4	0.12	-0.69	0.90	0.12	-0.69	0.90
All mortality	<75	2	8	0.14	-0.68	0.97	0.14	-0.68	0.97
All mortality	<75	2	12	0.20	-0.83	0.88	0.20	-0.83	0.88
CVD mortality	All	0	4	0.03	-0.88	0.94	0.08	-1.11	1.17
CVD mortality	All	0	8	-0.23	-1.18	0.72	-0.23	-1.22	0.73
CVD mortality	All	0	12	-0.43	-1.41	0.55	-0.43	-1.41	0.55
CVD mortality	All	1	4	1.12	0.22	2.20	1.11	-0.18	2.41
CVD mortality	All	1	8	1.21	0.09	1.97	1.21	0.09	1.97
CVD mortality	All	1	12	1.10	0.13	2.07	1.10	0.13	2.07
CVD mortality	All	2	4	1.64	0.74	2.54	1.64	0.74	2.54
CVD mortality	All	2	8	1.77	0.83	2.71	1.77	0.83	2.71
CVD mortality	All	2	12	1.68	0.71	2.66	1.68	0.71	2.66
CVD mortality	≥75	0	4	-0.20	-1.21	1.16	-0.11	-1.62	1.41
CVD mortality	≥75	0	8	-0.45	-1.68	0.78	-0.45	-1.68	0.78
CVD mortality	≥75	0	12	-0.75	-2.21	0.52	-0.84	-2.28	0.60
CVD mortality	≥75	1	4	2.24	1.07	3.40	2.13	0.65	3.62
CVD mortality	≥75	1	8	2.14	0.92	3.35	2.14	0.92	3.35
CVD mortality	≥75	1	12	2.11	0.86	3.37	2.11	0.86	3.37
CVD mortality	≥75	2	4	2.43	1.26	3.59	2.28	1.01	3.55
CVD mortality	≥75	2	8	2.39	1.17	3.61	2.39	1.17	3.61
CVD mortality	≥75	2	12	2.23	0.97	3.49	1.36	-0.42	3.14
CVD mortality	<75	0	4	0.15	-1.28	1.58	0.44	-1.41	2.29
CVD mortality	<75	0	8	0.11	-1.38	1.60	0.29	-1.56	2.15
CVD mortality	<75	0	12	0.03	-1.52	1.57	0.06	-1.52	1.63

