Air pollution exposure and respiratory emergency visits among children in Edmonton

by

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Abstract

Ambient air pollution remains a significant public health concern in Alberta. Exposure to air pollution is associated with numerous adverse respiratory effects in children, especially wheezing, asthma, and bronchitis. Events such as wildfires can trigger an acute respiratory response due to the smoke produced. Over the past few years, Edmonton has experienced poor air quality days due to wildfire activities in Alberta and other provinces such as British Columbia. However, relatively little has been done to examine the health impacts of these events, particularly in vulnerable groups such as children.

In this study, air pollution data and the data of respiratory visits to emergency departments (ED) among children in Edmonton between 2016 to 2018 were collected. Time-series analysis with Poisson regression was used to explore associations between air pollution (carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), fine particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2)) levels and daily respiratory emergency visits (wheezing, asthma, and bronchitis) among children (under 17 years of age) in the Edmonton area between 2016 to 2018, a period of heightened wildfire smoke activity. Wildfire models, non-wildfire models, and yearly models were built to explore the impacts of wildfires on children's respiratory health. The differences between different sexes and ages were also examined. Multivariable logistic regression and multiple linear regression were applied to examine associations between air pollution levels and hospital admissions for respiratory conditions and length of stay (LOS) in ED (minutes) among children.

Strong evidence of positive associations between daily respiratory ED visits among children in Edmonton and exposures to NO_2 and O_3 was found. Clear differences by sex and age were observed. Male children were found to be more affected by air pollution than female children, and older children (5-16 years old) were more affected than younger children (0-4 years old).

Meanwhile, stronger associations were found in the wildfire season than in the non-wildfire season during the study period. Also, the consistency of the strongest associations, the greatest number of wildfire activities, and the strongest wildfire-related air pollution was found in 2016, the year of the Fort McMurray wildfire occurred. Additionally, hospital admissions were not associated with air pollution exposures. LOS was positively associated with exposures to NO_2 and $PM_{2.5}$.

In conclusion, this study indicates evidence of positive associations between air pollution levels (NO_2 and O_3) and increases in daily respiratory ED visits among children under 17 years old in Edmonton between 2016 to 2018. Results also indicate the adverse impacts of wildfire-related air pollution on children's respiratory health. The findings of this study are useful in terms of guiding health care providers, informing air quality advisories, and generating advice regarding children in Alberta. To protect children's health in Edmonton and in Canada, a recommendation is to conduct further health risk assessments and reduce children's exposure to air pollution. Meanwhile, further studies are needed to address knowledge gaps on the health impacts of wildfires. These include exploring more accurate and direct methods to measure health impacts of wildfire-related air pollution, examining the causes of increasing wildfires such as climate change, and investigating preventive measures to reduce wildfire hazards and maintain population health, especially in susceptible groups like children.

Preface

This thesis is an original work by Chunhui Tian, under the supervision of Drs. Shelby Yamamoto, Alvaro Osornio Vargas, and Yan Yuan. The research project, of which this thesis is a part, received ethics approval for this study from the University of Alberta (Pro00090081). No part of this thesis has been previously published.

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Chapter 1: Introduction

1.1 Air pollution and health impacts

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere[1]. Outdoor air pollution is a global problem with serious effects on human health[2]. It has been associated with various health conditions, including asthma, cardiovascular diseases, respiratory infections, adverse birth outcomes, and cancer[3]. Recent studies have also linked exposure to fine particulate matter ($PM_{2.5}$) with type 2 diabetes incidence and mortality, adverse reproductive outcomes, and neurologic effects[4]. According to the World Health Organization (WHO), ambient air pollution accounted for an estimated 4.2 million deaths per year due to stroke, heart disease, lung cancer, and chronic respiratory diseases in 2016. Around 91% of the world's population lives in places where average annual air quality levels exceed WHO limits[1]. Every day around 93% of the world's children under the age of 15 years (1.8 billion children) are at serious health risk due to polluted air. Approximately 600,000 children died from acute lower respiratory infections caused by polluted air in 2016[1].

In North America, the rapid evolution of technologies and growing demand for ground, marine, and air transportation, as well as the increasingly frequent wildfires, lead to significant increases in emissions of pollutants. The increasing frequency and intensity of wildfires has a strong association with the extreme temperature, relative humidity, and soil moisture anomalies[5]. As a result, the continuing need to focus on the human and environmental impacts of atmospheric pollutants is not waning, despite some gains. In 2018, approximately 1.6 million tonnes (Mt) of $PM_{2.5}$ were emitted in Canada. From 1990 to 2018, total particulate matter emissions have increased by 39%, and PM_{10} increase by 30%[6]. In 2018, 811 kilotons (Kt) of sulfur oxides (SO_x) were emitted[6]. Overall, however, SOx emissions decreased by 73% (2.2 Mt) between 1990 and 2018[6]. For nitrogen oxides, approximately 1.8 Mt of NO_x was released in Canada in 2018[6]. From 1990 to 2018, national nitrogen oxides (NOx) emissions also decreased by 25% (601 kt)[6].

In Alberta, strong economic activity and population growth have led to increases and projections of continual emissions increases of some air pollutants[7]. According to the report of emission trends and projections in Alberta, from 1990 to 2020, the emissions of NO_x, SO_x, and $PM_{2.5}$ increased by approximately 250 Kt tonnes, 100Kt tonnes, and 200Kt tonnes, respectively[7]. Meanwhile, the increasing wildfire activities in and near Alberta also impact the air quality significantly[8]. Across Alberta, 1376, 1244, and 1288 wildfires occurred there in 2016, 2017, and 2018, respectively[9]. In 2016, Alberta suffered one of the most devastating wildfires in its history, the Fort McMurray wildfire, burning about 590,000 hectares of areas, and destroying 2,400 buildings[10]. There were 5203, 5652, 7067 wildfires in Canada in 2016, 2017, and 2018, respectively, suggesting an upward trend[8]. Also, British Columbia, a province in which wildfires occur most frequently in Canada[11], routinely affects the air quality of Alberta as its neighboring province. Alberta is also affected by wildfires in the United States. The U.S. recorded 52,934 wildfires in 2020[12], often sending smoke to other locations, including Canada. Elevated CO, NO_2, and O_3 levels are observed when wildfires occur[13,14] Wildfire smoke was the largest contributor to $PM_{2.5}$ in the province, according to the 2015 Alberta Air Zones Report[13].

As the capital city of Alberta, Edmonton's air pollution is a matter of concern. The 2018 annual average concentration of SO_2, NO_2, O_3, CO, $PM_{2.5}$ ranged from 1.0-1.7 ppb, 7.88-16.07 ppb, 22.0-28.3 ppb, 0.2-0.3 ppb, and 5.9-11.4 $\mu g/m^3$, respectively[15]. Compared with other main Canadian cities, the annual average concentrations of NO_2 and $PM_{2.5}$ in Edmonton are ranked third and fifth out of 24 communities, higher than the national average. There were 93 exceedance events for the 24-hour average concentration of $PM_{2.5}$ in 2018, observed as an increasing trend during the 18 years of monitoring[15]. Exceedance events indicate that the 24-hour average concentration of $PM_{2.5}$ exceeds the standard 27 $\mu g/m^3$ (Canadian Ambient Air Quality Standards)[16]. The WHO's guideline of 24-hour average concentration of $PM_{2.5}$ is 15 $\mu g/m^3$ [17]. Air pollution in Edmonton is typically affected by wildfire smoke from April to September (due to wildfires in Alberta, British Columbia, and the US, as mentioned above)[15].

In Canada, it was estimated that 2,682 premature deaths, 10,966 hospital admissions, 92,690 emergency department visits, 62.3 million doctor's office visits, and $257,934 million in health care costs resulted from air pollution in 2008[18]. Several national-level studies in Canada suggested that mortality from all-cause, cardiovascular disease, respiratory disease, ischaemic heart disease, and cancer increase with the rise of particulates ($PM_{2.5}$, PM_{10}, total suspended particles) and gaseous (O_3, CO, SO_2, NO_2) pollutants[19–22]. A study that included 117 health regions in Canada showed strong associations between $PM_{2.5}$ and diabetes, asthma, and high blood pressure[23]. Diseases such as acute myocardial infarction, systemic autoimmune rheumatic disease, ischemic stroke, otitis media, depression, and substance abuse were also found to be affected by air pollution[24–33]. In addition, there is increasing evidence of air pollution contributing to adverse birth outcomes and early childhood diseases in Canada[34,35].

In Alberta, 173 premature deaths, 894 hospital admissions, 8,638 emergency department visits, 54,887 doctor's office visits, and $34.9 million in health care costs were associated with air pollution in 2008[18]. A case-crossover study in northern Alberta indicated that the interquartile range of the 5-day average for NO_2 and CO levels between April and September was associated with a 50% and 48% increase, respectively, in the number of emergency department visits involving children from 2 to 4 years and the elderly (>75 years)[36]. O_3 and particulate matter levels were also correlated with asthma visits[36]. The impact of the adverse effects of air pollution on children's health may also be compounded by projected population growth. The population of those aged 5 to 17 years is predicted to increase by 2.1% annually in Alberta between 2017 to 2025[37].

Regional variations in the impacts of air pollution also occur as pollutant sources and population densities differ across Alberta. Stieb et al.[38] observed that certain areas of Alberta (Lloydminster, Red Deer, and Edmonton) experienced increases in fine particulate matter levels between 2000-2011 that were linked to increases in mortality of 3.8%, 4.3%, and 1.8%, respectively. Future projections for 2050 indicate worsening air quality in many Canadian communities, which will increase health risks, especially for sensitive groups such as children[39,40].

1.2 At-risk groups

Inequities in the impacts of air pollution have been observed: children, pregnant women, the elderly, and those with pre-existing medical conditions are susceptible to air pollution[3]. Children are a particularly susceptible population[3]. The health impacts of air pollution on children begin during the prenatal period when air pollution can impair organogenesis and organ development, leading to long-term complications, even death[41]. There is evidence showing that intrauterine exposure to air pollution is associated with an increased incidence of neurodevelopmental problems such as attention-deficit hyperactivity disorder, autism spectrum disorders, academic failure, and the start of Alzheimer's pathogenesis[42–45]. Prenatal exposure to air pollutants also adversely affects lung development and respiratory health in children[41,46,47]. A recent systematic review indicates that air pollution exposure during pregnancy, especially NO_2 and PM, increases the risk of infant mortality[48].

Early exposure to ambient air pollution may affect children's normal growth and lung development, as their immune and organ systems are still developing[49,50]. Young children have a greater permeability of the lung epithelial layer as lung functionality is not fully developed until about the age of six[50]. Children inhale more air per unit body weight than adults, increasing their susceptibility to air pollution[51]. Also, children are involved in vigorous outdoor activities and spend more time outdoors, compared to adults[52,53]. A study conducted in U.S. inner cities indicated that higher concentrations of NO_2, $PM_{2.5}$ and SO_2 were associated with significantly lower pulmonary function of schoolchildren[54]. Also, short-term O_3 exposure was linked with lower levels of lung function (both FEV1 and FVC) in healthy children and those with asthma from a study in Mexico City[55].

Epidemiological studies from around the world report associations between air pollution exposure in children and adverse health outcomes such as the development and exacerbation of wheezing, asthma, allergies, pneumonia, atopic dermatitis, otitis media, and leukemia[50,56–70]. In Canada, those most affected are children, and asthma remains the leading cause of hospitalization among Canadian children[36]. It is estimated that more than 3.8 million people in Canada currently suffer from asthma, of which about 850,000 are children under the age of 14. A systematic review focused on Southeast Asia observed that each increase of $10\mu g/m^3$ in concentrations of $PM_{2.5}$ was associated with a 1-2% increase in the risk of wheeze-associated disorders[69]. A study in the United States among children aged 0 to 4 showed that O_3 had the strongest associations with upper respiratory infection in children[71]. In a time-series study conducted in China, NO_2 presented the most significant effect on childhood asthma hospital admissions[72]. Similar results were found in a study based in Edmonton, where O_3 and NO_2 were significant associated with the increase of emergency department visits for asthma among children below ten years old[27]. Further, it is demonstrated that compared with younger children aged 0 to 5 years old, children aged 6 to 18 were more vulnerable to the adverse effects of air pollution[72]. According to the government of Alberta, the population of those aged 5 to 17 years is expected to increase by 2.1% annually between 2017 to 2025 in the province[37]. As a result, it is imperative to study the health impacts of air pollution on children, as they will invite some of the largest health risks and gains[73].

1.3 Factors influencing the association between air pollution and emergency visits for respiratory diseases among children

Wheeze, asthma, and bronchiolitis are common, heterogeneous respiratory diseases caused by a combination of genetic and environmental influences[74]. It is well recognized that exposure to outdoor air pollution adversely affects respiratory health, and children are considered to be more susceptible to the effects of ambient air pollution[75]. There are many factors that can affect the associations between air pollution and emergency visits for respiratory diseases among children. Two studies conducted in Canada, in Alberta and Windsor, Ontario, indicated that associations between ambient air pollution levels and ED visits for respiratory diseases among children were particularly pronounced during transitions between seasons (April, May, September, October)[36,75]. Jalaludin et al[76] also observed that associations between ambient air pollutants and ED visits for asthma in children were greater in the warm season in Sydney, Australia. However, a study conducted in another Australian city, Adelaide, showed that the association was stronger in the cool season compared to the warm season[77]. Three studies conducted in Atlanta, U.S.; Athens, Greece; and Ningbo, China reported stronger associations of air pollution for older children aged 5-14 years[74,78,79]. Conversely, a study conducted in Lanzhou, China demonstrated that younger children aged 0 to 3 years were most affected by air pollution[80]. A study conducted in Palermo, Italy found that the associations of air pollution and ED visits were greater in female children than male children[81]. Moreover, studies found that temperature was a risk factor, while the wind was a protective factor for the health impact of air pollutants on children[78,82]. Influenza episodes can also influence the results[78,82]. As a result, season, age, sex, meteorological variables, and influenza activities interact and might confound the outcomes of the association between respiratory disease and air pollutant exposure among children.

The findings above indicate that the air pollution effects differed among countries and cities. Villeneuve et al[36] observed that sources of air pollution in Alberta in 2007 represented a mixture of industry and traffic, different from the present situation in which wildfires substantially add to the deterioration of air quality[15]. In comparison, in Windsor, Canada, the main source stems primarily from industry[75]. The Australian city of Adelaide also had mixed sources of air pollution, including motor vehicles, industrial production, home heating sources, and bushfires, as well as dust storms[77]. The study in Athens, Greece mainly focused on air pollution from desert dust[78]. The

Chinese city of Lanzhou is an industrial city, which is also affected by dust storms[80]. The air pollution of Palermo, Italy was reported as mainly stemming from traffic[81]. There is evidence that many environmental factors are associated with the development and exacerbation of asthma, including allergens, airborne irritants, weather conditions and indoor conditions[83]. As a result, sources of air pollution are also an important factor affecting the association between air pollution levels and respiratory diseases.

1.4 Significance

There are only a few studies focusing on the acute effects of ambient air pollution in infants and children in Alberta. The most recent study examined the monthly patterns of all ages asthma presentations to EDs between 1999-2011[84], and the results showed that the strongest estimates occurred in the pediatric subgroup[84]. Therefore, this study aims to evaluate the acute effects of daily relationships, using data of daily concentration of air pollutants and daily ED attendances for respiratory diseases among children between 2016 to 2018. This period covers a gap in which there were notable changes in sources and concentrations of air pollutants. As previously mentioned, there has been a significant increase in wildfire activity in and around Alberta between 2016 to 2018. Meanwhile, the most recent study examining acute effects of ambient air pollution in infants and children in Alberta was in 2015[84]. Therefore, 2016 to 2018 was chosen to be the study period, during which the wildfires occurred more frequently. The aim was to explore more recent trends of air pollution levels and respiratory health conditions among children in Alberta in the face of increasing wildfire smoke exposure.

Previous studies have shown that public health information about environmental events, such as poor air quality and adverse meteorological conditions, do not reach the population[85]. A study in six U.S. states (Colorado, Florida, Indiana, Kansas, Massachusetts, and Wisconsin) found that compared with single media alerts, awareness of media alerts, as well as health professional advice, can encourage both sensitive groups and the general public to make more informed decisions regarding activities during harmful air pollution episodes[86]. The findings from this study can help inform health professional advice and media alerts to better guide the public. Findings will be widely shared and posted on Twitter, Facebook, and other social media platforms.

In conclusion, the results of this study will show current trends in air pollution levels and respiratory health conditions among children, as well as illustrate the health impacts of wildfire-related air pollution, an increasingly important source of air pollution in Edmonton. Additionally, these results can help to guide health care providers and inform sensitive populations in Alberta.

1.5 Objectives

1. To investigate trends in associations between air pollution (fine particulate matter, nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide) levels and respiratory (wheeze, asthma, bronchiolitis) emergency departments visits in Edmonton among children under 17 years of age between 2016-2018.
2. To investigate the associations between air pollution (fine particulate matter, nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide) exposure and respiratory (wheeze, asthma, bronchiolitis) hospital admissions and LOS among children under 17 years of age in Edmonton between 2016-2018.
3. To explore the impacts of wildfire-related air pollution on respiratory (wheeze, asthma, bronchiolitis) health among children under 17 years of age in Edmonton between 2016-2018.

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Chapter 2: Methodology

2.1 Study area and population

The study area was Edmonton, the capital city of the Canadian province of Alberta, including St. Albert and Sherwood Park. The metro area of Edmonton had a population of 972,223 in 2019, making it Alberta's second-largest city and Canada's fifth-largest municipality[1]. The population of children under 15 years old was 150,980, comprising 15.5% of the total population in Edmonton. Edmonton is near the world's 3rd largest proven oil reserves and Alberta's vast natural gas deposits, so it has a well developed petrochemical industry[2]. The population of interest for this study was children under 17 years of age, as evidence suggests that this group is among the most affected by air pollution[3,4]. Figure 2.1 shows a map of Edmonton including air pollution monitoring stations, forested areas, and wind direction.

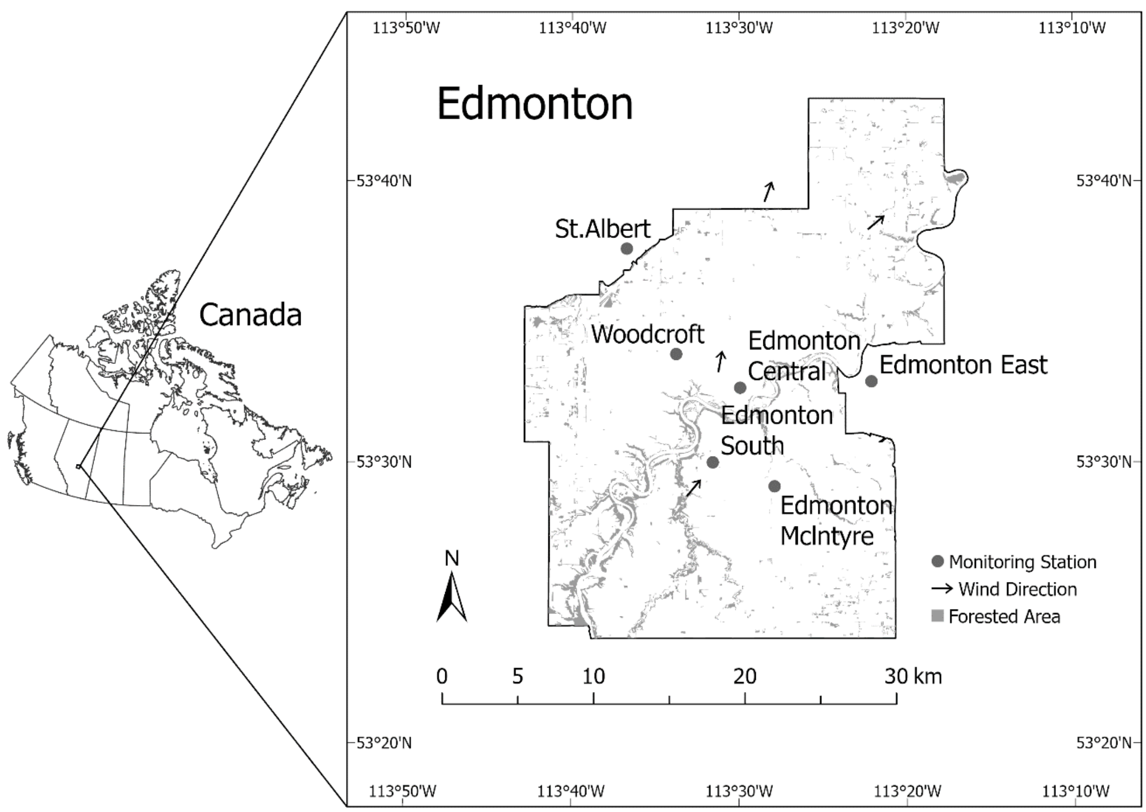

Figure 2.1 Map of Edmonton with air pollution monitoring stations, forested area, and wind direction

2.2 Data collection

Air pollution monitoring data: The study includes air pollutant data on carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), fine particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2) in Edmonton between 2016 to 2018. These are the most widely and consistently monitored air pollutants and have been shown to affect children adversely[5]. Data on these five air pollutants was obtained from the National Air Pollution Surveillance (NAPS) program, freely available from Environment and Climate Change Canada[6]. CO, NO_2, O_3, $PM_{2.5}$ and SO_2 were obtained as hourly mean concentrations from six monitoring stations (Edmonton Central, Edmonton East, Edmonton South, Edmonton McIntyre, St. Albert, and Woodcraft, as shown in figure 2.1).

Air pollution data from land use regression models: Land use regression models (LUR) are capable of estimating air pollution exposure based on geographical location[7]. The LUR data representing yearly mean concentrations of NO_2, O_3, $PM_{2.5}$, and SO_2 by postal codes were obtained from the Canadian Urban Environmental Health Research Consortium website. Bootstrap approach of the random selection of monitors and leave-one-out analysis were applied to validate the LUR model[8]. The most recent data for 2015 for NO_2, 2016 for O_3 and SO_2, and 2016 to 2018 for $PM_{2.5}$ were used in the study. The LUR data can reflect the difference in air pollution exposure between different geographical locations (postal codes) of participants. This is different from monitoring data that were averaged across the whole city. Thus, the daily monitoring data were used for time-series analysis and the LUR data were used for multiple linear regression and multivariate logistic regression.

Meteorological variables: Data on meteorological variables in Edmonton between 2016 to 2018 were obtained from the Alberta Climate Information Service, including temperature (°C), relative humidity (%), and precipitation (mm). The data included daily means of the three meteorological variables.

Flu data: Data on influenza activity was obtained from the Strategic Analytics & Decision Support team at Alberta Health Services. Influenza was diagnosed according to clinical standards and were not confirmed through laboratory testing.

Children's respiratory ED visits data: Data on children's respiratory ED visits and total ED visits in Edmonton during 2016 to 2018 were obtained via the Strategic Analytics & Decision Support team in the Department of Pediatrics, Faculty of Medicine & Dentistry, and University of Alberta.

The data included date of visit, hospital admission (yes/no/transfer), age (years), sex (male/female), postal code (only children with postal codes belonging to Edmonton were included), length of stay (LOS) in ED, and the Canadian Triage and Acuity Scale (CTAS) score of each visitor. LOS is the number of minutes children spent in the ED. In general, longer LOS could be an indicator of higher severity of conditions. Total daily ED visits divided by children's daily respiratory ED visits was calculated as an indication the busyness of ED, which can affect LOS duration. CTAS score is also an indicator of severity with five levels: level 1: resuscitation – conditions that are threats to life or limb; level 2: emergent – conditions that are a potential threat to life, limb, or function; level 3: urgent – serious conditions that require emergency intervention; level 4: less urgent – conditions that relate to patient distress or potential complications that would benefit from intervention; level 5: non-urgent – conditions that are non-urgent or that may be part of a chronic problem[9]. CTAS scores are assigned at initial presentation to the ED. Causes of hospital visits were coded according to the International Classification of Diseases, Revision 10 (ICD-10): asthma (J45.00), wheeze (R06.2), and bronchiolitis (J21)[10].

Pampalon index data: The Pampalon index[11] was used to assign socioeconomic status (SES) for each of the participants. This was obtained from the website of Statistics Canada. Children's SES (1 (lowest) to 5 (highest)) were assigned by postal code.

Wildfire season and non-wildfire season: According to the Alberta wildfire website, wildfire season is from April to September while non-wildfire season runs from October to March[12].

2.3 Statistical analysis

The sample size in time-series analysis was the numbers of days of study period. For time-series three-year models (including sex- and age-stratified models), sample size was 1,096 days (from January 1,2016 to December 31, 2018). For time-series wildfire models, the sample size was 549 (total days in wildfire seasons over three years). For time-series non-wildfire models, the sample size was 547 (total days in non-wildfire seasons over three years). The sample size of time-series yearly models was 366, 365, and 365 for 2016, 2017, and 2018, respectively.

The sample size for multiple linear regression and multivariable logistic regression was the visits included. For NO_2, O_3, and SO_2, the sample size was 2,753 as the study focused on 2016 visits data, to correspond with available air pollutant data. For $PM_{2.5}$, the sample size was 8,250, which was number of visits over the three years, for which additional pollutant data was available (2016-2018).

2.3.1 Descriptive analysis

Descriptive analyses were first performed to examine the data. Summary statistics of air pollutant monitor data were calculated. Daily mean concentrations of CO (ppm), NO_2 (ppm), $PM_{2.5}$ ($\mu g/m^3$), and SO_2 (ppm) were calculated based on the hourly mean concentration of each day. The 8-hour daily maximum concentration of O_3 (ppm) was calculated. Only days with valid values ⩾80% were included. Average concentrations of air pollutants in different years, seasons of the year, monitor locations, wildfire seasons, and non-wildfire seasons were calculated across the study period (2016-2018). Four seasons were divided according to temperature: March to May (spring), June to August (summer), September to October (fall), and November to February (winter)[13]. Time series diagrams of the daily mean concentration of CO, NO_2, $PM_{2.5}$, SO_2, and meteorological variables and 8-hour daily maximum concentration of O_3 were generated to show trends over the study period. Children's counts and proportions of ED visits for respiratory symptoms were also calculated by sex, age, hospital admissions (yes/no), ICD-10 diagnosis, year, season, and CTAS score.

Missing data were also explored. The monitoring data included hourly mean concentrations of air pollutants of each day from 2016 to 2018: one data point was one hourly mean value. The total days were 1,096 and the total number of data points from each monitor was 26,304 (1096 × 24). A day with more than 20% missing data points (⩾5) was regarded as a missing day. The calculation of missing data points and missing days did not include monitors if a particular pollutant was not measured at that station. CO levels were measured at Edmonton central, Edmonton east, Edmonton south, and St. Albert stations, but not at Edmonton McIntyre and Woodcraft. Similarly, the calculation of missing values of NO_2 and O_3 included all stations except for Edmonton McIntyre. $PM_{2.5}$ included all stations except Edmonton East and St. Albert, and SO_2 included all stations except Edmonton Central, Edmonton McIntyre and St. Albert. The missing values of LUR data and other variables were also explored.

2.3.2 Time-series regression analysis

Daily mean concentration and maximum daily moving average concentration based on monitoring data were used in time-series regression analysis. Time-series regression studies examine short-term associations between exposure and outcome of interest regularly over a period of time in a population[14,15]. The aim of time-series regression analyses is to investigate whether changes in the exposure can explain some of the short-term variations in an outcome[15]. Previous studies have used this approach in examining associations between air pollution and adverse health outcomes[10,16–25]. The outpatient and ED visits among children with respiratory disease (wheeze, asthma, and bronchiolitis) is a low probability event, which results in a distribution similar to that of the Poisson distribution. Therefore, Poisson regression and negative binomial regression models were conducted after testing overdispersion[25,26].

Different lag structures (e.g., lag 0: same-day effects, lag 1: effects observed after one day) were examined for the air pollutants and covariates to account for lagged exposure effects, which were also adjusted for collinearity (constrained distributed lag models)[15]. In unconstrained models, the estimated individual lag effects were confounded by each other, so the constrained models were used to control the collinearity. The constrained lags were decided by the patterns revealed in the unconstrained model and lags with close values were defined to be the same[15]. Too many lags in the model could increase the error, and too few lags could omit crucial relevant information. In time series analysis, three criteria, the Akaike's information criterion (AIC), the Hannan and Quinn information criterion (HQ), and the Schwarz's Bayesian information criterion (SBIC), are commonly used to determine the optimal numbers of lags[27]. The AIC is used for monthly data, and HQIC and SBIC are typically used for quarterly data[27]. Since daily data were utilized in this study, AIC was selected as the most appropriate criterion for this study.

Potential confounders or interaction terms that might impact the association between air pollution exposure and counts of respiratory visits to the emergency department were identified. Factors varying over time, including seasonality, average daily temperature, relative humidity, statutory holidays and weekends, and influenza activity (counts), were identified as critical potential confounders and were adjusted in the model[15,22,28]. Confounders such as age, sex, and socioeconomic status that typically influence non-ecological studies remain relatively stable and are assumed to change relatively slowly with this study design because the relationship is estimated at the population level (e.g., population sex distribution). Long-term trends and seasonality were controlled for as a fixed effect by periodic functions (Fourier terms). Flexible spline functions were also assessed but resulted in model convergence issues. The linearity assumption of continuous variables (air pollutants concentrations, temperature, humidity, influenza activity) was examined by generating a scatter plot. Air pollutants concentrations did not meet the linearity assumption, so the natural log of air pollutants was used in the model. Variable flu also did not meet the linearity assumption and there were lots of 0 value. In order to avoid large numbers of missing values after transformation, a constant of 1 was added to each value of flu and then transformed into natural log. Potential collinearity between independent variables was examined using the Variance inflation factor (VIF). The purposeful selection method based on a prior knowledge was employed to build the model. The model-building steps were repeated for each sex (males, females) and age group (younger children: 0-4 years old, older children: 5-16 years old) to examine the difference by effects of sex and age. Time series regression models were also built for wildfire and non-wildfire seasons and for each year (2016-2018) to explore the impact of wildfire activity in and around Alberta on the risk of ED visits for respiratory symptoms among children. Model fit was examined by checking residuals. Therefore, ten kinds of time-series models were built in this study: three-year models, sex-stratified models (male and female), age-stratified models (0-4 years old and 5-16 years old), wildfire season models, non-wildfire models, and models for each year (2016, 2017, and 2018). The three-year models, sex-stratified models, and age-stratified models have the same number of lags of each variable because they were based on the same study period (2016 to 2018). The wildfire season models only included wildfire seasons (April to September) for the three years, and the non-wildfire season models only included non-wildfire seasons (January to March and October to December) for the three years. Models for each year were based on a one-year period. Therefore, the lag selection for wildfire season model, non-wildfire season models, and yearly models was different. Models without air pollutants were also built as baseline time-series models. Models with air pollutants were compared with the baseline models by AIC and BIC.

2.3.3 Multivariable logistic regression and multiple linear regression

LUR data were used for multivariable logistic regression and multiple linear regression. Multivariable logistic regression was conducted to explore the association between air pollution exposure and hospital admissions (yes/no) (transfer and yes were combined into one group) for respiratory reasons (wheeze, asthma, and bronchiolitis) among children. Multiple linear regression was conducted to explore the association between air pollution exposure and LOS. Models were adjusted for the potential confounders including age (continuous variable), sex (male, female), socioeconomic status (1 (lowest) to 5 (highest)), the rate of ED visits among children to total ED visits per day, and CTAS score. None of the children assessed as CTAS 5 were admitted to the hospital and the numbers were fewer than other four groups, so CTAS 5 was combined with CTAS 4 to create a new CTAS 4 category and was set to be the reference group. The number assessed as CTAS 1 was too small to be the reference group. A purposeful selection method was used to build the model, based on a priori knowledge. Model fit was assessed by conducting a goodness-of-fit test and checking residuals. Only the 2015 LUR data of NO_2 was obtained, so the 2016 visits data was used for NO_2. Only 2016 LUR data for O_3 and SO_2 was obtained so 2016 visits data were used. LUR data between 2016 to 2018 of $PM_{2.5}$ was available so three years' visits data was used. Linear assumption of continuous variables was examined. O_3 and age did not meet the linear assumption, so they were transformed into quartiles.

2.4 Ethical considerations

We have received ethics approval for this study from the University of Alberta (Pro00090081).

2.5 Software

STATA 16.1 and R Studio were employed for statistical analysis in this study.

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Chapter 3: Results

3.1 Descriptive analysis

3.1.1 Summary of health data

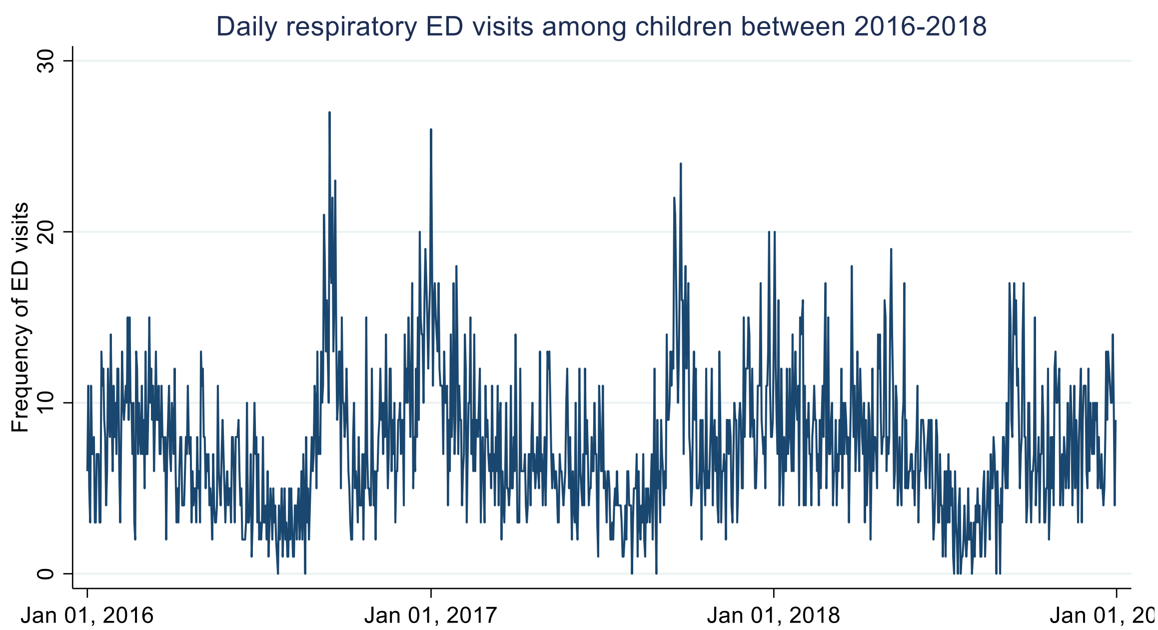
As table 3.1 shows, a total of 8,250 emergency department visits for respiratory diseases among children between 2016-2018 in Edmonton were included in the study. Age groups are divided based on the subgroups used in the Canadian Census. Children aged 0 to 4 visited emergency rooms for respiratory problems at a much higher rate (69.5%) than any other age group. Male children visited the ED more often than female children, representing 62.53% of the total visits. More than half of the visits (56.1%) were for *Predominantly allergic asthma without stated status asthmaticus* (ICD-10 code J4500). Only 13.7% of visits resulted in hospital inpatient admission after attending the ED. The proportion of visits to emergency rooms for respiratory diseases was lowest in summer (15.0%) and higher in fall and winter (28.8%, 31.8%). Most of ED visits were assigned to CTAS 3 (49%) and fewest were assigned to CTAS 5 (0.32%). Figure 3.1 shows the daily respiratory ED visits among children under 17 years old in Edmonton between 2016 to 2018. Visits could represent the same child on multiple occasions. The prevalence of the daily respiratory ED visits among children was used in this study, rather than incident cases.

Table 3.1 Summary of emergency visits for asthma, wheezing, and bronchiolitis among children under 17 ages in Edmonton between 2016 to 2018

Characteristic	Number of visits	%
Age (in years)		
0-4	5731	69.5
5-9	1557	18.9
10-14	765	9.3
15-16	197	2.4
Sex		
Male	5158	62.5
Female	3092	37.5
Diagnosis type		
ICD-10 code J210-Acute bronchiolitis due to respiratory syncytial virus	76	0.9
ICD-10 code J211-Acute bronchiolitis due to human metapneumovirus	4	0.1
ICD-10 code J218-Acute bronchiolitis due to other specified organisms	38	0.5
ICD-10 code J219-Acute bronchiolitis, unspecified	3017	36.6
ICD-10 code J4500-Predominantly allergic asthma without stated status asthmaticus	4631	56.1
ICD-10 code J4501-Predominantly allergic asthma with stated status asthmaticus	21	0.3

ICD-10 code R062-Wheezing	463	5.6
Admitted To Inpatient		
No	7122	86.3
Transferred to other facilities	203	2.5
Yes	925	11.2
Year		
2016	2753	33.4
2017	2792	33.9
2018	2705	32.8
Season		
Spring (March to May)	2013	24.4
Summer (June to Aug)	1237	15.0
Fall (Sep to Oct)	1595	19.3
Winter (Nov to Feb)	3405	41.3
CTAS Score		
1	45	0.6
2	3,644	44.2
3	4,043	49.0
4	492	6.0
5	26	0.3
Total	8250	100
	Mean	SD
LOS (minutes)	252.77	153.1

A



B

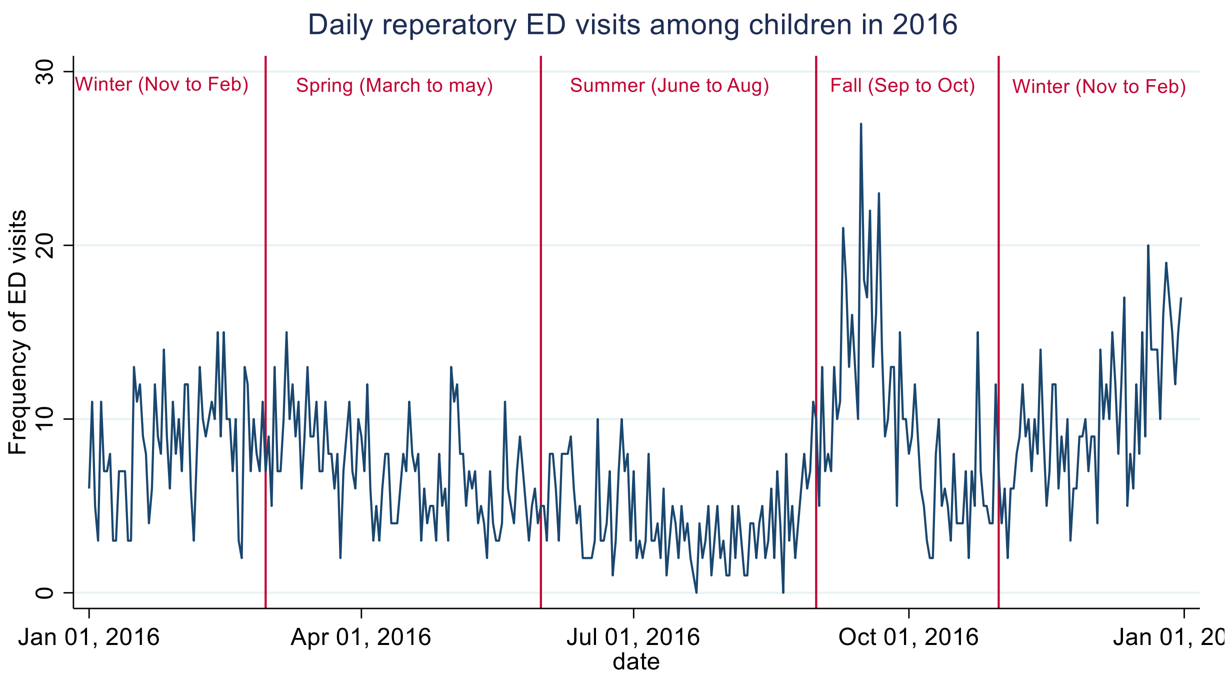


Figure 3.1 Daily respiratory emergency department visits among children under 17 ages in Edmonton between 2016 and 2018 (A) and in 2016 with seasons (B)

3.1.2 Summary of air pollution data

Table 3.2 presents the summary of the monitored air pollutant data. Figure 3.2 shows changes in the daily mean concentration of pollutants. WHO guidelines of 24-hour average concentrations of NO_2, $PM_{2.5}$ and SO_2, and 8-hour daily maximum concentration of O_3 are shown in the figure. Canadian ambient air quality standards of 24-hour average concentrations of $PM_{2.5}$ and 8-hour daily maximum concentration of O_3 are also shown in the figure. From 2016 to 2018, the annual mean concentration of $PM_{2.5}$ in Edmonton increased. Other pollutants had no obvious trend. The mean concentration of CO was the highest in winter, and $PM_{2.5}$ was the highest in summer. There was a significant peak in the daily mean concentration of both CO and $PM_{2.5}$ in the second half of 2018. The concentration of NO_2 was the lowest in summer and the highest in winter, while the concentration of O_3 was highest in summer and lowest in winter, showing expected opposite trends.

Table 3.3 presents a summary of the LUR data. The LUR annual mean and median concentrations of $PM_{2.5}$ calculated from 2016 to 2018 were lower than annual mean monitored concentrations of

2016 to 2018. Similarly, the annual mean and median concentrations of SO_2 calculated from 2016 LUR data were lower than annual mean concentrations of 2016 monitored data. For O_3, the LUR data was provided as an annual mean concentration, and the monitoring data was based on mean 8-hour daily maximum concentrations, so they cannot directly compare. However, the annual mean concentration of O_3 of the 2016 LUR data appears to be higher than that of the 2016 monitoring data.