Table C-5 . Pooled percent change in mortality/hospital admissions associated with a 10 ug/m [3] increase in $PM_{2.5}$, combined for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
CVD mortality	<75	1	4	-0.43	-3.68	2.82	-0.43	-3.68	2.82
CVD mortality	<75	1	8	-1.44	-4.84	1.96	-1.44	-4.84	1.96
CVD mortality	<75	1	12	-0.50	-3.62	2.59	-0.50	-3.62	2.59
CVD mortality	<75	2	4	0.53	-0.90	1.95	0.53	-0.90	1.95
CVD mortality	<75	2	8	0.88	-0.61	2.36	0.88	-0.61	2.36
CVD mortality	<75	2	12	0.89	-0.64	2.43	0.89	-0.64	2.43
Resp mortality	All	0	4	-0.51	-2.49	1.48	-1.42	-4.80	1.97
Resp mortality	All	0	8	-1.12	-3.19	0.95	-2.39	-6.28	1.50
Resp mortality	All	0	12	-0.91	-3.05	1.22	-1.60	-5.32	2.12
Resp mortality	All	1	4	0.80	-1.11	2.71	0.80	-1.11	2.71
Resp mortality	All	1	8	0.30	-1.72	2.33	0.24	-2.20	2.52
Resp mortality	All	1	12	0.33	-1.75	2.41	0.33	-1.75	2.41
Resp mortality	All	2	4	2.08	0.12	4.04	2.08	0.12	4.04
Resp mortality	All	2	8	1.31	-0.75	3.36	1.31	-0.75	3.36
Resp mortality	All	2	12	1.39	-0.73	3.50	0.89	-2.14	3.91
Resp mortality	≥75	0	4	-0.75	-3.19	1.69	-1.86	-5.79	2.06
Resp mortality	≥75	0	8	-0.95	-3.54	1.64	-1.24	-4.71	2.21
Resp mortality	≥75	0	12	-0.71	-3.39	1.97	-0.83	-4.11	2.44
Resp mortality	≥75	1	4	1.41	-0.96	3.78	1.41	-0.96	3.78
Resp mortality	≥75	1	8	0.73	-1.74	3.21	0.52	-2.83	3.87
Resp mortality	≥75	1	12	0.97	-2.42	4.35	1.08	-3.74	5.90
Resp mortality	≥75	2	4	3.84	1.40	6.28	3.67	0.53	6.82
Resp mortality	≥75	2	8	3.17	0.61	5.72	2.81	-0.59	6.21
Resp mortality	≥75	2	12	3.63	0.99	6.26	2.53	-2.46	7.53
Resp mortality	<75	0	4	-0.32	-3.94	3.31	-0.32	-3.94	3.31
Resp mortality	<75	0	8	0.04	-3.81	3.90	0.04	-3.81	3.90
Resp mortality	<75	0	12	-0.23	-4.16	3.69	-0.23	-4.16	3.69
Resp mortality	<75	1	4	-0.32	-3.61	2.96	-0.32	-3.61	2.96
Resp mortality	<75	1	8	-0.27	-3.87	3.33	-0.27	-3.87	3.33
Resp mortality	<75	1	12	-0.48	-4.30	3.33	-0.48	-4.30	3.33
Resp mortality	<75	2	4	-1.54	-4.91	1.83	-1.54	-4.91	1.83
Resp mortality	<75	2	8	-1.77	-5.54	2.00	-1.77	-5.54	2.00
Resp mortality	<75	2	12	-3.18	-7.28	0.92	-3.18	-7.28	0.92
CVD HA	All	0	4	0.76	0.18	1.35	0.76	0.18	1.35
CVD HA	All	0	8	0.63	0.13	1.13	0.63	0.13	1.13
CVD HA	All	0	12	0.69	0.05	1.32	0.69	0.05	1.32
CVD HA	All	1	4	0.57	-0.07	1.21	0.57	-0.07	1.21
CVD HA	All	1	8	0.52	-0.15	1.18	0.52	-0.15	1.18
CVD HA	All	1	12	0.52	-0.16	1.21	0.52	-0.16	1.21
CVD HA	All	2	4	0.51	-0.14	1.15	0.51	-0.14	1.15
CVD HA	All	2	8	0.48	-0.19	1.16	0.41	-0.34	1.16
CVD HA	All	2	12	0.50	-0.19	1.19	0.37	-0.49	1.23
Resp HA	All	0	4	0.76	0.00	1.53	0.77	-0.12	1.66
Resp HA	All	0	8	0.54	-0.27	1.36	0.54	-0.27	1.36
Resp HA	All	0	12	0.22	-0.62	1.06	0.30	-0.89	1.48
Resp HA	All	1	4	1.44	0.59	2.28	1.44	0.59	2.28
Resp HA	All	1	8	1.25	0.36	2.13	1.25	0.36	2.13
Resp HA	All	1	12	1.04	0.13	1.95	1.04	0.13	1.95
Resp HA	All	2	4	1.82	0.97	2.67	0.77	-1.10	2.55

Table C-5 . Pooled percent change in mortality/hospital admissions associated with a 10 ug/m^3 increase in $PM_{2.5}$, combined for various lag periods and degrees of freedom (per year for time variable) in single pollutant models.

Outcome	Age group	Lag period	df/yr (time)	Fixed effects model			Random effects model		
				Effect (%)	95% CI		Effect	95% CI	
					Lower	*Upper*		*Lower*	*Upper*
Resp HA	All	2	8	1.69	0.81	2.57	0.98	-0.51	2.45
Resp HA	All	2	12	1.38	0.47	2.29	0.74	-0.68	2.15
CVD HA	≥65	0	4	0.71	0.01	1.42	0.71	0.01	1.42
CVD HA	≥65	0	8	0.71	-0.03	1.45	0.77	-0.10	1.64
CVD HA	≥65	0	12	0.76	-0.11	1.53	0.76	-0.11	1.53
CVD HA	≥65	1	4	0.28	-0.51	1.07	0.28	-0.51	1.07
CVD HA	≥65	1	8	0.28	-0.54	1.10	0.07	-0.97	1.12
CVD HA	≥65	1	12	0.30	-0.54	1.14	0.30	-0.54	1.14
CVD HA	≥65	2	4	0.33	-0.47	1.12	0.19	-0.73	1.11
CVD HA	≥65	2	8	0.34	-0.48	1.16	0.34	-0.48	1.16
CVD HA	≥65	2	12	0.26	-0.58	1.10	0.26	-0.58	1.10
Resp HA	≥65	0	4	0.82	-0.29	1.93	0.82	-0.29	1.93
Resp HA	≥65	0	8	0.43	-0.74	1.60	0.43	-0.74	1.60
Resp HA	≥65	0	12	-0.05	-1.25	1.14	0.20	-1.48	1.53
Resp HA	≥65	1	4	1.55	0.31	2.79	1.55	0.31	2.79
Resp HA	≥65	1	8	1.43	0.14	2.73	1.68	-0.24	3.61
Resp HA	≥65	1	12	1.26	-0.07	2.59	1.64	-0.43	3.71
Resp HA	≥65	2	4	2.12	0.87	3.36	1.32	-0.65	3.29
Resp HA	≥65	2	8	1.90	0.60	3.19	1.90	0.60	3.19
Resp HA	≥65	2	12	1.68	0.35	3.01	1.68	0.35	3.01