Table 3.2 Summary of monitoring data of air pollutants

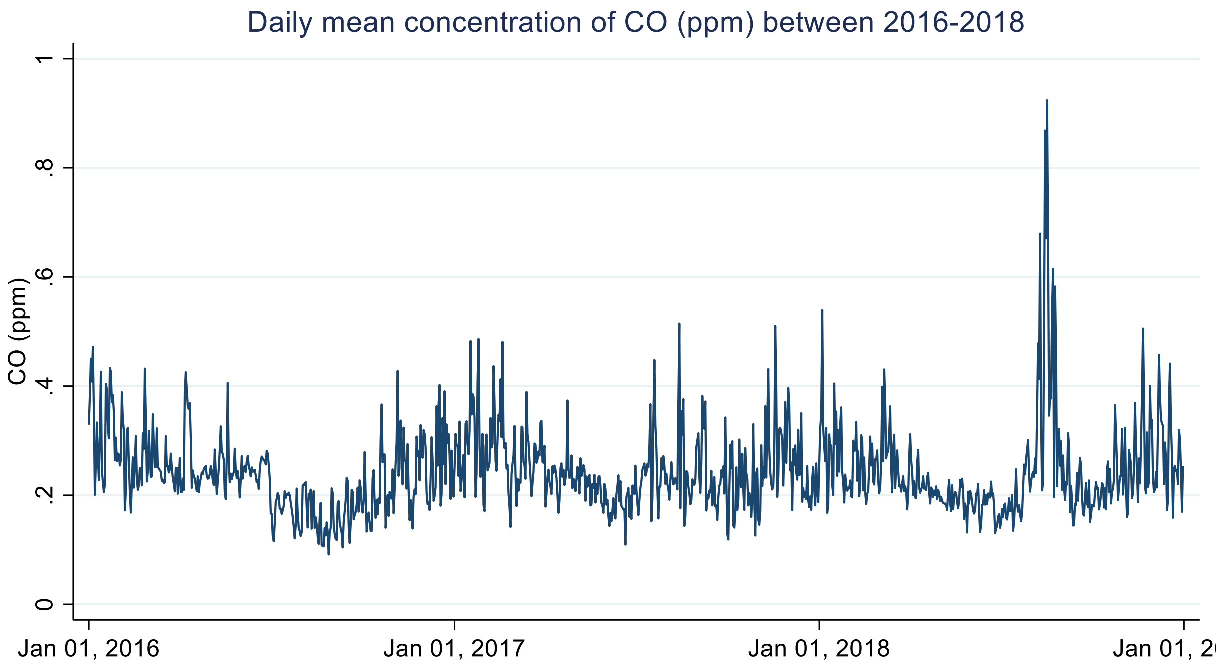
		CO (ppm)	NO_2 (ppm)	O_3 (ppm)	$PM_{2.5}$ (μg/m^3)	SO_2 (ppm)
Year						
2016	Mean	0.2351	0.0117	0.0293	7.3700	0.0006
	SD	0.0703	0.0070	0.0119	4.7162	0.0006
	Min	0.0914	0.0014	0.0023	1.3859	0.0000
	P25	0.1914	0.0065	0.0208	4.5060	0.0002
	Median	0.2292	0.0097	0.0287	6.1042	0.0004
	P75	0.2681	0.0154	0.0373	8.6250	0.0009
	Max	0.4722	0.0360	0.0646	40.021	0.0044
2017	Mean	0.2460	0.0128	0.0305	8.9148	0.0006
	SD	0.0668	0.0070	0.0100	6.1473	0.0007
	Min	0.1095	0.0029	0.0068	1.6250	0.0000
	P25	0.2021	0.0077	0.0233	5.1250	0.0002
	Median	0.2333	0.0104	0.0304	7.5208	0.0004
	P75	0.2750	0.0164	0.0369	10.146	0.0008
	Max	0.5146	0.0336	0.0648	48.583	0.0053
2018	Mean	0.2469	0.0129	0.0325	10.370	0.0006
	SD	0.0974	0.0076	0.0136	13.436	0.0006
	Min	0.1304	0.0026	0.0048	1.3056	0.0000
	P25	0.1924	0.0070	0.0222	5.0208	0.0002
	Median	0.2174	0.0107	0.0316	6.9886	0.0004
	P75	0.2696	0.0170	0.0428	10.917	0.0008
	Max	0.9239	0.0390	0.0692	119.46	0.0051
Season						
Spring (March to May)	Mean	0.2391	0.0105	0.0391	8.4422	0.0007
	SD	0.0477	0.0056	0.0100	5.3742	0.0007
	Min	0.1315	0.0014	0.0115	1.3859	0.0000
	P25	0.2067	0.0065	0.0325	4.9479	0.0002
	Median	0.2314	0.0095	0.0401	7.2301	0.0004
	P75	0.2543	0.0132	0.0458	10.298	0.0010
	Max	0.4319	0.0390	0.0647	44.771	0.0051

Summer (June to Aug)	Mean	0.2266	0.0071	0.0373	11.796	0.0007
	SD	0.1064	0.0025	0.0104	15.460	0.0006
	Min	0.0914	0.0026	0.0118	1.3056	0.0000
	P25	0.1689	0.0053	0.0305	5.2396	0.0002
	Median	0.2037	0.0070	0.0360	7.6458	0.0004
	P75	0.2460	0.0087	0.0443	11.271	0.0010
	Max	0.9239	0.0176	0.0692	119.46	0.0032
Fall (Sep to Oct)	Mean	0.2280	0.0127	0.0224	6.9722	0.0005
	SD	0.0677	0.0060	0.0085	4.2487	0.0005
	Min	0.1042	0.0024	0.0023	1.3864	0.0000
	P25	0.1826	0.0083	0.0173	4.2708	0.0001
	Median	0.2141	0.0113	0.0227	5.9167	0.0003
	P75	0.2620	0.0162	0.0271	8.5208	0.0006
	Max	0.5104	0.0332	0.0648	26.833	0.0053
Winter (Nov to Feb)	Mean	0.2765	0.0195	0.0240	8.2922	0.0006
	SD	0.0737	0.0074	0.0081	5.1512	0.0005
	Min	0.1417	0.0051	0.0063	1.7500	0.0000
	P25	0.2194	0.0135	0.0182	4.8125	0.0002
	Median	0.2639	0.0189	0.0243	7.0417	0.0005
	P75	0.3200	0.0251	0.0307	9.5625	0.0008
	Max	0.5599	0.0374	0.0394	40.021	0.0031
Overall	Mean	0.2427	0.0124	0.0308	8.8836	0.0006
	SD	0.0792	0.0072	0.0120	9.0272	0.0006
	Min	0.0914	0.0014	0.0023	1.3056	0.0000
	P25	0.1960	0.0071	0.0222	4.8750	0.0002
	Median	0.2281	0.0102	0.0302	6.9167	0.0004
	P75	0.2711	0.0163	0.0386	9.9074	0.0009
	Max	0.9239	0.0398	0.0692	119.46	0.0051

Table 3.3 Summary of land use regression data of air pollutants

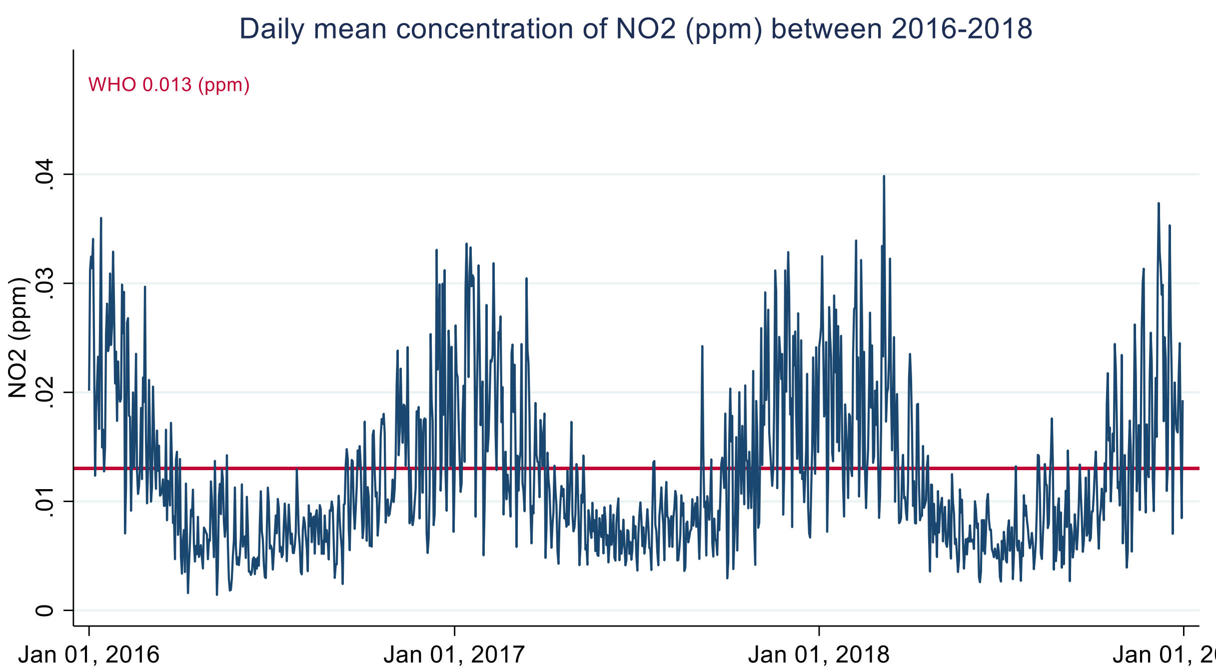
	NO_2 (ppm) (2015)	O_3 (ppm) (2016)	$PM_{2.5}$ (μg/m^3) (2016-2018)	SO_2 (ppm) (2016)
Mean	0.0132	0.0321	7.8927	0.0003
SD	0.0033	0.0013	1.5844	0.0001
Min	0.0055	0.0307	4.8000	0.0001
P25	0.0112	0.0310	6.6000	0.0002
Median	0.0125	0.0314	7.8000	0.0002
P75	0.0149	0.0329	8.8000	0.0004
Max	0.0321	0.0382	11.9000	0.0007

A



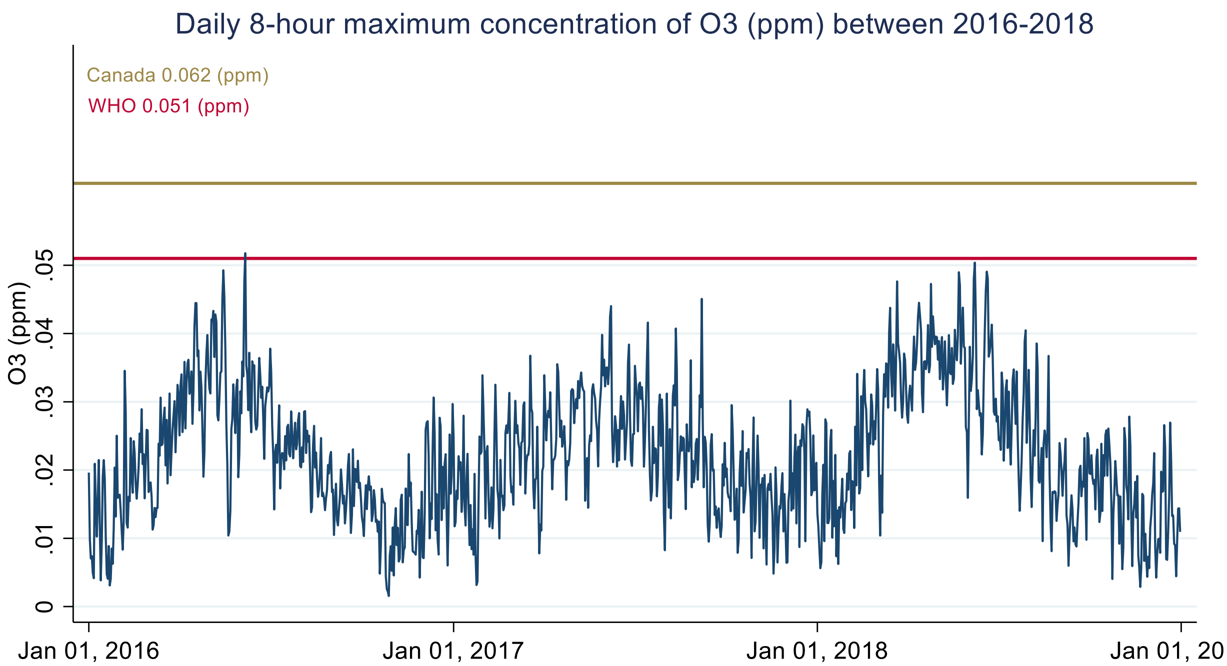
Daily mean concentration of CO (ppm) between 2016-2018
CO (ppm)
0
.2
.4
.6
.8
1
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

B

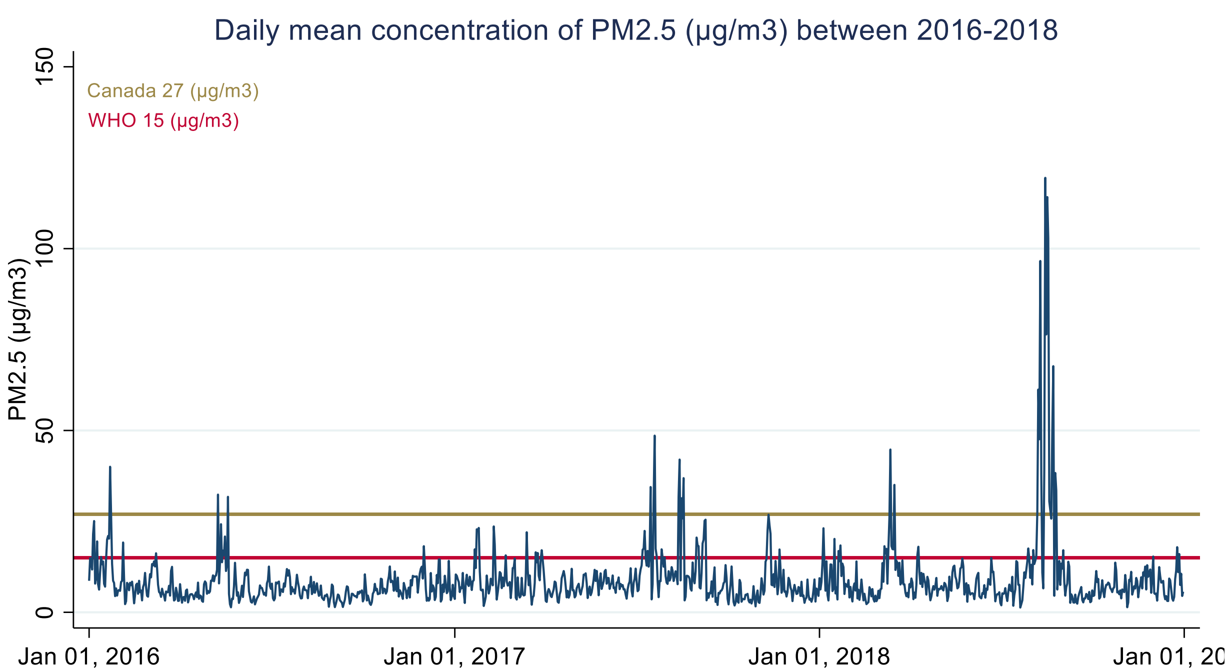


Daily mean concentration of NO2 (ppm) between 2016-2018
WHO 0.013 (ppm)
NO2 (ppm)
0
.01
.02
.03
.04
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

C


Daily 8-hour maximum concentration of O3 (ppm) between 2016-2018
Canada 0.062 (ppm)
WHO 0.051 (ppm)
O3 (ppm)
0
.01
.02
.03
.04
.05
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

D


Daily mean concentration of PM2.5 (µg/m3) between 2016-2018
Canada 27 (µg/m3)
WHO 15 (µg/m3)
PM2.5 (µg/m3)
0
50
100
150
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

E

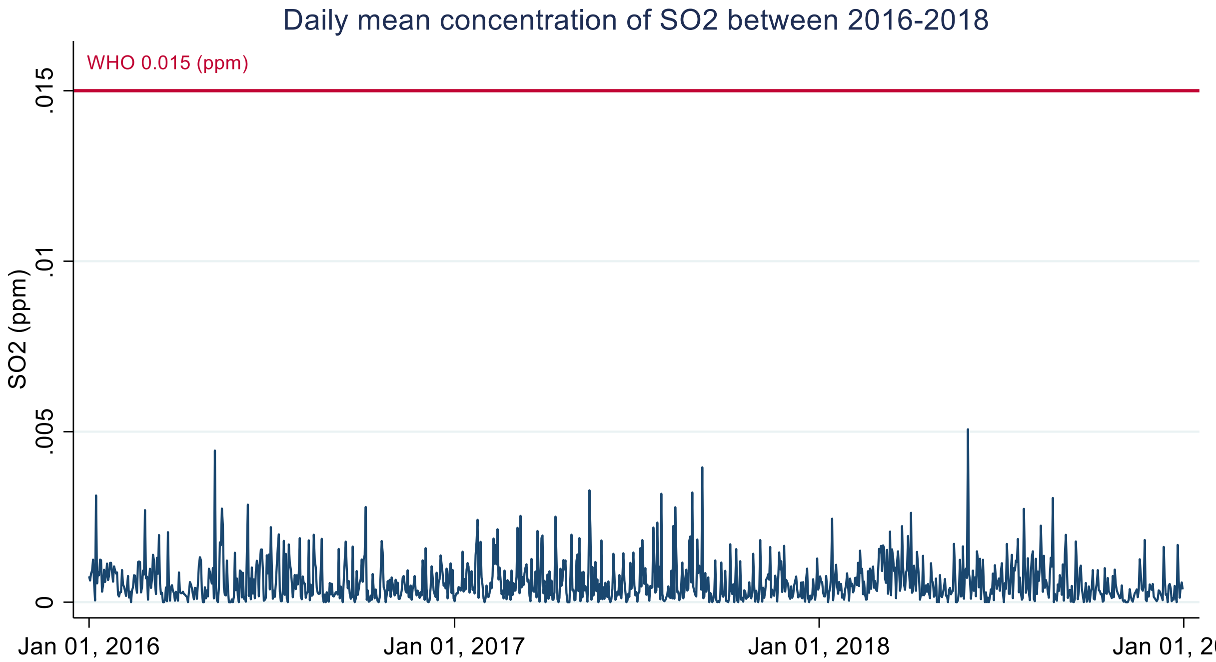
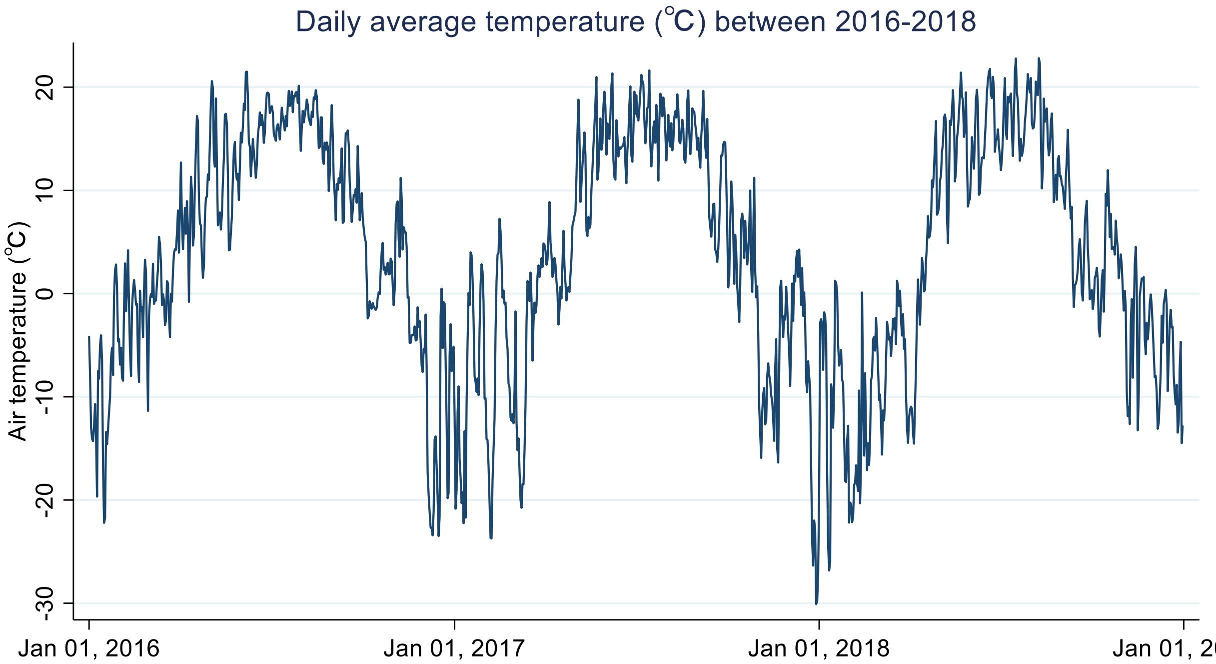


Figure 3.2 Daily mean concentrations of (A) CO, (B) NO_2, (C) O_3, (D) $PM_{2.5}$ and © SO_2 in Edmonton between 2016 to 2018 with WHO guidelines[1] and Canadian ambient air quality standards[2] of 24-hour average concentrations (there is no guideline for CO)

3.1.3 Summary of meteorological factors

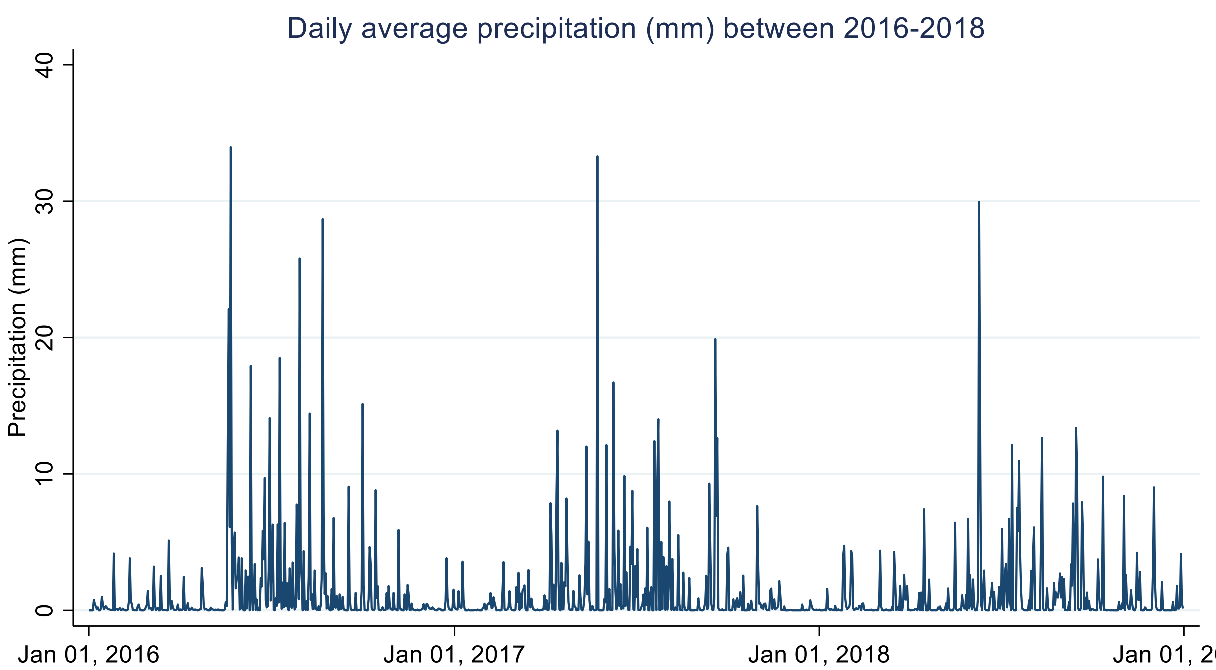
Between 2016 to 2018, the average temperature in Edmonton was 3.78 ℃, with a minimum daily average temperature of -30.09 ℃ and a maximum of 22.81 ℃. The average precipitation was 1.20 mm. The daily average precipitation ranged from 0 to 33.96 mm. For humidity, the three-year average was 71.4%. The minimum daily average humidity was 25.4%, and the maximum was 98.3%. The daily average temperature and precipitation in Edmonton showed significant seasonality. Annually, the temperature gradually rose from winter to summer, reached its peak, and then gradually decreased. Precipitation tended to occur when the temperature was higher. For humidity, the lowest daily average usually occurred in summer. A summary of meteorological factors in Edmonton from January 01, 2016, to December 31, 2018, is presented in figure 3.3.

A



Daily average temperature (℃) between 2016-2018
Air temperature (℃)
20
10
0
-10
-20
-30
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

B



Daily average precipitation (mm) between 2016-2018
Precipitation (mm)
40
30
20
10
0
Jan 01, 2016
Jan 01, 2017
Jan 01, 2018
Jan 01, 20

C

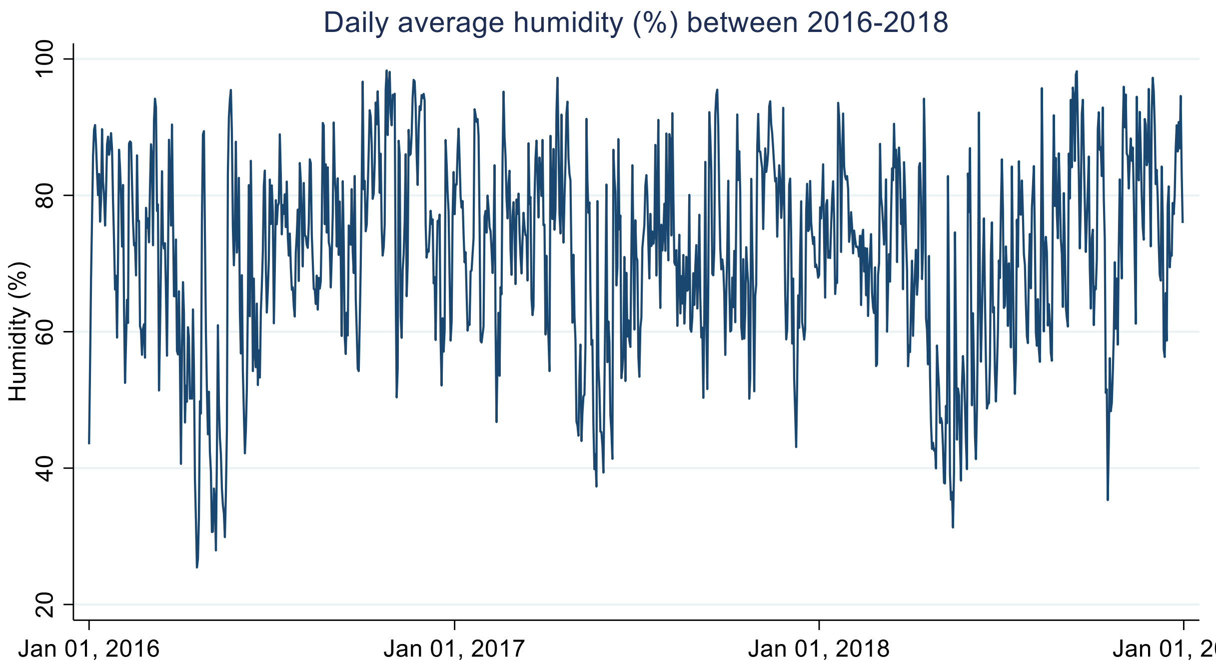


Figure 3.3 Daily average (A) temperature, (B) precipitation, and (C) relative humidity in Edmonton from 2016 to 2018

3.1.4 Summary of missing data

Table 3.4 shows the summary of missing monitoring data. The original data was hourly mean concentrations of air pollutants for each day from 2016 to 2018. One data point was one hourly mean value. The total amount of data points in each area were 26,304 and the total days were 1,096. A day with more than 20% missing data points was regarded as a missing day. As stated in the methods, the calculation of missing data points and missing days did not include pollutants that were specifically not measured there. The monitoring data of NO_2 had the highest percentage of missing data (5.9%) and missing days (6.0%). In contrast, the monitoring data of $PM_{2.5}$ had the lowest percentage of missing data (2.3%), and SO_2 had the lowest percentage of missing days (2.9%).

Table 3.5 shows the summary of missing LUR data. As stated in methods, 2016 ED visit data was used for NO_2, O_3, and SO_2, so the total number of data points for these three pollutants was 2,753 for each pollutant. ED visit data between 2016 to 2018 was used for $PM_{2.5}$, so the total number of data points was 8,250. NO_2 had the highest percentage of missing values (5.45%), followed by SO_2 (4.27%). Health data is matched to LUR data by postal code. Missing data means that there was no LUR data for that postal code.

For other variables, meteorological data and flu data did not have missing values. SES had 253 (3.1%) missing values in three year, 59 (2.1%) missing values in 2016, 88 (3.2%) missing values in 2017, and 106 (3.9%) missing values in 2018.

Table 3.4 Summary of missing data of monitoring data

Area		Pollutant				
		CO	NO_2	O_3	$PM_{2.5}$	SO_2
Central	Missing data points	592 (2.3%)	653 (2.5%)	617 (2.4%)	1591 (6.1%)	-
	Missing days	19 (1.7%)	34 (3.1%)	13 (1.2%)	72 (6.6%)	-
East	Missing data points	610 (2.3%)	767 (2.9%)	729 (2.8%)	-	597 (2.3%)
	Missing days	19 (1.7%)	35 (3.2%)	18 (1.6%)	-	21 (1.9%)
South	Missing data points	1037 (3.9%)	1106 (4.2%)	795 (3.0%)	306 (1.2%)	749 (2.9%)
	Missing days	39 (3.6%)	59 (5.4%)	19 (1.7%)	21 (1.9%)	22 (2.0%)
McIntyre	Missing data points	-	-	-	513 (2.0%)	-
	Missing days	-	-	-	37 (3.4%)	-
St. Albert	Missing data points	3219 (12.2%)	3391 (12.9%)	3182 (12.1%)	-	-
	Missing days	116 (10.6%)	144 (13.1%)	110 (10.0%)	-	-
Woodcraft	Missing data points	-	1802 (6.9%)	1662 (6.3%)	47 (0.2%)	1642 (6.2%)
	Missing days	-	58 (5.3%)	52 (4.7%)	9 (0.8%)	51 (4.7%)
Total	Missing data points	5458 (5.2%)	7719 (5.9%)	6985 (5.3%)	2457 (2.3%)	2988 (3.8%)
	Missing days	193 (4.4%)	330 (6.0%)	212 (3.9%)	139 (3.2%)	94 (2.9%)

Table 3.5 Summary of missing data of LUR data

	Pollutant			
	NO_2 (2015)	O_3 (2016)	$PM_{2.5}$ (2016-2018)	SO_2 (2016)
Missing values	150	1	7	118
Total values	2753	2753	8250	2753
Percentage	5.5%	0.04%	0.1%	4.3%

3.2 Results of time-series regression

3.2.1 Results of lag selection for time-series models

As stated in the methods, in time series analysis, three criteria, the Aka'ke's information criterion (AIC), the Hannan and Quinn information criterion (HQ), and the Schw'rz's Bayesian information criterion (SBIC), were used to determine the optimal numbers of lags. The AIC was used for monthly data, and HQIC and SBIC were used for quarterly data[3]. Since daily data were utilized in this study, AIC was the most appropriate criterion for this study.

In this study, three kinds of time-series models were built: the three-year model, wildfire and non-wildfire models, and models for each year (2016, 2017, and 2018). Three-year models were also stratified by age and sex. According to the results of the AIC, for the three-year models, the optimal number of lags for air pollutants CO, NO_2, O_3, $PM_{2.5}$, and SO_2 were 8, 14, 11, 7, and 9, respectively. The optimal number of lags for the covariate's temperature, humidity, and flu were 10, 13, and 1, respectively.

Models for wildfire season and non-wildfire season were built to explore differences in respiratory emergency department visits among children from 2016 to 2018. For air pollutants CO, NO_2, O_3, $PM_{2.5}$, and SO_2 during the wildfire season, the most appropriate number of lags were 9, 13, 11, 7, and 0, respectively. For meteorological factors temperature, and humidity, the optimal number of lags were 6 and 1. The variable flu does not fit this model due to the small number of cases during the wildfire seasons. For non-wildfire models, the optimal number of lags were 3, 10, 8, 3, and 10 for air pollutants CO, NO_2, O_3, $PM_{2.5}$, and SO_2, respectively. The optimal number of lags for covariates temperature, humidity, and flu in non-wildfire models were 8, 3, and 1, respectively.

Models for the separate years 2016, 2017, and 2018 were built to further explore the impacts of wildfires on children's respiratory issues in Edmonton. According to the AIC, the optimal number of lags were 7, 7, 15, 7, and 0 for CO, NO_2, O_3, $PM_{2.5}$, and SO_2, respectively, in the 2016 models. The optimal number of lags were 3, 1, and 1, respectively, for covariates temperature, humidity, and flu. For 2017 models, the optimal number of lags for air pollutants CO, NO_2, O_3, $PM_{2.5}$, and SO_2, were 8, 14, 11, 9, and 9, respectively. Moreover, for covariates temperature, humidity, and flu, the optimal number of lags were 10, 5, 1, respectively. For 2018 models, the optimal numbers for air pollutants CO, NO_2, O_3, $PM_{2.5}$, and SO_2 were 13, 14, 9, 6, and 9, respectively. For temperature, humidity, and flu, the optimal lags were 8, 1, and 0, respectively.

The complete tables are shown in Appendix: A1 to A8 for three-year models, A9 to A15 for wildfire models, A16 to A23 for non-wildfire models, A24 to A31 for models of 2016, A32 to A39 for models of 2017, and A40 to A 47 for models of 2018.

3.2.2 Results of time-series three-year models

Tables 3.6 to 3.10 show the results of the time-series three-year model for five air pollutants and selected lags over the study period. Incidence rate ratios (IRR) and 95% confidence intervals for daily respiratory emergency visits are shown for a one unit increase in the natural log of air pollutants concentrations. Strong evidence of significant increases in daily respiratory emergency department visits with increasing NO_2 concentrations for the 4-day lag was found. The estimated IRR for daily respiratory ED visits with the increase of NO_2 was 1.085 (95%CI: 1.007, 1.169) indicating an 8.5% increase in expected daily respiratory ED visits among children for one unit increase of natural log after adjusting for other variables. In other words, the expected daily respiratory ED visits among children increased by 8.5% when 4-day lag NO_2 concentrations increased (e-1) times after adjusting for other variables (e: Euler's number. The value is approximately 2.71828). The expected daily respiratory ED visits among children increased by [(IRR-1) * 100] % when pollutant concentration increased (e-1) times, after adjusting for other variables. Results also show evidence of positive associations between daily respiratory ED visits and mean daily O_3 concentration for 5-, 9-, and 11-day lags and evidence of a negative association for 4-day lag. The estimated IRR for the positive association was 1.080 (95%CI: 1.018, 1.146), and for the negative association was 0.880 (95% CI: 0.804, 0.981). The IRR of 5-, 9-, and 11-day lags exposure of O_3 concentration was the same because they were defined as the same in the constrained model. There were no significant associations between daily respiratory ED visits and CO, $PM_{2.5}$ and SO_2 concentrations.

Both AIC and BIC in CO and $PM_{2.5}$ three-year models were only slightly larger than that of the baseline model. AIC in NO_2 and O_3 three-year models were smaller than that of the baseline model, though BIC was larger than that in the baseline model. For three-year SO_2 model, both AIC and

BIC in the three-year model were smaller than in the baseline model. Results of the three-year baseline model are presented in Appendix 2 Table A 2.1.

The number of observations included in models of CO, O_3, and $PM_{2.5}$ was 1,083. This was obtained from 1,096 (total days over three years) minus 13 (maximum number of lags (humidity)). The number of observations of NO_2 model was 1,082, being obtained from 1,096 minus 14 (maximum number of lags (NO_2)). The number of observations included in the SO_2 model was only 647 because there were 58 missing values of SO_2 due to natural log transformation (original value was 0). From SO_2_lag0 to SO_2_lag9, there were 10 variables with 580 missing values in total. Only 436 observations were excluded from the model due to overlap. Thus, the total number of observations was 1,096 minus 13 minus 436.

Table 3.6 Results of time-series three-year model of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.946	0.035	-1.510	0.130	0.881	1.017	
CO_lag1	0.946	0.035	-1.510	0.130	0.881	1.017	
CO_lag2	0.998	0.040	-0.060	0.954	0.922	1.080	
CO_lag3	0.932	0.063	-1.040	0.300	0.816	1.065	
CO_lag4	0.998	0.040	-0.060	0.954	0.922	1.080	
CO_lag5	0.893	0.060	-1.690	0.090	0.783	1.018	*
CO_lag6	1.016	0.069	0.240	0.811	0.890	1.161	
CO_lag7	0.998	0.040	-0.060	0.954	0.922	1.080	
CO_lag8	1.034	0.063	0.550	0.584	0.918	1.165	
Temperature_lag0	1.007	0.005	1.550	0.121	0.998	1.016	
Temperature_lag1	0.994	0.006	-0.900	0.368	0.982	1.007	
Temperature_lag2	1.008	0.006	1.290	0.195	0.996	1.021	
Temperature_lag3	0.994	0.006	-0.930	0.352	0.982	1.007	
Temperature_lag4	1.007	0.007	1.060	0.290	0.994	1.020	
Temperature_lag5	0.997	0.006	-0.540	0.586	0.984	1.009	
Temperature_lag6	0.998	0.006	-0.330	0.738	0.985	1.010	
Temperature_lag7	1.001	0.006	0.100	0.921	0.988	1.013	
Temperature_lag8	1.002	0.006	0.290	0.772	0.989	1.014	
Temperature_lag9	1.006	0.006	1.030	0.304	0.994	1.019	
Temperature_lag10	0.995	0.004	-1.230	0.219	0.986	1.003	
Humidity_lag0	1.000	0.002	0.050	0.958	0.997	1.003	
Humidity_lag1	0.999	0.002	-0.440	0.659	0.995	1.003	
Humidity_lag2	1.000	0.002	0.170	0.869	0.997	1.004	
Humidity_lag3	1.000	0.002	-0.060	0.950	0.996	1.004	
Humidity_lag4	1.001	0.002	0.510	0.613	0.997	1.005	

Humidity_lag5	1.000	0.002	-0.190	0.846	0.996	1.003	
Humidity_lag6	0.999	0.002	-0.330	0.742	0.996	1.003	
Humidity_lag7	0.999	0.002	-0.610	0.544	0.995	1.003	
Humidity_lag8	1.002	0.002	1.030	0.304	0.998	1.006	
Humidity_lag9	1.000	0.002	0.240	0.812	0.997	1.004	
Humidity_lag10	1.001	0.002	0.510	0.611	0.997	1.005	
Humidity_lag11	1.000	0.002	-0.240	0.813	0.996	1.003	
Humidity_lag12	1.000	0.002	0.010	0.989	0.996	1.004	
Humidity_lag13	1.001	0.001	0.420	0.676	0.998	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.081	0.031	2.690	0.007	1.021	1.144	***
Flu_lag0	0.985	0.029	-0.510	0.612	0.930	1.044	
Flu_lag1	0.990	0.030	-0.350	0.724	0.933	1.049	
Flu_lag2	0.940	0.028	-2.070	0.038	0.887	0.997	**
Flu_lag3	1.023	0.030	0.750	0.455	0.965	1.084	
Flu_lag4	1.020	0.030	0.660	0.510	0.962	1.081	
Flu_lag5	0.959	0.029	-1.400	0.163	0.904	1.017	
Flu_lag6	1.061	0.032	1.950	0.051	1.000	1.125	*
Flu_lag7	1.043	0.031	1.380	0.168	0.983	1.106	
Flu_lag8	1.030	0.031	0.980	0.328	0.971	1.092	
Flu_lag9	1.013	0.030	0.450	0.655	0.956	1.075	
Flu_lag10	1.005	0.030	0.150	0.880	0.947	1.065	
Flu_lag11	0.958	0.029	-1.440	0.151	0.903	1.016	
Flu_lag12	0.983	0.029	-0.580	0.559	0.928	1.041	
cos_1	1.647	0.105	7.820	0.000	1.453	1.866	***
cos_2	0.891	0.018	-5.580	0.000	0.856	0.928	***
cos_3	1.192	0.024	8.930	0.000	1.147	1.239	***
cos_4	1.087	0.021	4.260	0.000	1.046	1.130	***
sin_1	1.087	0.034	2.700	0.007	1.023	1.155	***
sin_2	0.944	0.019	-2.800	0.005	0.907	0.983	***
sin_3	1.216	0.025	9.590	0.000	1.168	1.265	***
sin_4	0.843	0.016	-9.090	0.000	0.812	0.874	***
Constant	4.093	0.857	6.730	0.000	2.715	6.171	***
lnalpha	-3.063	0.164	.b	.b	-3.385	-2.742	
Mean dependent var	7.538		SD dependent var		4.081		
Pseudo r-squared	.		Number of obs		1083		
Chi-square	613.270		Prob > chi2		0.000		
Akaike crit. (AIC)	5557.175		Bayesian crit. (BIC)		5831.487		

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg dailycounts colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.7 Results of time-series three-year model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	1.001	0.015	0.040	0.964	0.971	1.031	
NO_2_lag1	1.001	0.015	0.040	0.964	0.971	1.031	
NO_2_lag2	1.014	0.038	0.370	0.713	0.942	1.091	
NO_2_lag3	0.983	0.019	-0.870	0.383	0.947	1.021	
NO_2_lag4	**1.085**	**0.041**	**2.150**	**0.032**	**1.007**	**1.169**	**
NO_2_lag5	0.983	0.019	-0.870	0.383	0.947	1.021	
NO_2_lag6	1.043	0.040	1.080	0.278	0.967	1.125	
NO_2_lag7	0.983	0.019	-0.870	0.383	0.947	1.021	
NO_2_lag8	1.033	0.039	0.860	0.391	0.959	1.111	
NO_2_lag9	1.001	0.015	0.040	0.964	0.971	1.031	
NO_2_lag10	1.001	0.015	0.040	0.964	0.971	1.031	
NO_2_lag11	0.972	0.022	-1.280	0.199	0.931	1.015	
NO_2_lag12	0.972	0.022	-1.280	0.199	0.931	1.015	
NO_2_lag13	1.001	0.015	0.040	0.964	0.971	1.031	
NO_2_lag14	0.983	0.019	-0.870	0.383	0.947	1.021	
Temperature_lag0	1.005	0.005	1.050	0.292	0.996	1.014	
Temperature_lag1	0.995	0.006	-0.800	0.426	0.983	1.007	
Temperature_lag2	1.009	0.006	1.410	0.159	0.996	1.022	
Temperature_lag3	0.990	0.007	-1.450	0.147	0.978	1.003	
Temperature_lag4	1.008	0.006	1.310	0.191	0.996	1.021	
Temperature_lag5	0.995	0.007	-0.800	0.426	0.982	1.008	
Temperature_lag6	1.000	0.006	0.010	0.990	0.988	1.013	
Temperature_lag7	1.001	0.007	0.160	0.877	0.988	1.014	
Temperature_lag8	1.003	0.006	0.390	0.693	0.990	1.015	
Temperature_lag9	1.007	0.006	1.180	0.237	0.995	1.020	
Temperature_lag10	0.996	0.005	-0.820	0.412	0.987	1.005	
Humidity_lag0	1.000	0.002	-0.080	0.940	0.997	1.003	
Humidity_lag1	0.999	0.002	-0.460	0.647	0.995	1.003	
Humidity_lag2	1.000	0.002	0.180	0.858	0.997	1.004	
Humidity_lag3	1.000	0.002	-0.240	0.810	0.996	1.003	
Humidity_lag4	1.001	0.002	0.710	0.480	0.998	1.005	
Humidity_lag5	1.000	0.002	-0.220	0.828	0.996	1.003	
Humidity_lag6	1.000	0.002	-0.120	0.901	0.996	1.004	
Humidity_lag7	0.999	0.002	-0.550	0.585	0.995	1.003	
Humidity_lag8	1.002	0.002	1.120	0.262	0.998	1.006	
Humidity_lag9	1.001	0.002	0.370	0.709	0.997	1.005	
Humidity_lag10	1.001	0.002	0.630	0.529	0.998	1.005	
Humidity_lag11	0.999	0.002	-0.380	0.704	0.996	1.003	
Humidity_lag12	1.000	0.002	0.000	0.997	0.996	1.004	
Humidity_lag13	1.000	0.001	0.010	0.989	0.997	1.003	