Table C-6 . Pooled percent change in mortality/hospital admissions at a lag period of 1-day and 8 degrees of freedom (per year for time variable) in two pollutant models. Estimates are associated with a 10 ppb increase in ozone and a 10 ug/m^3 increase in $PM_{2.5}$

Pollutant	Outcome	Age group	Fixed effects model			Random effects model		
			Effect	95% CI		Effect	95% CI	
				Lower	*Upper*		*Lower*	*Upper*
Ozone ctrl PM	All mortality	All ages	0.53	0.01	1.05	0.53	0.01	1.05
Ozone ctrl PM	All mortality	≥75	-0.18	-0.91	0.56	-0.18	-0.91	0.56
Ozone ctrl PM	All mortality	<75	1.25	0.52	1.97	1.25	0.52	1.97
Ozone ctrl PM	CVD mortality	All ages	0.29	-0.54	1.13	0.29	-0.54	1.13
Ozone ctrl PM	CVD mortality	≥75	0.22	-0.87	1.31	0.22	-0.87	1.31
Ozone ctrl PM	CVD mortality	<75	0.28	-1.06	1.63	0.28	-1.06	1.63
Ozone ctrl PM	Resp mortality	All ages	0.85	-0.98	2.68	1.40	-1.11	3.91
Ozone ctrl PM	Resp mortality	≥75	0.08	-2.21	2.36	0.60	-2.40	3.60
Ozone ctrl PM	Resp mortality	<75	2.46	-1.09	6.02	2.46	-1.09	6.02
Ozone ctrl PM	Resp HA	All ages	0.87	0.14	1.59	0.87	0.14	1.59
Ozone ctrl PM	Resp HA	≥65	0.56	-0.50	1.63	0.56	-0.50	1.63
Ozone ctrl PM	CVD HA	All ages	0.17	-0.36	0.69	0.17	-0.36	0.69
Ozone ctrl PM	CVD HA	≥65	0.35	-0.29	0.98	0.35	-0.29	0.98
PM ctrl Ozone	All mortality	All ages	1.21	0.60	1.82	1.21	0.60	1.82
PM ctrl Ozone	All mortality	≥75	1.83	0.97	2.70	1.83	0.97	2.70
PM ctrl Ozone	All mortality	<75	0.60	-0.26	1.46	0.60	-0.26	1.46
PM ctrl Ozone	CVD mortality	All ages	0.87	-0.11	1.85	0.87	-0.11	1.85
PM ctrl Ozone	CVD mortality	≥75	1.98	0.71	3.24	1.98	0.71	3.24
PM ctrl Ozone	CVD mortality	<75	-0.86	-2.43	0.70	-0.86	-2.43	0.70
PM ctrl Ozone	Resp mortality	All ages	0.23	-1.86	2.32	0.23	-1.86	2.32
PM ctrl Ozone	Resp mortality	≥75	0.72	-1.89	3.33	0.63	-2.37	3.64
PM ctrl Ozone	Resp mortality	<75	-0.54	-4.42	3.35	-0.54	-4.42	3.35
PM ctrl Ozone	Resp HA	All ages	1.02	0.12	1.93	1.02	0.12	1.93
PM ctrl Ozone	Resp HA	≥65	1.34	0.01	2.67	1.52	-0.08	3.12
PM ctrl Ozone	CVD HA	All ages	0.42	-0.28	1.11	0.35	-0.45	1.15
PM ctrl Ozone	CVD HA	≥65	0.07	-0.78	0.92	-0.22	-1.35	0.90