0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.077	0.033	2.420	0.016	1.014	1.144	**
Flu_lag0	0.987	0.029	-0.430	0.665	0.932	1.046	
Flu_lag1	0.993	0.030	-0.230	0.822	0.937	1.053	
Flu_lag2	0.939	0.028	-2.110	0.034	0.886	0.995	**
Flu_lag3	1.022	0.030	0.740	0.462	0.964	1.084	
Flu_lag4	1.020	0.030	0.660	0.509	0.962	1.081	
Flu_lag5	0.957	0.029	-1.460	0.145	0.902	1.015	
Flu_lag6	1.053	0.032	1.710	0.087	0.993	1.117	*
Flu_lag7	1.043	0.032	1.400	0.162	0.983	1.107	
Flu_lag8	1.026	0.031	0.840	0.400	0.967	1.088	
Flu_lag9	1.014	0.030	0.470	0.640	0.956	1.076	
Flu_lag10	0.997	0.030	-0.110	0.914	0.940	1.057	
Flu_lag11	0.960	0.029	-1.350	0.178	0.906	1.019	
Flu_lag12	0.984	0.029	-0.560	0.575	0.928	1.042	
cos_1	1.576	0.137	5.230	0.000	1.329	1.869	***
cos_2	0.886	0.018	-5.900	0.000	0.851	0.922	***
cos_3	1.193	0.023	8.940	0.000	1.148	1.240	***
cos_4	1.104	0.021	5.120	0.000	1.063	1.147	***
sin_1	1.087	0.036	2.550	0.011	1.020	1.159	**
sin_2	0.935	0.020	-3.140	0.002	0.897	0.975	***
sin_3	1.230	0.025	10.300	0.000	1.182	1.279	***
sin_4	0.842	0.016	-9.120	0.000	0.812	0.874	***
Constant	7.375	3.580	4.120	0.000	2.848	19.099	***
lnalpha	-3.056	0.163	.b	.b	-3.376	-2.736	

Mean dependent var	7.543	SD dependent var	4.081
Pseudo r-squared	.	Number of obs	1082
Chi-square	610.950	Prob > chi2	0.000
Akaike crit. (AIC)	5555.195	Bayesian crit. (BIC)	5834.442

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg dailycounts no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/8) irr

Table 3.8 Results of time-series three-year model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.005	0.026	0.180	0.855	0.954	1.058	
O_3_lag1	1.005	0.026	0.180	0.855	0.954	1.058	
O_3_lag2	1.028	0.039	0.730	0.466	0.955	1.107	
O_3_lag3	1.005	0.026	0.180	0.855	0.954	1.058	
O_3_lag4	**0.888**	**0.045**	**-2.330**	**0.020**	**0.804**	**0.981**	**
O_3_lag5	**1.080**	**0.033**	**2.540**	**0.011**	**1.018**	**1.146**	**

O_3_lag6	0.930	0.047	-1.440	0.149	0.843	1.026	
O_3_lag7	0.970	0.036	-0.820	0.410	0.901	1.044	
O_3_lag8	1.028	0.039	0.730	0.466	0.955	1.107	
O_3_lag9	**1.080**	**0.033**	**2.540**	**0.011**	**1.018**	**1.146**	**
O_3_lag10	0.970	0.036	-0.820	0.410	0.901	1.044	
O_3_lag11	**1.080**	**0.033**	**2.540**	**0.011**	**1.018**	**1.146**	**
Temperature_lag0	1.005	0.004	1.110	0.268	0.996	1.014	
Temperature_lag1	0.996	0.006	-0.630	0.528	0.984	1.008	
Temperature_lag2	1.007	0.006	1.050	0.294	0.994	1.019	
Temperature_lag3	0.992	0.006	-1.180	0.240	0.980	1.005	
Temperature_lag4	1.009	0.006	1.360	0.174	0.996	1.022	
Temperature_lag5	0.995	0.006	-0.820	0.410	0.982	1.007	
Temperature_lag6	0.999	0.006	-0.200	0.839	0.986	1.011	
Temperature_lag7	1.002	0.006	0.330	0.739	0.990	1.015	
Temperature_lag8	1.004	0.006	0.560	0.573	0.991	1.016	
Temperature_lag9	1.005	0.006	0.860	0.388	0.993	1.018	
Temperature_lag10	0.996	0.004	-0.900	0.366	0.987	1.005	
Humidity_lag0	1.000	0.002	0.130	0.894	0.997	1.003	
Humidity_lag1	0.999	0.002	-0.410	0.683	0.995	1.003	
Humidity_lag2	1.000	0.002	0.180	0.857	0.996	1.004	
Humidity_lag3	1.000	0.002	-0.140	0.889	0.996	1.004	
Humidity_lag4	1.000	0.002	-0.220	0.828	0.996	1.004	
Humidity_lag5	1.000	0.002	0.180	0.860	0.996	1.004	
Humidity_lag6	0.999	0.002	-0.690	0.493	0.995	1.003	
Humidity_lag7	0.999	0.002	-0.710	0.480	0.995	1.002	
Humidity_lag8	1.003	0.002	1.390	0.166	0.999	1.007	
Humidity_lag9	1.001	0.002	0.650	0.514	0.997	1.005	
Humidity_lag10	1.001	0.002	0.350	0.723	0.997	1.004	
Humidity_lag11	1.001	0.002	0.530	0.598	0.997	1.005	
Humidity_lag12	1.000	0.002	0.080	0.936	0.997	1.004	
Humidity_lag13	1.000	0.001	0.220	0.829	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.087	0.031	2.880	0.004	1.027	1.150	***
Flu_lag0	0.978	0.029	-0.750	0.456	0.923	1.036	
Flu_lag1	0.998	0.030	-0.070	0.946	0.941	1.058	
Flu_lag2	0.934	0.028	-2.300	0.021	0.881	0.990	**
Flu_lag3	1.023	0.030	0.760	0.449	0.965	1.084	
Flu_lag4	1.025	0.031	0.820	0.413	0.967	1.086	
Flu_lag5	0.959	0.029	-1.380	0.167	0.905	1.018	
Flu_lag6	1.052	0.032	1.680	0.093	0.992	1.116	*
Flu_lag7	1.047	0.032	1.500	0.132	0.986	1.111	
Flu_lag8	1.026	0.031	0.880	0.381	0.968	1.088	
Flu_lag9	1.007	0.030	0.240	0.811	0.949	1.069	
Flu_lag10	1.010	0.030	0.330	0.744	0.952	1.071	

Flu_lag11	0.959	0.029	-1.390	0.163	0.905	1.017	
Flu_lag12	0.986	0.029	-0.480	0.628	0.930	1.044	
cos_1	1.632	0.134	5.970	0.000	1.390	1.917	***
cos_2	0.887	0.019	-5.670	0.000	0.851	0.925	***
cos_3	1.189	0.024	8.610	0.000	1.143	1.236	***
cos_4	1.099	0.022	4.760	0.000	1.057	1.142	***
sin_1	1.076	0.033	2.370	0.018	1.013	1.143	**
sin_2	0.934	0.020	-3.150	0.002	0.896	0.975	***
sin_3	1.234	0.027	9.660	0.000	1.183	1.288	***
sin_4	0.840	0.016	-9.250	0.000	0.809	0.872	***
Constant	6.516	1.796	6.800	0.000	3.796	11.185	***
lnalpha	-3.074	0.166	.b	.b	-3.400	-2.749	

Mean dependent var	7.538	SD dependent var	4.081
Pseudo r-squared	.	Number of obs	1083
Chi-square	615.163	Prob > chi2	0.000
Akaike crit. (AIC)	5556.252	Bayesian crit. (BIC)	5830.564

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

asdoc xi: nbreg dailycounts o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/6) irr

Table 3.9 Results of time-series three-year model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.994	0.018	-0.330	0.741	0.960	1.029	
$PM_{2.5}$_lag1	0.967	0.030	-1.100	0.273	0.910	1.027	
$PM_{2.5}$_lag2	0.994	0.018	-0.330	0.741	0.960	1.029	
$PM_{2.5}$_lag3	1.003	0.021	0.150	0.881	0.963	1.045	
$PM_{2.5}$_lag4	0.981	0.020	-0.910	0.364	0.942	1.022	
$PM_{2.5}$_lag5	0.994	0.018	-0.330	0.741	0.960	1.029	
$PM_{2.5}$_lag6	0.981	0.020	-0.910	0.364	0.942	1.022	
$PM_{2.5}$_lag7	1.003	0.021	0.150	0.881	0.963	1.045	
Temperature_lag0	1.006	0.004	1.400	0.161	0.998	1.015	
Temperature_lag1	0.996	0.006	-0.700	0.486	0.984	1.008	
Temperature_lag2	1.006	0.007	0.990	0.321	0.994	1.019	
Temperature_lag3	0.994	0.007	-0.840	0.399	0.982	1.007	
Temperature_lag4	1.006	0.007	0.930	0.350	0.993	1.019	
Temperature_lag5	0.997	0.006	-0.550	0.582	0.984	1.009	
Temperature_lag6	0.999	0.006	-0.190	0.850	0.986	1.011	
Temperature_lag7	1.000	0.006	0.010	0.991	0.988	1.013	
Temperature_lag8	1.003	0.006	0.460	0.647	0.990	1.016	
Temperature_lag9	1.007	0.006	1.050	0.293	0.994	1.019	
Temperature_lag10	0.995	0.004	-1.200	0.229	0.986	1.003	

Humidity_lag0	1.000	0.002	0.170	0.868	0.997	1.003	
Humidity_lag1	0.999	0.002	-0.270	0.786	0.996	1.003	
Humidity_lag2	1.000	0.002	0.010	0.989	0.996	1.004	
Humidity_lag3	1.000	0.002	-0.180	0.855	0.996	1.004	
Humidity_lag4	1.001	0.002	0.630	0.527	0.997	1.005	
Humidity_lag5	0.999	0.002	-0.300	0.762	0.996	1.003	
Humidity_lag6	1.000	0.002	-0.100	0.918	0.996	1.004	
Humidity_lag7	0.998	0.002	-0.760	0.446	0.995	1.002	
Humidity_lag8	1.002	0.002	1.140	0.252	0.998	1.006	
Humidity_lag9	1.000	0.002	0.250	0.799	0.997	1.004	
Humidity_lag10	1.001	0.002	0.530	0.599	0.997	1.005	
Humidity_lag11	1.000	0.002	-0.240	0.812	0.996	1.003	
Humidity_lag12	1.000	0.002	0.060	0.950	0.997	1.004	
Humidity_lag13	1.000	0.001	0.190	0.850	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.079	0.031	2.670	0.008	1.020	1.141	***
Flu_lag0	0.984	0.029	-0.550	0.584	0.928	1.043	
Flu_lag1	0.992	0.030	-0.280	0.781	0.935	1.052	
Flu_lag2	0.937	0.028	-2.180	0.029	0.884	0.994	**
Flu_lag3	1.024	0.031	0.800	0.421	0.966	1.086	
Flu_lag4	1.015	0.030	0.500	0.614	0.957	1.076	
Flu_lag5	0.960	0.029	-1.370	0.171	0.905	1.018	
Flu_lag6	1.058	0.032	1.870	0.062	0.997	1.122	*
Flu_lag7	1.042	0.032	1.360	0.175	0.982	1.106	
Flu_lag8	1.029	0.031	0.960	0.336	0.971	1.091	
Flu_lag9	1.015	0.031	0.490	0.621	0.957	1.077	
Flu_lag10	1.004	0.030	0.140	0.892	0.947	1.065	
Flu_lag11	0.959	0.029	-1.390	0.166	0.905	1.017	
Flu_lag12	0.987	0.029	-0.440	0.662	0.932	1.046	
cos_1	1.583	0.098	7.440	0.000	1.403	1.787	***
cos_2	0.892	0.019	-5.470	0.000	0.856	0.929	***
cos_3	1.194	0.024	8.950	0.000	1.148	1.241	***
cos_4	1.085	0.022	4.050	0.000	1.043	1.129	***
sin_1	1.077	0.033	2.440	0.015	1.015	1.143	**
sin_2	0.945	0.020	-2.730	0.006	0.907	0.984	***
sin_3	1.215	0.025	9.450	0.000	1.167	1.265	***
sin_4	0.844	0.016	-8.960	0.000	0.813	0.876	***
Constant	6.831	1.169	11.230	0.000	4.884	9.553	***
lnalpha	-3.043	0.162	.b	.b	-3.360	-2.725	
Mean dependent var	7.538		SD dependent var	4.081			
Pseudo r-squared	.		Number of obs	1083			
Chi-square	605.790		Prob > chi2	0.000			
Akaike crit. (AIC)	5558.618		Bayesian crit. (BIC)	5822.955			

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend
xi: nbreg dailycounts pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.10 Results of time-series three-year model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.994	0.016	-0.360	0.722	0.962	1.027	
SO_2_lag1	1.006	0.017	0.330	0.740	0.973	1.039	
SO_2_lag2	1.015	0.017	0.860	0.391	0.982	1.049	
SO_2_lag3	1.010	0.017	0.600	0.551	0.977	1.044	
SO_2_lag4	1.005	0.017	0.300	0.766	0.972	1.039	
SO_2_lag5	0.996	0.017	-0.230	0.821	0.964	1.029	
SO_2_lag6	1.011	0.017	0.670	0.503	0.978	1.045	
SO_2_lag7	1.012	0.017	0.730	0.466	0.980	1.046	
SO_2_lag8	1.014	0.016	0.870	0.382	0.983	1.047	
SO_2_lag9	1.018	0.017	1.090	0.277	0.986	1.051	
Temperature_lag0	1.002	0.005	0.380	0.702	0.992	1.012	
Temperature_lag1	0.996	0.007	-0.540	0.587	0.983	1.010	
Temperature_lag2	1.008	0.007	1.160	0.245	0.994	1.023	
Temperature_lag3	0.992	0.007	-1.130	0.260	0.978	1.006	
Temperature_lag4	1.001	0.007	0.090	0.929	0.987	1.015	
Temperature_lag5	0.999	0.007	-0.100	0.920	0.986	1.013	
Temperature_lag6	1.000	0.007	-0.070	0.947	0.986	1.014	
Temperature_lag7	1.001	0.007	0.130	0.893	0.987	1.015	
Temperature_lag8	1.002	0.007	0.260	0.799	0.988	1.016	
Temperature_lag9	1.010	0.007	1.530	0.125	0.997	1.024	
Temperature_lag10	0.995	0.005	-1.070	0.286	0.985	1.004	
Humidity_lag0	0.999	0.002	-0.480	0.629	0.995	1.003	
Humidity_lag1	0.999	0.002	-0.520	0.606	0.994	1.003	
Humidity_lag2	1.001	0.002	0.460	0.644	0.996	1.006	
Humidity_lag3	1.000	0.002	-0.130	0.900	0.995	1.004	
Humidity_lag4	1.001	0.002	0.430	0.664	0.996	1.006	
Humidity_lag5	0.997	0.002	-1.070	0.285	0.993	1.002	
Humidity_lag6	1.001	0.002	0.270	0.786	0.996	1.005	
Humidity_lag7	0.999	0.002	-0.490	0.626	0.994	1.004	
Humidity_lag8	1.002	0.002	0.940	0.349	0.997	1.007	
Humidity_lag9	1.000	0.002	-0.170	0.867	0.995	1.004	
Humidity_lag10	1.001	0.002	0.580	0.564	0.997	1.006	
Humidity_lag11	0.999	0.002	-0.240	0.809	0.995	1.004	
Humidity_lag12	1.000	0.002	0.140	0.889	0.996	1.005	
Humidity_lag13	0.999	0.002	-0.540	0.589	0.995	1.003	

0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.066	0.038	1.810	0.070	0.995	1.142	*
Flu_lag0	0.977	0.034	-0.660	0.507	0.913	1.046	
Flu_lag1	0.949	0.033	-1.510	0.130	0.886	1.016	
Flu_lag2	0.906	0.031	-2.870	0.004	0.847	0.969	***
Flu_lag3	1.040	0.036	1.120	0.265	0.971	1.114	
Flu_lag4	1.005	0.035	0.130	0.896	0.938	1.076	
Flu_lag5	0.956	0.034	-1.270	0.203	0.892	1.025	
Flu_lag6	1.050	0.038	1.370	0.171	0.979	1.127	
Flu_lag7	1.072	0.039	1.940	0.052	0.999	1.151	*
Flu_lag8	1.055	0.037	1.530	0.126	0.985	1.130	
Flu_lag9	1.061	0.038	1.680	0.093	0.990	1.138	*
Flu_lag10	1.038	0.036	1.060	0.289	0.969	1.111	
Flu_lag11	0.980	0.034	-0.570	0.569	0.916	1.049	
Flu_lag12	0.962	0.033	-1.130	0.257	0.899	1.029	
cos_1	1.596	0.107	6.960	0.000	1.399	1.820	***
cos_2	0.922	0.025	-3.050	0.002	0.875	0.971	***
cos_3	1.165	0.029	6.050	0.000	1.109	1.224	***
cos_4	1.090	0.027	3.470	0.001	1.038	1.145	***
sin_1	1.067	0.040	1.720	0.086	0.991	1.148	*
sin_2	0.901	0.025	-3.760	0.000	0.854	0.952	***
sin_3	1.178	0.031	6.280	0.000	1.119	1.239	***
sin_4	0.877	0.021	-5.430	0.000	0.837	0.920	***
Constant	13.856	5.517	6.600	0.000	6.349	30.238	***
lnalpha	-3.671	0.342	.b	.b	-4.342	-3.000	
Mean dependent var	7.344		SD dependent var		3.975		
Pseudo r-squared	0.110		Number of obs		674		
Chi-square	407.782		Prob > chi2		0.000		
Akaike crit. (AIC)	3411.074		Bayesian crit. (BIC)		3677.354		

*** p<.01, ** p<.05, * p<.1

H&W: holiday & weekend

xi: nbreg dailycounts so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/5) irr

3.2.3 Results of time-series sex-stratified models

Tables 3.11 to 3.20 present the adjusted results of the sex-stratified models for the five air pollutants and selected lags over the study period. IRRs and 95% confidence intervals for daily respiratory ED visits by different sex are shown as a one unit increase in the natural log of air pollutants concentrations. In other words, expected daily respiratory ED visits among children increased by [(IRR-1) * 100] % when air pollutant concentration increased (e-1) times after adjusting for other variables (e: Euler's number. The value is approximately 2.71828). For male children, strong evidence of a positive association between daily respiratory ED visits and 4-, 6-, and 8-day lag exposures to NO_2 was found. The estimated IRR was 1.071 (95%CI: 1.009-1.137), indicating a 7.1% significant increase in expected daily respiratory ED visits of male children for one unit increase of natural log of 4-day lag NO_2 concentration after adjusting for other variables. The results also show evidence of positive associations between daily respiratory ED visits and exposure to 5- and 11-day lags of O_3 concentration. The estimated IRR was 1.109 (95%CI: 1.017-1.210). No significant associations of exposure to CO, $PM_{2.5}$, and SO_2 were found for male children. For female children, there were no significant associations between daily respiratory ED visits and exposure to the five pollutants.

For female children, both AIC and BIC in sex-stratified models of CO, NO_2, O_3, and $PM_{2.5}$ were larger than in the baseline models. Both AIC and BIC in SO_2 sex-stratified model were smaller than in the baseline model. Results of the female sex-stratified baseline model is presented in Appendix 2 Table A 2.2. For male children, AIC in CO and NO_2 sex-stratified models were smaller than in the baseline model, and BIC were larger than in the baseline model. Both AIC and BIC in O_3 and $PM_{2.5}$ sex-stratified models were larger than in the baseline model. Both AIC and BIC in SO_2 sex-stratified models were smaller than in the baseline models. Results of the male sex-stratified baseline model are presented in Appendix 2 Table A 2.3.

Table 3.11 Results of time-series sex-stratified model of associations between daily respiratory ED visits among female children and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.946	0.094	-0.570	0.572	0.778	1.148	
CO_lag1	0.984	0.081	-0.200	0.843	0.837	1.156	
CO_lag2	0.966	0.109	-0.310	0.758	0.775	1.204	
CO_lag3	0.984	0.081	-0.200	0.843	0.837	1.156	
CO_lag4	0.998	0.107	-0.010	0.988	0.809	1.232	
CO_lag5	1.013	0.113	0.110	0.909	0.814	1.261	
CO_lag6	1.105	0.124	0.880	0.376	0.886	1.377	
CO_lag7	0.929	0.103	-0.660	0.508	0.747	1.155	
CO_lag8	1.039	0.104	0.380	0.702	0.854	1.265	
Temperature_lag0	1.003	0.007	0.410	0.683	0.989	1.017	
Temperature_lag1	1.001	0.010	0.090	0.925	0.982	1.020	
Temperature_lag2	1.015	0.010	1.550	0.121	0.996	1.034	

Temperature_lag3	0.980	0.010	-2.070	0.039	0.961	0.999	**
Temperature_lag4	1.017	0.010	1.760	0.079	0.998	1.037	*
Temperature_lag5	0.981	0.010	-2.000	0.045	0.962	1.000	**
Temperature_lag6	1.002	0.010	0.250	0.801	0.983	1.022	
Temperature_lag7	1.011	0.010	1.140	0.255	0.992	1.031	
Temperature_lag8	1.002	0.010	0.210	0.833	0.983	1.021	
Temperature_lag9	0.997	0.009	-0.320	0.747	0.979	1.016	
Temperature_lag10	1.002	0.007	0.310	0.754	0.989	1.016	
Humidity_lag0	1.000	0.002	-0.200	0.842	0.995	1.004	
Humidity_lag1	1.003	0.003	1.070	0.285	0.997	1.009	
Humidity_lag2	1.000	0.003	0.040	0.966	0.994	1.006	
Humidity_lag3	1.000	0.003	-0.150	0.882	0.994	1.006	
Humidity_lag4	1.000	0.003	-0.010	0.993	0.994	1.006	
Humidity_lag5	0.996	0.003	-1.330	0.182	0.990	1.002	
Humidity_lag6	1.002	0.003	0.600	0.548	0.996	1.008	
Humidity_lag7	1.000	0.003	-0.150	0.880	0.994	1.006	
Humidity_lag8	1.002	0.003	0.660	0.507	0.996	1.008	
Humidity_lag9	1.002	0.003	0.500	0.618	0.996	1.008	
Humidity_lag10	1.000	0.003	-0.150	0.881	0.994	1.005	
Humidity_lag11	1.001	0.003	0.360	0.719	0.995	1.007	
Humidity_lag12	0.999	0.003	-0.290	0.769	0.994	1.005	
Humidity_lag13	1.001	0.002	0.520	0.601	0.997	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.063	0.049	1.340	0.179	0.972	1.163	
Flu_lag0	0.941	0.043	-1.350	0.177	0.861	1.028	
Flu_lag1	1.016	0.047	0.350	0.725	0.929	1.112	
Flu_lag2	0.938	0.043	-1.400	0.163	0.858	1.026	
Flu_lag3	1.011	0.046	0.230	0.815	0.924	1.105	
Flu_lag4	1.031	0.047	0.660	0.510	0.942	1.127	
Flu_lag5	1.006	0.046	0.130	0.899	0.919	1.101	
Flu_lag6	1.073	0.050	1.520	0.127	0.980	1.175	
Flu_lag7	1.089	0.051	1.840	0.066	0.994	1.193	*
Flu_lag8	1.023	0.047	0.490	0.627	0.934	1.119	
Flu_lag9	0.976	0.045	-0.540	0.592	0.892	1.068	
Flu_lag10	0.991	0.045	-0.200	0.838	0.906	1.083	
Flu_lag11	0.980	0.044	-0.450	0.651	0.896	1.071	
Flu_lag12	0.935	0.042	-1.480	0.138	0.856	1.022	
cos_1	1.767	0.171	5.880	0.000	1.462	2.137	***
cos_2	0.908	0.030	-2.960	0.003	0.852	0.968	***
cos_3	1.277	0.040	7.840	0.000	1.202	1.358	***
cos_4	1.042	0.032	1.340	0.180	0.981	1.107	
sin_1	1.137	0.054	2.710	0.007	1.036	1.248	***

sin_2	0.938	0.030	-2.010	0.045	0.881	0.998	**
sin_3	1.191	0.038	5.490	0.000	1.119	1.268	***
sin_4	0.839	0.025	-5.950	0.000	0.792	0.889	***
Constant	1.713	0.547	1.680	0.092	0.916	3.204	*
lnalpha	-2.588	0.252	.b	.b	-3.083	-2.093	
Mean dependent var	2.820		SD dependent var		2.144		
Pseudo r-squared	.		Number of obs		1083		
Chi-square	330.918		Prob > chi2		0.000		
Akaike crit. (AIC)	4280.690		Bayesian crit. (BIC)		4564.977		

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg female colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/1) irr

Table 3.12 Results of time-series sex-stratified model of associations between daily respiratory ED visits among male children and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.929	0.050	-1.370	0.172	0.835	1.033	
CO_lag1	0.895	0.072	-1.380	0.166	0.765	1.047	
CO_lag2	1.041	0.084	0.500	0.614	0.890	1.219	
CO_lag3	0.929	0.050	-1.370	0.172	0.835	1.033	
CO_lag4	0.929	0.037	-1.840	0.066	0.859	1.005	*
CO_lag5	0.929	0.037	-1.840	0.066	0.859	1.005	*
CO_lag6	0.950	0.076	-0.640	0.519	0.812	1.111	
CO_lag7	0.929	0.037	-1.840	0.066	0.859	1.005	*
CO_lag8	1.098	0.077	1.320	0.185	0.956	1.261	
Temperature_lag0	1.011	0.005	2.080	0.038	1.001	1.021	**
Temperature_lag1	0.989	0.007	-1.440	0.150	0.975	1.004	
Temperature_lag2	1.004	0.008	0.560	0.574	0.990	1.019	
Temperature_lag3	1.004	0.007	0.500	0.618	0.989	1.018	
Temperature_lag4	0.999	0.007	-0.080	0.936	0.985	1.014	
Temperature_lag5	1.006	0.007	0.780	0.433	0.991	1.020	
Temperature_lag6	0.998	0.007	-0.280	0.780	0.984	1.012	
Temperature_lag7	0.992	0.007	-1.020	0.306	0.978	1.007	
Temperature_lag8	1.001	0.007	0.160	0.875	0.987	1.016	
Temperature_lag9	1.013	0.007	1.820	0.068	0.999	1.027	*
Temperature_lag10	0.990	0.005	-2.020	0.043	0.980	1.000	**
Humidity_lag0	1.001	0.002	0.370	0.712	0.997	1.004	
Humidity_lag1	0.997	0.002	-1.490	0.136	0.992	1.001	
Humidity_lag2	1.000	0.002	0.060	0.954	0.996	1.005	
Humidity_lag3	1.000	0.002	0.130	0.895	0.996	1.005	
Humidity_lag4	1.002	0.002	0.690	0.492	0.997	1.006	

Humidity_lag5	1.002	0.002	0.700	0.482	0.997	1.006	
Humidity_lag6	0.999	0.002	-0.660	0.509	0.994	1.003	
Humidity_lag7	0.998	0.002	-0.760	0.449	0.994	1.003	
Humidity_lag8	1.001	0.002	0.560	0.578	0.997	1.006	
Humidity_lag9	1.000	0.002	0.110	0.910	0.996	1.005	
Humidity_lag10	1.002	0.002	0.910	0.361	0.998	1.006	
Humidity_lag11	0.998	0.002	-0.720	0.469	0.994	1.003	
Humidity_lag12	1.000	0.002	0.190	0.845	0.996	1.005	
Humidity_lag13	1.000	0.002	0.250	0.805	0.997	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.082	0.036	2.360	0.018	1.013	1.155	**
Flu_lag0	1.014	0.035	0.420	0.677	0.949	1.085	
Flu_lag1	0.970	0.034	-0.890	0.374	0.906	1.038	
Flu_lag2	0.944	0.033	-1.660	0.096	0.882	1.010	*
Flu_lag3	1.031	0.035	0.890	0.372	0.964	1.103	
Flu_lag4	1.008	0.035	0.220	0.826	0.942	1.078	
Flu_lag5	0.932	0.032	-2.010	0.044	0.871	0.998	**
Flu_lag6	1.056	0.037	1.560	0.119	0.986	1.130	
Flu_lag7	1.011	0.035	0.320	0.747	0.944	1.083	
Flu_lag8	1.034	0.036	0.970	0.330	0.967	1.106	
Flu_lag9	1.042	0.036	1.190	0.233	0.974	1.115	
Flu_lag10	1.008	0.035	0.240	0.812	0.942	1.079	
Flu_lag11	0.943	0.033	-1.690	0.091	0.881	1.009	*
Flu_lag12	1.017	0.035	0.490	0.623	0.951	1.087	
cos_1	1.590	0.118	6.260	0.000	1.375	1.839	***
cos_2	0.876	0.021	-5.590	0.000	0.836	0.918	***
cos_3	1.153	0.026	6.270	0.000	1.103	1.205	***
cos_4	1.108	0.025	4.540	0.000	1.060	1.158	***
sin_1	1.062	0.038	1.690	0.091	0.990	1.140	*
sin_2	0.952	0.023	-2.040	0.042	0.909	0.998	**
sin_3	1.226	0.029	8.700	0.000	1.171	1.284	***
sin_4	0.843	0.018	-7.840	0.000	0.808	0.880	***
Constant	2.293	0.554	3.440	0.001	1.429	3.680	***
lnalpha	-3.602	0.372	.b	.b	-4.331	-2.873	

Mean dependent var	4.718	SD dependent var	2.782
Pseudo r-squared	.	Number of obs	1083
Chi-square	440.540	Prob > chi2	0.000
Akaike crit. (AIC)	4859.192	Bayesian crit. (BIC)	5133.504

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg male colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/3) irr

Table 3.13 Results of time-series sex-stratified model of associations between daily respiratory ED visits among female children and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	0.999	0.031	-0.020	0.984	0.940	1.062	
NO_2_lag1	0.982	0.028	-0.660	0.510	0.929	1.038	
NO_2_lag2	0.999	0.031	-0.020	0.984	0.940	1.062	
NO_2_lag3	1.024	0.036	0.670	0.501	0.955	1.098	
NO_2_lag4	1.043	0.065	0.690	0.492	0.924	1.178	
NO_2_lag5	1.107	0.067	1.680	0.094	0.983	1.247	*
NO_2_lag6	1.024	0.036	0.670	0.501	0.955	1.098	
NO_2_lag7	0.944	0.058	-0.940	0.348	0.836	1.065	
NO_2_lag8	0.982	0.028	-0.660	0.510	0.929	1.038	
NO_2_lag9	1.024	0.036	0.670	0.501	0.955	1.098	
NO_2_lag10	0.999	0.031	-0.020	0.984	0.940	1.062	
NO_2_lag11	0.920	0.052	-1.470	0.142	0.823	1.028	
NO_2_lag12	0.982	0.028	-0.660	0.510	0.929	1.038	
NO_2_lag13	0.999	0.031	-0.020	0.984	0.940	1.062	
NO_2_lag14	0.982	0.028	-0.660	0.510	0.929	1.038	
Temperature_lag0	1.002	0.007	0.250	0.806	0.989	1.015	
Temperature_lag1	1.002	0.009	0.270	0.788	0.985	1.021	
Temperature_lag2	1.014	0.010	1.400	0.161	0.995	1.033	
Temperature_lag3	0.978	0.010	-2.190	0.028	0.959	0.998	**
Temperature_lag4	1.017	0.010	1.640	0.102	0.997	1.037	
Temperature_lag5	0.981	0.010	-1.920	0.055	0.962	1.000	*
Temperature_lag6	1.006	0.010	0.590	0.553	0.986	1.026	
Temperature_lag7	1.012	0.010	1.270	0.204	0.993	1.032	
Temperature_lag8	1.001	0.010	0.130	0.898	0.982	1.020	
Temperature_lag9	0.997	0.009	-0.270	0.786	0.979	1.016	
Temperature_lag10	1.004	0.007	0.520	0.602	0.990	1.017	
Humidity_lag0	1.000	0.002	-0.120	0.907	0.995	1.005	
Humidity_lag1	1.003	0.003	1.110	0.266	0.997	1.009	
Humidity_lag2	0.999	0.003	-0.190	0.853	0.994	1.005	
Humidity_lag3	1.000	0.003	-0.110	0.912	0.994	1.006	
Humidity_lag4	1.000	0.003	0.100	0.924	0.994	1.006	
Humidity_lag5	0.997	0.003	-1.070	0.285	0.991	1.003	
Humidity_lag6	1.003	0.003	0.890	0.374	0.997	1.009	
Humidity_lag7	0.999	0.003	-0.280	0.783	0.993	1.005	
Humidity_lag8	1.002	0.003	0.670	0.504	0.996	1.008	
Humidity_lag9	1.002	0.003	0.570	0.570	0.996	1.008	
Humidity_lag10	1.000	0.003	-0.170	0.868	0.994	1.005	
Humidity_lag11	1.001	0.003	0.270	0.790	0.995	1.006	

Humidity_lag12	0.999	0.003	-0.500	0.619	0.993	1.004	
Humidity_lag13	1.001	0.002	0.420	0.677	0.996	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.038	0.050	0.770	0.440	0.944	1.141	
Flu_lag0	0.942	0.042	-1.320	0.186	0.863	1.029	
Flu_lag1	1.020	0.046	0.440	0.659	0.934	1.115	
Flu_lag2	0.935	0.042	-1.500	0.134	0.856	1.021	
Flu_lag3	1.013	0.046	0.280	0.780	0.927	1.107	
Flu_lag4	1.027	0.047	0.590	0.555	0.940	1.123	
Flu_lag5	1.001	0.046	0.010	0.990	0.915	1.094	
Flu_lag6	1.065	0.049	1.380	0.168	0.974	1.165	
Flu_lag7	1.089	0.050	1.860	0.063	0.995	1.192	*
Flu_lag8	1.016	0.047	0.340	0.736	0.928	1.111	
Flu_lag9	0.978	0.045	-0.490	0.624	0.894	1.069	
Flu_lag10	0.985	0.045	-0.320	0.747	0.901	1.077	
Flu_lag11	0.980	0.044	-0.440	0.662	0.897	1.071	
Flu_lag12	0.937	0.042	-1.460	0.145	0.858	1.023	
cos_1	1.847	0.237	4.780	0.000	1.436	2.375	***
cos_2	0.907	0.029	-3.000	0.003	0.852	0.967	***
cos_3	1.284	0.040	8.010	0.000	1.208	1.365	***
cos_4	1.049	0.032	1.600	0.110	0.989	1.114	
sin_1	1.172	0.058	3.200	0.001	1.064	1.292	***
sin_2	0.939	0.031	-1.910	0.056	0.880	1.002	*
sin_3	1.194	0.037	5.660	0.000	1.123	1.270	***
sin_4	0.838	0.025	-6.030	0.000	0.791	0.887	***
Constant	1.768	1.245	0.810	0.419	0.445	7.032	
lnalpha	-2.634	0.262	.b	.b	-3.147	-2.121	

Mean dependent var	2.821	SD dependent var	2.145
Pseudo r-squared	.	Number of obs	1082
Chi-square	341.225	Prob > chi2	0.000
Akaike crit. (AIC)	4267.785	Bayesian crit. (BIC)	4547.033

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg female no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/8) irr

Table 3.14 Results of time-series sex-stratified model of associations between daily respiratory ED visits among male children and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	1.003	0.024	0.150	0.883	0.958	1.051	
NO_2_lag1	0.932	0.041	-1.610	0.107	0.855	1.015	
NO_2_lag2	1.035	0.035	1.010	0.313	0.968	1.105	

NO_2_lag3	0.970	0.031	-0.960	0.337	0.912	1.032	
NO_2_lag4	**1.071**	**0.033**	**2.240**	**0.025**	**1.009**	**1.137**	**
NO_2_lag5	0.941	0.034	-1.690	0.090	0.876	1.010	*
NO_2_lag6	**1.071**	**0.033**	**2.240**	**0.025**	**1.009**	**1.137**	**
NO_2_lag7	0.941	0.034	-1.690	0.090	0.876	1.010	*
NO_2_lag8	**1.071**	**0.033**	**2.240**	**0.025**	**1.009**	**1.137**	**
NO_2_lag9	0.970	0.031	-0.960	0.337	0.912	1.032	
NO_2_lag10	1.003	0.024	0.150	0.883	0.958	1.051	
NO_2_lag11	1.003	0.024	0.150	0.883	0.958	1.051	
NO_2_lag12	0.911	0.039	-2.160	0.031	0.838	0.991	**
NO_2_lag13	1.035	0.035	1.010	0.313	0.968	1.105	
NO_2_lag14	1.018	0.043	0.430	0.668	0.937	1.106	
Temperature_lag0	1.010	0.005	1.830	0.067	0.999	1.020	*
Temperature_lag1	0.990	0.007	-1.440	0.149	0.976	1.004	
Temperature_lag2	1.005	0.008	0.640	0.521	0.990	1.020	
Temperature_lag3	1.000	0.008	-0.050	0.956	0.985	1.015	
Temperature_lag4	1.002	0.008	0.250	0.804	0.987	1.017	
Temperature_lag5	1.002	0.007	0.320	0.752	0.988	1.017	
Temperature_lag6	1.000	0.007	-0.050	0.964	0.985	1.014	
Temperature_lag7	0.993	0.007	-1.000	0.316	0.978	1.007	
Temperature_lag8	1.003	0.007	0.460	0.648	0.989	1.018	
Temperature_lag9	1.013	0.007	1.780	0.075	0.999	1.027	*
Temperature_lag10	0.991	0.005	-1.670	0.096	0.981	1.002	*
Humidity_lag0	1.000	0.002	0.240	0.814	0.997	1.004	
Humidity_lag1	0.997	0.002	-1.550	0.121	0.992	1.001	
Humidity_lag2	1.000	0.002	0.020	0.982	0.996	1.005	
Humidity_lag3	1.000	0.002	0.000	0.999	0.996	1.004	
Humidity_lag4	1.002	0.002	0.800	0.426	0.997	1.006	
Humidity_lag5	1.002	0.002	0.740	0.461	0.997	1.006	
Humidity_lag6	0.998	0.002	-0.760	0.446	0.994	1.003	
Humidity_lag7	0.998	0.002	-0.680	0.495	0.994	1.003	
Humidity_lag8	1.002	0.002	0.880	0.378	0.998	1.006	
Humidity_lag9	1.000	0.002	0.220	0.830	0.996	1.005	
Humidity_lag10	1.002	0.002	0.900	0.366	0.998	1.006	
Humidity_lag11	0.999	0.002	-0.680	0.494	0.994	1.003	
Humidity_lag12	1.000	0.002	0.060	0.955	0.996	1.004	
Humidity_lag13	1.000	0.002	-0.010	0.994	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.107	0.040	2.810	0.005	1.031	1.188	***
Flu_lag0	1.025	0.035	0.730	0.466	0.959	1.097	
Flu_lag1	0.971	0.034	-0.860	0.392	0.907	1.039	
Flu_lag2	0.947	0.033	-1.570	0.116	0.885	1.014	

Flu_lag3	1.025	0.035	0.700	0.484	0.957	1.096	
Flu_lag4	1.009	0.035	0.270	0.790	0.943	1.080	
Flu_lag5	0.925	0.032	-2.240	0.025	0.864	0.990	**
Flu_lag6	1.049	0.037	1.370	0.170	0.980	1.123	
Flu_lag7	1.013	0.036	0.380	0.705	0.946	1.085	
Flu_lag8	1.032	0.036	0.900	0.369	0.964	1.104	
Flu_lag9	1.038	0.036	1.090	0.278	0.970	1.111	
Flu_lag10	1.006	0.035	0.160	0.870	0.940	1.076	
Flu_lag11	0.946	0.033	-1.590	0.112	0.884	1.013	
Flu_lag12	1.016	0.035	0.470	0.635	0.951	1.087	
cos_1	1.556	0.152	4.510	0.000	1.284	1.885	***
cos_2	0.870	0.021	-5.900	0.000	0.830	0.911	***
cos_3	1.147	0.026	5.970	0.000	1.096	1.199	***
cos_4	1.129	0.025	5.430	0.000	1.081	1.180	***
sin_1	1.046	0.040	1.180	0.238	0.971	1.127	
sin_2	0.945	0.024	-2.260	0.024	0.900	0.993	**
sin_3	1.248	0.029	9.530	0.000	1.192	1.306	***
sin_4	0.843	0.018	-7.830	0.000	0.808	0.880	***
Constant	3.389	1.791	2.310	0.021	1.202	9.550	**
lnalpha	-3.553	0.356	.b	.b	-4.251	-2.854	

Mean dependent var	4.722	SD dependent var	2.781
Pseudo r-squared	.	Number of obs	1082
Chi-square	432.092	Prob > chi2	0.000
Akaike crit. (AIC)	4864.930	Bayesian crit. (BIC)	5149.165

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg male no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/7) irr

Table 3.15 Results of time-series sex-stratified model of associations between daily respiratory ED visits among female children and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.028	0.083	0.340	0.735	0.878	1.203	
O_3_lag1	1.024	0.088	0.280	0.782	0.865	1.212	
O_3_lag2	1.007	0.062	0.110	0.912	0.892	1.137	
O_3_lag3	1.013	0.079	0.170	0.867	0.869	1.182	
O_3_lag4	0.910	0.054	-1.590	0.111	0.809	1.022	
O_3_lag5	1.029	0.058	0.500	0.619	0.921	1.149	
O_3_lag6	0.901	0.072	-1.320	0.188	0.770	1.053	
O_3_lag7	1.007	0.062	0.110	0.912	0.892	1.137	
O_3_lag8	0.910	0.054	-1.590	0.111	0.809	1.022	

O_3_lag9	1.148	0.096	1.650	0.098	0.975	1.351	*
O_3_lag10	0.943	0.079	-0.710	0.480	0.801	1.110	
O_3_lag11	1.029	0.058	0.500	0.619	0.921	1.149	
Temperature_lag0	1.001	0.007	0.200	0.838	0.988	1.015	
Temperature_lag1	1.002	0.009	0.180	0.855	0.983	1.020	
Temperature_lag2	1.013	0.010	1.310	0.189	0.994	1.032	
Temperature_lag3	0.979	0.010	-2.150	0.031	0.960	0.998	**
Temperature_lag4	1.019	0.010	1.960	0.050	1.000	1.039	**
Temperature_lag5	0.981	0.010	-1.970	0.048	0.962	1.000	**
Temperature_lag6	1.002	0.010	0.210	0.831	0.983	1.021	
Temperature_lag7	1.009	0.010	0.960	0.335	0.990	1.029	
Temperature_lag8	1.007	0.010	0.680	0.500	0.988	1.026	
Temperature_lag9	0.994	0.009	-0.610	0.539	0.976	1.013	
Temperature_lag10	1.002	0.007	0.360	0.716	0.989	1.016	
Humidity_lag0	1.000	0.003	-0.050	0.959	0.994	1.005	
Humidity_lag1	1.003	0.003	1.070	0.285	0.997	1.010	
Humidity_lag2	1.000	0.003	-0.140	0.891	0.993	1.006	
Humidity_lag3	1.000	0.003	-0.010	0.991	0.994	1.006	
Humidity_lag4	0.999	0.003	-0.350	0.724	0.993	1.005	
Humidity_lag5	0.996	0.003	-1.150	0.249	0.990	1.003	
Humidity_lag6	1.000	0.003	-0.020	0.985	0.994	1.006	
Humidity_lag7	0.999	0.003	-0.170	0.867	0.993	1.006	
Humidity_lag8	1.001	0.003	0.470	0.639	0.995	1.008	
Humidity_lag9	1.003	0.003	0.940	0.348	0.997	1.009	
Humidity_lag10	0.999	0.003	-0.460	0.644	0.993	1.005	
Humidity_lag11	1.002	0.003	0.570	0.569	0.996	1.008	
Humidity_lag12	0.999	0.003	-0.200	0.841	0.994	1.005	
Humidity_lag13	1.001	0.002	0.320	0.748	0.996	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.061	0.048	1.330	0.184	0.972	1.159	
Flu_lag0	0.934	0.042	-1.520	0.130	0.855	1.020	
Flu_lag1	1.023	0.046	0.510	0.613	0.936	1.119	
Flu_lag2	0.935	0.042	-1.490	0.136	0.855	1.022	
Flu_lag3	1.012	0.046	0.260	0.797	0.926	1.106	
Flu_lag4	1.032	0.047	0.690	0.490	0.944	1.128	
Flu_lag5	1.009	0.046	0.200	0.840	0.923	1.104	
Flu_lag6	1.064	0.049	1.360	0.173	0.973	1.165	
Flu_lag7	1.089	0.050	1.840	0.065	0.995	1.192	*
Flu_lag8	1.026	0.047	0.560	0.576	0.938	1.123	
Flu_lag9	0.970	0.045	-0.660	0.506	0.886	1.061	
Flu_lag10	0.997	0.046	-0.070	0.943	0.911	1.090	
Flu_lag11	0.984	0.044	-0.360	0.719	0.900	1.075	
Flu_lag12	0.938	0.042	-1.440	0.151	0.859	1.024	
cos_1	1.689	0.211	4.190	0.000	1.322	2.158	***

cos_2	0.903	0.030	-3.080	0.002	0.846	0.964	***
cos_3	1.274	0.040	7.640	0.000	1.198	1.356	***
cos_4	1.049	0.032	1.560	0.119	0.988	1.115	
sin_1	1.141	0.054	2.800	0.005	1.040	1.252	***
sin_2	0.942	0.032	-1.790	0.074	0.882	1.006	*
sin_3	1.186	0.040	5.020	0.000	1.110	1.268	***
sin_4	0.839	0.025	-5.970	0.000	0.792	0.888	***
Constant	1.561	0.664	1.050	0.295	0.679	3.591	
lnalpha	-2.613	0.257	.b	.b	-3.118	-2.109	

Mean dependent var	2.820	SD dependent var	2.144
Pseudo r-squared	.	Number of obs	1083
Chi-square	337.238	Prob > chi2	0.000
Akaike crit. (AIC)	4277.892	Bayesian crit. (BIC)	4567.167

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg female o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.16 Results of time-series sex-stratified model of associations between daily respiratory ED visits among male children and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.002	0.035	0.060	0.952	0.935	1.074	
O_3_lag1	1.002	0.035	0.060	0.952	0.935	1.074	
O_3_lag2	1.052	0.048	1.110	0.265	0.962	1.150	
O_3_lag3	0.946	0.058	-0.910	0.362	0.839	1.066	
O_3_lag4	0.936	0.042	-1.470	0.142	0.858	1.022	
O_3_lag5	**1.109**	**0.049**	**2.350**	**0.019**	**1.017**	**1.210**	**
O_3_lag6	0.936	0.042	-1.470	0.142	0.858	1.022	
O_3_lag7	0.964	0.059	-0.600	0.548	0.854	1.087	
O_3_lag8	1.052	0.048	1.110	0.265	0.962	1.150	
O_3_lag9	1.071	0.069	1.060	0.289	0.943	1.215	
O_3_lag10	0.970	0.061	-0.490	0.625	0.857	1.097	
O_3_lag11	**1.109**	**0.049**	**2.350**	**0.019**	**1.017**	**1.210**	**
Temperature_lag0	1.008	0.005	1.520	0.127	0.998	1.018	
Temperature_lag1	0.992	0.007	-1.100	0.272	0.978	1.006	
Temperature_lag2	1.002	0.007	0.270	0.787	0.987	1.017	
Temperature_lag3	1.002	0.007	0.290	0.770	0.988	1.017	
Temperature_lag4	1.002	0.007	0.280	0.781	0.988	1.017	
Temperature_lag5	1.004	0.007	0.480	0.628	0.989	1.018	
Temperature_lag6	0.997	0.007	-0.420	0.671	0.983	1.011	
Temperature_lag7	0.996	0.007	-0.540	0.589	0.982	1.011	
Temperature_lag8	1.003	0.007	0.430	0.668	0.989	1.018	

Temperature_lag9	1.012	0.007	1.600	0.110	0.997	1.026	
Temperature_lag10	0.992	0.005	-1.490	0.135	0.982	1.002	
Humidity_lag0	1.001	0.002	0.440	0.662	0.997	1.005	
Humidity_lag1	0.997	0.002	-1.460	0.144	0.992	1.001	
Humidity_lag2	1.001	0.002	0.310	0.759	0.996	1.005	
Humidity_lag3	0.999	0.002	-0.360	0.717	0.994	1.004	
Humidity_lag4	1.001	0.002	0.390	0.697	0.996	1.006	
Humidity_lag5	1.003	0.002	1.170	0.243	0.998	1.007	
Humidity_lag6	0.998	0.002	-1.050	0.293	0.993	1.002	
Humidity_lag7	0.998	0.002	-0.680	0.499	0.994	1.003	
Humidity_lag8	1.003	0.002	1.180	0.238	0.998	1.007	
Humidity_lag9	1.001	0.002	0.230	0.821	0.996	1.005	
Humidity_lag10	1.002	0.002	0.820	0.410	0.997	1.006	
Humidity_lag11	1.000	0.002	0.170	0.865	0.996	1.005	
Humidity_lag12	1.001	0.002	0.370	0.709	0.997	1.005	
Humidity_lag13	1.000	0.002	-0.020	0.981	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.104	0.037	2.960	0.003	1.034	1.179	***
Flu_lag0	1.009	0.035	0.250	0.800	0.943	1.079	
Flu_lag1	0.984	0.034	-0.460	0.646	0.920	1.053	
Flu_lag2	0.931	0.032	-2.070	0.038	0.870	0.996	**
Flu_lag3	1.034	0.036	0.980	0.329	0.967	1.106	
Flu_lag4	1.015	0.035	0.440	0.659	0.949	1.086	
Flu_lag5	0.928	0.032	-2.140	0.033	0.867	0.994	**
Flu_lag6	1.045	0.036	1.250	0.212	0.975	1.119	
Flu_lag7	1.021	0.036	0.590	0.553	0.953	1.094	
Flu_lag8	1.026	0.035	0.730	0.466	0.958	1.097	
Flu_lag9	1.034	0.036	0.970	0.331	0.966	1.108	
Flu_lag10	1.015	0.035	0.440	0.658	0.949	1.087	
Flu_lag11	0.941	0.033	-1.740	0.082	0.880	1.008	*
Flu_lag12	1.016	0.035	0.450	0.651	0.950	1.086	
cos_1	1.604	0.153	4.970	0.000	1.331	1.933	***
cos_2	0.873	0.021	-5.560	0.000	0.832	0.916	***
cos_3	1.150	0.027	5.980	0.000	1.098	1.203	***
cos_4	1.123	0.026	5.060	0.000	1.074	1.175	***
sin_1	1.040	0.037	1.090	0.277	0.969	1.115	
sin_2	0.933	0.024	-2.750	0.006	0.888	0.980	***
sin_3	1.262	0.032	9.250	0.000	1.201	1.326	***
sin_4	0.839	0.018	-7.990	0.000	0.804	0.876	***
Constant	5.261	1.681	5.200	0.000	2.813	9.842	***
lnalpha	-3.536	0.352	.b	.b	-4.227	-2.846	
Mean dependent var	4.718		SD dependent var		2.782		

Pseudo r-squared	.	Number of obs	1083
Chi-square	428.832	Prob > chi2	0.000
Akaike crit. (AIC)	4872.837	Bayesian crit. (BIC)	5157.124

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg male o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.17 Results of time-series sex-stratified model of associations between daily respiratory ED visits among female children and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.979	0.041	-0.510	0.610	0.901	1.063	
$PM_{2.5}$_lag1	0.989	0.026	-0.410	0.684	0.939	1.042	
$PM_{2.5}$_lag2	0.989	0.026	-0.410	0.684	0.939	1.042	
$PM_{2.5}$_lag3	1.013	0.046	0.280	0.778	0.926	1.108	
$PM_{2.5}$_lag4	1.004	0.019	0.190	0.850	0.967	1.041	
$PM_{2.5}$_lag5	1.004	0.019	0.190	0.850	0.967	1.041	
$PM_{2.5}$_lag6	1.004	0.019	0.190	0.850	0.967	1.041	
$PM_{2.5}$_lag7	0.969	0.040	-0.770	0.443	0.894	1.050	
Temperature_lag0	1.003	0.007	0.410	0.680	0.989	1.016	
Temperature_lag1	1.001	0.010	0.130	0.894	0.983	1.020	
Temperature_lag2	1.014	0.010	1.410	0.159	0.995	1.033	
Temperature_lag3	0.979	0.010	-2.150	0.031	0.960	0.998	**
Temperature_lag4	1.018	0.010	1.820	0.068	0.999	1.038	*
Temperature_lag5	0.982	0.009	-1.890	0.058	0.964	1.001	*
Temperature_lag6	1.003	0.010	0.280	0.777	0.984	1.022	
Temperature_lag7	1.011	0.010	1.170	0.241	0.992	1.031	
Temperature_lag8	1.002	0.010	0.230	0.816	0.984	1.021	
Temperature_lag9	0.997	0.009	-0.330	0.740	0.979	1.015	
Temperature_lag10	1.001	0.007	0.200	0.843	0.988	1.015	
Humidity_lag0	1.000	0.003	-0.070	0.946	0.995	1.005	
Humidity_lag1	1.003	0.003	1.010	0.313	0.997	1.009	
Humidity_lag2	1.000	0.003	-0.040	0.965	0.994	1.006	
Humidity_lag3	0.999	0.003	-0.190	0.848	0.993	1.005	
Humidity_lag4	1.000	0.003	0.050	0.957	0.994	1.006	
Humidity_lag5	0.996	0.003	-1.280	0.200	0.990	1.002	
Humidity_lag6	1.002	0.003	0.660	0.507	0.996	1.008	
Humidity_lag7	1.000	0.003	-0.130	0.897	0.994	1.006	
Humidity_lag8	1.002	0.003	0.720	0.471	0.996	1.008	
Humidity_lag9	1.001	0.003	0.460	0.647	0.995	1.007	
Humidity_lag10	0.999	0.003	-0.190	0.848	0.994	1.005	

Humidity_lag11	1.001	0.003	0.340	0.733	0.995	1.007	
Humidity_lag12	0.999	0.003	-0.310	0.756	0.994	1.005	
Humidity_lag13	1.001	0.002	0.440	0.663	0.997	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.055	0.047	1.180	0.236	0.966	1.152	
Flu_lag0	0.936	0.042	-1.450	0.146	0.857	1.023	
Flu_lag1	1.016	0.046	0.350	0.725	0.930	1.111	
Flu_lag2	0.934	0.042	-1.500	0.133	0.855	1.021	
Flu_lag3	1.012	0.046	0.270	0.790	0.926	1.106	
Flu_lag4	1.032	0.047	0.690	0.493	0.944	1.128	
Flu_lag5	1.008	0.046	0.180	0.860	0.922	1.103	
Flu_lag6	1.070	0.049	1.480	0.140	0.978	1.171	
Flu_lag7	1.092	0.050	1.910	0.057	0.998	1.196	*
Flu_lag8	1.020	0.047	0.440	0.662	0.932	1.117	
Flu_lag9	0.976	0.045	-0.530	0.595	0.892	1.068	
Flu_lag10	0.989	0.045	-0.230	0.815	0.905	1.082	
Flu_lag11	0.983	0.044	-0.380	0.702	0.900	1.074	
Flu_lag12	0.934	0.042	-1.510	0.131	0.856	1.020	
cos_1	1.766	0.165	6.090	0.000	1.470	2.120	***
cos_2	0.911	0.030	-2.820	0.005	0.854	0.972	***
cos_3	1.281	0.040	7.930	0.000	1.205	1.362	***
cos_4	1.036	0.033	1.130	0.259	0.974	1.102	
sin_1	1.140	0.053	2.830	0.005	1.041	1.249	***
sin_2	0.942	0.030	-1.850	0.065	0.885	1.004	*
sin_3	1.186	0.038	5.290	0.000	1.113	1.263	***
sin_4	0.839	0.025	-5.920	0.000	0.792	0.889	***
Constant	2.022	0.533	2.670	0.007	1.207	3.388	***
lnalpha	-2.587	0.252	.b	.b	-3.082	-2.093	

Mean dependent var	2.820	SD dependent var	2.144
Pseudo r-squared	.	Number of obs	1083
Chi-square	331.083	Prob > chi2	0.000
Akaike crit. (AIC)	4274.908	Bayesian crit. (BIC)	4544.232

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg female pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.18 Results of time-series sex-stratified model of associations between daily respiratory ED visits among male children and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.999	0.024	-0.060	0.951	0.953	1.046	

$PM_{2.5}$_lag1	0.956	0.033	-1.310	0.190	0.893	1.023	
$PM_{2.5}$_lag2	0.993	0.025	-0.280	0.783	0.945	1.044	
$PM_{2.5}$_lag3	0.999	0.024	-0.060	0.951	0.953	1.046	
$PM_{2.5}$_lag4	0.967	0.033	-0.990	0.324	0.904	1.034	
$PM_{2.5}$_lag5	0.993	0.025	-0.280	0.783	0.945	1.044	
$PM_{2.5}$_lag6	0.967	0.035	-0.940	0.348	0.901	1.038	
$PM_{2.5}$_lag7	1.022	0.034	0.650	0.517	0.958	1.090	
Temperature_lag0	1.009	0.005	1.700	0.090	0.999	1.019	*
Temperature_lag1	0.992	0.007	-1.130	0.258	0.978	1.006	
Temperature_lag2	1.002	0.008	0.320	0.750	0.988	1.017	
Temperature_lag3	1.004	0.008	0.500	0.619	0.989	1.019	
Temperature_lag4	0.999	0.007	-0.110	0.911	0.985	1.014	
Temperature_lag5	1.006	0.008	0.790	0.430	0.991	1.021	
Temperature_lag6	0.996	0.007	-0.490	0.625	0.982	1.011	
Temperature_lag7	0.992	0.007	-1.020	0.306	0.978	1.007	
Temperature_lag8	1.004	0.007	0.470	0.638	0.989	1.018	
Temperature_lag9	1.013	0.007	1.750	0.080	0.999	1.027	*
Temperature_lag10	0.991	0.005	-1.800	0.071	0.981	1.001	*
Humidity_lag0	1.001	0.002	0.360	0.722	0.997	1.004	
Humidity_lag1	0.997	0.002	-1.190	0.236	0.993	1.002	
Humidity_lag2	1.000	0.002	0.000	0.998	0.995	1.005	
Humidity_lag3	1.000	0.002	-0.060	0.954	0.995	1.004	
Humidity_lag4	1.002	0.002	0.860	0.389	0.997	1.006	
Humidity_lag5	1.001	0.002	0.590	0.553	0.997	1.006	
Humidity_lag6	0.999	0.002	-0.620	0.538	0.994	1.003	
Humidity_lag7	0.998	0.002	-0.960	0.337	0.993	1.002	
Humidity_lag8	1.002	0.002	0.940	0.345	0.998	1.007	
Humidity_lag9	1.000	0.002	-0.010	0.989	0.996	1.004	
Humidity_lag10	1.002	0.002	0.950	0.341	0.998	1.006	
Humidity_lag11	0.999	0.002	-0.680	0.496	0.994	1.003	
Humidity_lag12	1.001	0.002	0.340	0.730	0.997	1.005	
Humidity_lag13	1.000	0.002	-0.090	0.926	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.094	0.036	2.690	0.007	1.024	1.167	***
Flu_lag0	1.015	0.035	0.430	0.668	0.949	1.086	
Flu_lag1	0.977	0.034	-0.660	0.507	0.913	1.046	
Flu_lag2	0.938	0.032	-1.860	0.062	0.876	1.003	*
Flu_lag3	1.033	0.036	0.940	0.348	0.965	1.105	
Flu_lag4	1.003	0.035	0.100	0.923	0.938	1.074	
Flu_lag5	0.929	0.032	-2.110	0.035	0.868	0.995	**
Flu_lag6	1.049	0.037	1.380	0.168	0.980	1.123	
Flu_lag7	1.014	0.036	0.400	0.690	0.947	1.086	
Flu_lag8	1.034	0.036	0.960	0.338	0.966	1.106	

Flu_lag9	1.042	0.036	1.190	0.235	0.973	1.116	
Flu_lag10	1.011	0.035	0.300	0.763	0.944	1.082	
Flu_lag11	0.943	0.033	-1.680	0.094	0.881	1.010	*
Flu_lag12	1.020	0.035	0.580	0.563	0.954	1.091	
cos_1	1.492	0.107	5.570	0.000	1.296	1.718	***
cos_2	0.877	0.021	-5.470	0.000	0.836	0.919	***
cos_3	1.152	0.026	6.220	0.000	1.102	1.205	***
cos_4	1.109	0.026	4.430	0.000	1.059	1.160	***
sin_1	1.044	0.037	1.220	0.222	0.974	1.118	
sin_2	0.951	0.023	-2.100	0.036	0.907	0.997	**
sin_3	1.230	0.029	8.720	0.000	1.174	1.289	***
sin_4	0.845	0.019	-7.660	0.000	0.810	0.883	***
Constant	4.925	0.976	8.040	0.000	3.339	7.263	***
lnalpha	-3.507	0.343	.b	.b	-4.180	-2.835	

Mean dependent var	4.718	SD dependent var	2.782
Pseudo r-squared	.	Number of obs	1083
Chi-square	426.535	Prob > chi2	0.000
Akaike crit. (AIC)	4870.447	Bayesian crit. (BIC)	5144.759

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg male pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/2) irr

Table 3.19 Results of time-series sex-stratified model of associations between daily respiratory ED visits among female children and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	1.025	0.016	1.630	0.103	0.995	1.056	
SO_2_lag1	1.032	0.019	1.680	0.093	0.995	1.070	*
SO_2_lag2	1.028	0.020	1.430	0.153	0.990	1.068	
SO_2_lag3	1.025	0.016	1.630	0.103	0.995	1.056	
SO_2_lag4	1.032	0.019	1.680	0.093	0.995	1.070	*
SO_2_lag5	0.983	0.026	-0.670	0.505	0.933	1.035	
SO_2_lag6	1.025	0.016	1.630	0.103	0.995	1.056	
SO_2_lag7	1.021	0.027	0.800	0.424	0.970	1.075	
SO_2_lag8	1.028	0.020	1.430	0.153	0.990	1.068	
SO_2_lag9	1.041	0.027	1.540	0.124	0.989	1.095	
Temperature_lag0	1.000	0.008	-0.050	0.962	0.984	1.015	
Temperature_lag1	1.005	0.011	0.470	0.639	0.984	1.026	
Temperature_lag2	1.011	0.011	1.000	0.317	0.990	1.033	
Temperature_lag3	0.982	0.011	-1.590	0.112	0.961	1.004	
Temperature_lag4	1.012	0.011	1.110	0.266	0.991	1.034	
Temperature_lag5	0.985	0.011	-1.430	0.154	0.964	1.006	

Temperature_lag6	0.997	0.011	-0.280	0.783	0.976	1.019	
Temperature_lag7	1.015	0.011	1.390	0.166	0.994	1.037	
Temperature_lag8	1.003	0.011	0.260	0.794	0.982	1.024	
Temperature_lag9	0.997	0.010	-0.260	0.791	0.977	1.018	
Temperature_lag10	1.006	0.008	0.760	0.449	0.991	1.021	
Humidity_lag0	0.999	0.003	-0.370	0.708	0.993	1.005	
Humidity_lag1	1.003	0.004	0.710	0.476	0.995	1.010	
Humidity_lag2	1.002	0.004	0.560	0.578	0.995	1.009	
Humidity_lag3	1.000	0.004	-0.070	0.944	0.992	1.007	
Humidity_lag4	1.000	0.004	0.040	0.969	0.993	1.008	
Humidity_lag5	0.995	0.004	-1.270	0.203	0.988	1.003	
Humidity_lag6	1.003	0.004	0.840	0.398	0.996	1.011	
Humidity_lag7	0.997	0.004	-0.920	0.356	0.989	1.004	
Humidity_lag8	1.004	0.004	1.060	0.291	0.997	1.012	
Humidity_lag9	0.998	0.004	-0.440	0.658	0.991	1.006	
Humidity_lag10	1.000	0.004	0.020	0.981	0.993	1.007	
Humidity_lag11	1.000	0.004	0.120	0.901	0.993	1.008	
Humidity_lag12	0.999	0.004	-0.170	0.867	0.992	1.007	
Humidity_lag13	0.998	0.003	-0.630	0.528	0.992	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.018	0.057	0.320	0.746	0.913	1.135	
Flu_lag0	0.918	0.049	-1.610	0.108	0.827	1.019	
Flu_lag1	0.969	0.052	-0.580	0.561	0.873	1.077	
Flu_lag2	0.917	0.049	-1.630	0.104	0.827	1.018	
Flu_lag3	0.994	0.053	-0.110	0.914	0.895	1.104	
Flu_lag4	1.036	0.056	0.650	0.516	0.932	1.151	
Flu_lag5	0.993	0.054	-0.130	0.899	0.893	1.105	
Flu_lag6	1.069	0.059	1.220	0.224	0.960	1.192	
Flu_lag7	1.114	0.061	1.950	0.051	0.999	1.241	*
Flu_lag8	1.116	0.060	2.020	0.043	1.003	1.241	**
Flu_lag9	1.015	0.055	0.270	0.785	0.912	1.129	
Flu_lag10	1.094	0.058	1.690	0.091	0.986	1.214	*
Flu_lag11	0.976	0.052	-0.450	0.650	0.880	1.083	
Flu_lag12	0.910	0.048	-1.790	0.074	0.821	1.009	*
cos_1	1.834	0.188	5.900	0.000	1.500	2.243	***
cos_2	0.931	0.040	-1.640	0.100	0.855	1.014	
cos_3	1.246	0.051	5.410	0.000	1.151	1.350	***
cos_4	0.996	0.039	-0.110	0.914	0.921	1.076	
sin_1	1.165	0.069	2.590	0.010	1.038	1.309	***
sin_2	0.830	0.036	-4.310	0.000	0.762	0.903	***
sin_3	1.094	0.046	2.140	0.033	1.007	1.188	**
sin_4	0.936	0.036	-1.730	0.084	0.868	1.009	*
Constant	16.251	10.314	4.390	0.000	4.684	56.381	***
lnalpha	-3.296	0.585	.b	.b	-4.443	-2.149	

Mean dependent var	2.782	SD dependent var	2.142
Pseudo r-squared	.	Number of obs	674
Chi-square	293.087	Prob > chi2	0.000
Akaike crit. (AIC)	2633.318	Bayesian crit. (BIC)	2881.546

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg female so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.20 Results of time-series sex-stratified model of associations between daily respiratory ED visits among male children and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.969	0.019	-1.630	0.103	0.933	1.006	
SO_2_lag1	0.993	0.009	-0.760	0.445	0.976	1.011	
SO_2_lag2	0.993	0.009	-0.760	0.445	0.976	1.011	
SO_2_lag3	0.993	0.009	-0.760	0.445	0.976	1.011	
SO_2_lag4	0.993	0.009	-0.760	0.445	0.976	1.011	
SO_2_lag5	1.004	0.010	0.430	0.669	0.984	1.025	
SO_2_lag6	1.019	0.013	1.450	0.147	0.993	1.046	
SO_2_lag7	1.004	0.010	0.430	0.669	0.984	1.025	
SO_2_lag8	1.019	0.013	1.450	0.147	0.993	1.046	
SO_2_lag9	1.004	0.010	0.430	0.669	0.984	1.025	
Temperature_lag0	1.004	0.006	0.610	0.539	0.992	1.016	
Temperature_lag1	0.990	0.008	-1.210	0.227	0.974	1.006	
Temperature_lag2	1.008	0.008	0.960	0.339	0.992	1.025	
Temperature_lag3	0.997	0.008	-0.380	0.705	0.981	1.013	
Temperature_lag4	0.994	0.008	-0.720	0.471	0.978	1.010	
Temperature_lag5	1.009	0.008	1.050	0.296	0.993	1.025	
Temperature_lag6	0.999	0.008	-0.060	0.949	0.983	1.016	
Temperature_lag7	0.992	0.008	-0.910	0.361	0.976	1.009	
Temperature_lag8	1.001	0.008	0.120	0.904	0.985	1.017	
Temperature_lag9	1.019	0.008	2.390	0.017	1.003	1.035	**
Temperature_lag10	0.989	0.006	-1.950	0.051	0.978	1.000	*
Humidity_lag0	0.999	0.002	-0.430	0.666	0.995	1.003	
Humidity_lag1	0.997	0.003	-1.230	0.217	0.991	1.002	
Humidity_lag2	1.000	0.003	0.050	0.961	0.995	1.006	
Humidity_lag3	1.000	0.003	-0.040	0.969	0.994	1.005	
Humidity_lag4	1.002	0.003	0.550	0.583	0.996	1.007	
Humidity_lag5	0.998	0.003	-0.560	0.577	0.993	1.004	
Humidity_lag6	0.999	0.003	-0.180	0.855	0.994	1.005	
Humidity_lag7	1.000	0.003	-0.080	0.933	0.994	1.005	
Humidity_lag8	1.001	0.003	0.470	0.640	0.996	1.007	

Humidity_lag9	1.000	0.003	0.090	0.926	0.995	1.006	
Humidity_lag10	1.002	0.003	0.870	0.384	0.997	1.008	
Humidity_lag11	0.999	0.003	-0.480	0.633	0.993	1.004	
Humidity_lag12	1.001	0.003	0.410	0.685	0.996	1.006	
Humidity_lag13	0.999	0.002	-0.270	0.790	0.995	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.095	0.045	2.220	0.027	1.011	1.186	**
Flu_lag0	1.018	0.041	0.430	0.665	0.940	1.102	
Flu_lag1	0.934	0.038	-1.670	0.095	0.862	1.012	*
Flu_lag2	0.897	0.036	-2.690	0.007	0.829	0.971	***
Flu_lag3	1.067	0.044	1.590	0.112	0.985	1.157	
Flu_lag4	0.984	0.040	-0.410	0.685	0.908	1.066	
Flu_lag5	0.932	0.039	-1.710	0.088	0.859	1.011	*
Flu_lag6	1.037	0.044	0.870	0.384	0.955	1.126	
Flu_lag7	1.053	0.045	1.220	0.222	0.969	1.145	
Flu_lag8	1.017	0.042	0.420	0.676	0.939	1.103	
Flu_lag9	1.096	0.046	2.200	0.028	1.010	1.189	**
Flu_lag10	1.003	0.041	0.070	0.944	0.926	1.086	
Flu_lag11	0.980	0.040	-0.510	0.611	0.905	1.061	
Flu_lag12	0.997	0.040	-0.070	0.945	0.922	1.079	
cos_1	1.474	0.117	4.890	0.000	1.262	1.722	***
cos_2	0.921	0.028	-2.670	0.008	0.867	0.978	***
cos_3	1.122	0.033	3.870	0.000	1.058	1.189	***
cos_4	1.144	0.034	4.590	0.000	1.080	1.212	***
sin_1	1.018	0.045	0.400	0.688	0.934	1.110	
sin_2	0.950	0.031	-1.540	0.123	0.891	1.014	
sin_3	1.221	0.037	6.550	0.000	1.150	1.296	***
sin_4	0.846	0.024	-5.890	0.000	0.800	0.894	***
Constant	4.638	2.152	3.310	0.001	1.869	11.514	***
lnalpha	-4.969	1.740	.b	.b	-8.379	-1.558	

Mean dependent var	4.562	SD dependent var	2.700
Pseudo r-squared	.	Number of obs	674
Chi-square	344.731	Prob > chi2	0.000
Akaike crit. (AIC)	2986.786	Bayesian crit. (BIC)	3225.987

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg male so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/6) irr

3.2.4 Results of time-series age-stratified models

Tables 3.21 to 3.30 show the adjusted results of the time-series age-stratified model for the five air pollutants and selected lags over the study period. IRRs and 95% confidence intervals for daily respiratory ED visits by different sex are shown as a one unit increase in the natural log of air pollutants concentrations. In other words, expected daily respiratory ED visits among children increased by [(IRR-1) * 100] % when air pollutant concentration increased (e-1) times after adjusting for other variables (e: Euler's number. The value is approximately 2.71828). The participants were divided into two groups according to their age: 0-4 years old and 5-16 years old. IRRs and 95% confidence intervals for daily respiratory ED visits of different age groups are shown for a one unit increase in the natural log of air pollutants concentrations. For younger children (0-4 years old), the models show strong evidence of a significant increase in daily respiratory ED visits with increasing NO_2 concentrations for the 4- and 8-day lags. The IRR was 1.068 (95%CI: 1.002-1.139), indicating a 6.8% increase in expected daily respiratory ED visits among younger children (0-4 years old) for one unit increase in natural log of NO_2 after adjusting for other variables. The results in this age group were also negatively associated with 4-day lag exposure of O_3, with the IRR of 0.89 (95%CI: 0.795-0.997). Exposure to CO, $PM_{2.5}$, and SO_2 was not significantly associated with daily respiratory ED visits among younger children.

For older children (5-16 years old), results show that daily respiratory ED visits were positively associated with 2-, 4-, 6-, and 10-day lag exposures to NO_2, with the same IRR of 1.074 (95%CI: 1.001-1.152). There were also significant positive associations between daily respiratory ED visits and 1 and 5-day lag exposures to O_3, with the same IRR of 1.152 (95%CI: 1.005-1.32). Meanwhile, daily respiratory ED visits among older children (5-16 years old) were positively associated 8- and 9-day lag exposures to SO_2, with the same IRR of 1.043 (95%CI: 1.005-1.082). Exposure to $PM_{2.5}$ was not significantly associated with daily respiratory ED visits among older children.

For younger children (0-4 years old) age-stratified models, AIC in CO models were smaller than in the baseline model, and BIC were larger than in the baseline model. Both AIC and BIC in NO_2, O_3 and $PM_{2.5}$ models were larger than in the baseline model. Both AIC and BIC in SO_2 models were smaller than in the baseline models. Results of the younger children (0-4 years old) age-stratified baseline model is presented in Appendix 2 Table A 2.4.

For older children (5-16 years old) age-stratified models, both AIC and BIC in models of CO, NO_2,

O_3 and $PM_{2.5}$ were larger than in the baseline model. Both AIC and BIC in SO_2 model were smaller than in the baseline models. Results of the older children (5-16 years old) age-stratified baseline model are presented in Appendix 2 Table A 2.5.

Table 3.21 Results of time-series age-stratified model of associations between daily respiratory ED visits among younger children (0-4 years old) and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.931	0.049	-1.360	0.173	0.841	1.032	
CO_lag1	0.955	0.047	-0.950	0.341	0.867	1.050	
CO_lag2	0.931	0.049	-1.360	0.173	0.841	1.032	
CO_lag3	0.989	0.078	-0.150	0.885	0.847	1.154	
CO_lag4	1.021	0.079	0.270	0.790	0.877	1.188	
CO_lag5	0.955	0.047	-0.950	0.341	0.867	1.050	
CO_lag6	1.009	0.079	0.120	0.905	0.866	1.176	
CO_lag7	0.955	0.047	-0.950	0.341	0.867	1.050	
CO_lag8	1.106	0.077	1.450	0.146	0.965	1.268	
Temperature_lag0	1.006	0.005	1.220	0.221	0.996	1.015	
Temperature_lag1	0.994	0.007	-0.980	0.328	0.981	1.007	
Temperature_lag2	1.007	0.007	1.010	0.314	0.993	1.021	
Temperature_lag3	0.990	0.007	-1.470	0.142	0.976	1.003	
Temperature_lag4	1.006	0.007	0.910	0.365	0.993	1.020	
Temperature_lag5	0.999	0.007	-0.110	0.911	0.986	1.013	
Temperature_lag6	0.996	0.007	-0.520	0.604	0.983	1.010	
Temperature_lag7	1.001	0.007	0.150	0.878	0.988	1.015	
Temperature_lag8	0.996	0.007	-0.570	0.565	0.983	1.009	
Temperature_lag9	1.010	0.007	1.570	0.116	0.997	1.024	
Temperature_lag10	0.994	0.005	-1.370	0.171	0.984	1.003	
Humidity_lag0	1.001	0.002	0.600	0.546	0.998	1.005	
Humidity_lag1	0.998	0.002	-0.930	0.353	0.994	1.002	
Humidity_lag2	1.002	0.002	1.020	0.309	0.998	1.007	
Humidity_lag3	0.998	0.002	-0.700	0.481	0.994	1.003	
Humidity_lag4	1.001	0.002	0.290	0.772	0.996	1.005	
Humidity_lag5	1.001	0.002	0.350	0.723	0.996	1.005	
Humidity_lag6	0.997	0.002	-1.480	0.140	0.992	1.001	
Humidity_lag7	1.000	0.002	0.150	0.885	0.996	1.005	
Humidity_lag8	1.002	0.002	0.870	0.387	0.998	1.006	
Humidity_lag9	0.999	0.002	-0.290	0.771	0.995	1.004	
Humidity_lag10	1.001	0.002	0.470	0.636	0.997	1.005	
Humidity_lag11	0.998	0.002	-0.770	0.439	0.994	1.003	
Humidity_lag12	1.001	0.002	0.320	0.751	0.997	1.005	
Humidity_lag13	1.001	0.002	0.630	0.532	0.998	1.004	
0b.H&W	1.000	.	.	.	.	.	

1.H&W	1.039	0.034	1.160	0.248	0.974	1.108	
Flu_lag0	0.994	0.032	-0.170	0.863	0.933	1.060	
Flu_lag1	0.958	0.032	-1.290	0.196	0.898	1.022	
Flu_lag2	0.919	0.030	-2.580	0.010	0.862	0.980	***
Flu_lag3	1.019	0.033	0.580	0.565	0.956	1.087	
Flu_lag4	1.021	0.033	0.650	0.517	0.958	1.089	
Flu_lag5	0.968	0.032	-0.970	0.330	0.908	1.033	
Flu_lag6	1.065	0.035	1.900	0.057	0.998	1.137	*
Flu_lag7	1.020	0.034	0.580	0.561	0.955	1.089	
Flu_lag8	1.028	0.034	0.850	0.396	0.964	1.097	
Flu_lag9	1.024	0.034	0.710	0.480	0.960	1.092	
Flu_lag10	1.030	0.034	0.900	0.370	0.966	1.098	
Flu_lag11	0.978	0.032	-0.670	0.502	0.918	1.043	
Flu_lag12	1.002	0.032	0.050	0.961	0.940	1.067	
cos_1	1.754	0.123	8.020	0.000	1.529	2.012	***
cos_2	0.930	0.022	-3.060	0.002	0.887	0.974	***
cos_3	1.175	0.027	7.040	0.000	1.124	1.230	***
cos_4	1.082	0.024	3.500	0.000	1.035	1.131	***
sin_1	1.112	0.039	3.080	0.002	1.039	1.191	***
sin_2	0.947	0.023	-2.270	0.023	0.904	0.993	**
sin_3	1.166	0.028	6.460	0.000	1.113	1.221	***
sin_4	0.856	0.019	-7.180	0.000	0.820	0.893	***
Constant	3.562	0.858	5.270	0.000	2.221	5.711	***
lnalpha	-3.307	0.259	.b	.b	-3.814	-2.799	

Mean dependent var	5.242	SD dependent var	3.374
Pseudo r-squared	.	Number of obs	1083
Chi-square	773.201	Prob > chi2	0.000
Akaike crit. (AIC)	4973.449	Bayesian crit. (BIC)	5247.761

*** p<.01, ** p<.05, * p<.1

H&W: H&W and weekend

xi: nbreg younger colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.22 Results of time-series age-stratified model of associations between daily respiratory ED visits among older children (5-16 years old) and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.910	0.105	-0.820	0.412	0.726	1.140	
CO_lag1	0.887	0.113	-0.950	0.344	0.691	1.137	
CO_lag2	1.255	0.160	1.780	0.075	0.977	1.612	*
CO_lag3	0.840	0.106	-1.380	0.167	0.655	1.076	
CO_lag4	0.922	0.111	-0.670	0.503	0.728	1.169	
CO_lag5	0.886	0.072	-1.500	0.133	0.756	1.038	
CO_lag6	1.018	0.123	0.150	0.880	0.804	1.289	

CO_lag7	1.071	0.128	0.580	0.564	0.848	1.353	
CO_lag8	0.886	0.072	-1.500	0.133	0.756	1.038	
Temperature_lag0	1.013	0.009	1.510	0.131	0.996	1.031	
Temperature_lag1	0.996	0.012	-0.340	0.731	0.972	1.020	
Temperature_lag2	1.012	0.013	0.970	0.330	0.988	1.037	
Temperature_lag3	1.008	0.013	0.620	0.532	0.983	1.033	
Temperature_lag4	1.006	0.012	0.520	0.601	0.982	1.031	
Temperature_lag5	0.987	0.012	-1.040	0.298	0.964	1.011	
Temperature_lag6	1.005	0.012	0.390	0.695	0.981	1.029	
Temperature_lag7	0.996	0.012	-0.300	0.765	0.973	1.020	
Temperature_lag8	1.024	0.012	1.940	0.053	1.000	1.048	*
Temperature_lag9	0.991	0.012	-0.740	0.458	0.969	1.014	
Temperature_lag10	0.999	0.008	-0.110	0.913	0.983	1.016	
Humidity_lag0	0.999	0.003	-0.500	0.616	0.993	1.004	
Humidity_lag1	1.001	0.003	0.390	0.693	0.995	1.008	
Humidity_lag2	0.997	0.003	-0.990	0.323	0.990	1.003	
Humidity_lag3	1.004	0.003	1.270	0.205	0.998	1.011	
Humidity_lag4	1.002	0.003	0.580	0.564	0.995	1.008	
Humidity_lag5	0.997	0.003	-1.020	0.306	0.990	1.003	
Humidity_lag6	1.004	0.003	1.360	0.174	0.998	1.011	
Humidity_lag7	0.996	0.003	-1.220	0.221	0.990	1.002	
Humidity_lag8	1.003	0.003	1.020	0.306	0.997	1.010	
Humidity_lag9	1.002	0.003	0.560	0.576	0.995	1.008	
Humidity_lag10	1.001	0.003	0.340	0.733	0.995	1.007	
Humidity_lag11	1.002	0.003	0.720	0.473	0.996	1.008	
Humidity_lag12	0.999	0.003	-0.310	0.757	0.993	1.005	
Humidity_lag13	1.000	0.002	-0.190	0.847	0.995	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.177	0.058	3.300	0.001	1.068	1.297	***
Flu_lag0	0.965	0.052	-0.670	0.502	0.868	1.071	
Flu_lag1	1.096	0.059	1.700	0.089	0.986	1.219	*
Flu_lag2	1.024	0.055	0.440	0.663	0.921	1.138	
Flu_lag3	1.038	0.056	0.690	0.489	0.934	1.153	
Flu_lag4	0.992	0.053	-0.160	0.875	0.893	1.101	
Flu_lag5	0.941	0.051	-1.130	0.259	0.846	1.046	
Flu_lag6	1.052	0.057	0.940	0.346	0.947	1.169	
Flu_lag7	1.116	0.060	2.040	0.042	1.004	1.240	**
Flu_lag8	1.029	0.055	0.540	0.593	0.926	1.143	
Flu_lag9	0.980	0.053	-0.380	0.704	0.881	1.089	
Flu_lag10	0.928	0.051	-1.360	0.173	0.835	1.033	
Flu_lag11	0.897	0.049	-2.010	0.045	0.806	0.997	**
Flu_lag12	0.927	0.050	-1.420	0.155	0.834	1.029	

cos_1	1.480	0.173	3.360	0.001	1.177	1.861	***
cos_2	0.752	0.027	-7.890	0.000	0.700	0.807	***
cos_3	1.173	0.039	4.760	0.000	1.098	1.252	***
cos_4	1.076	0.036	2.200	0.028	1.008	1.149	**
sin_1	1.084	0.059	1.480	0.140	0.974	1.207	
sin_2	0.913	0.032	-2.630	0.009	0.852	0.977	***
sin_3	1.307	0.045	7.830	0.000	1.222	1.397	***
sin_4	0.830	0.026	-5.880	0.000	0.780	0.883	***
Constant	0.604	0.205	-1.490	0.136	0.311	1.173	
lnalpha	-2.710	0.317	.b	.b	-3.330	-2.089	

Mean dependent var	2.296	SD dependent var	2.016
Pseudo r-squared	.	Number of obs	1083
Chi-square	406.788	Prob > chi2	0.000
Akaike crit. (AIC)	3960.926	Bayesian crit. (BIC)	4245.213

*** p<.01, ** p<.05, * p<.1

H&W: H&W and weekend

xi: nbreg older colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/1) irr

Table 3.23 Results of time-series age-stratified model of associations between daily respiratory ED visits among younger children (0-4 years old) and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	0.985	0.030	-0.500	0.619	0.929	1.045	
NO_2_lag1	0.952	0.033	-1.400	0.162	0.889	1.020	
NO_2_lag2	0.976	0.046	-0.530	0.597	0.890	1.070	
NO_2_lag3	0.952	0.033	-1.400	0.162	0.889	1.020	
NO_2_lag4	**1.068**	**0.035**	**2.030**	**0.042**	**1.002**	**1.139**	**
NO_2_lag5	0.983	0.020	-0.840	0.400	0.945	1.023	
NO_2_lag6	1.030	0.021	1.450	0.146	0.990	1.073	
NO_2_lag7	0.983	0.020	-0.840	0.400	0.945	1.023	
NO_2_lag8	**1.068**	**0.035**	**2.030**	**0.042**	**1.002**	**1.139**	**
NO_2_lag9	0.985	0.030	-0.500	0.619	0.929	1.045	
NO_2_lag10	0.983	0.020	-0.840	0.400	0.945	1.023	
NO_2_lag11	0.983	0.020	-0.840	0.400	0.945	1.023	
NO_2_lag12	0.941	0.039	-1.470	0.142	0.867	1.021	
NO_2_lag13	1.030	0.021	1.450	0.146	0.990	1.073	
NO_2_lag14	1.030	0.021	1.450	0.146	0.990	1.073	
Temperature_lag0	1.006	0.005	1.150	0.250	0.996	1.015	
Temperature_lag1	0.994	0.007	-0.920	0.359	0.980	1.007	
Temperature_lag2	1.008	0.007	1.210	0.228	0.995	1.022	
Temperature_lag3	0.987	0.007	-1.850	0.064	0.974	1.001	*

Temperature_lag4	1.007	0.007	0.980	0.325	0.993	1.021	
Temperature_lag5	0.998	0.007	-0.330	0.738	0.984	1.011	
Temperature_lag6	0.997	0.007	-0.370	0.710	0.984	1.011	
Temperature_lag7	1.000	0.007	0.060	0.949	0.987	1.014	
Temperature_lag8	0.998	0.007	-0.320	0.746	0.984	1.011	
Temperature_lag9	1.011	0.007	1.690	0.091	0.998	1.025	*
Temperature_lag10	0.994	0.005	-1.340	0.180	0.984	1.003	
Humidity_lag0	1.001	0.002	0.490	0.627	0.997	1.004	
Humidity_lag1	0.998	0.002	-0.960	0.335	0.994	1.002	
Humidity_lag2	1.002	0.002	0.950	0.342	0.998	1.006	
Humidity_lag3	0.998	0.002	-0.750	0.454	0.994	1.003	
Humidity_lag4	1.001	0.002	0.250	0.799	0.996	1.005	
Humidity_lag5	1.001	0.002	0.420	0.674	0.997	1.005	
Humidity_lag6	0.997	0.002	-1.540	0.125	0.992	1.001	
Humidity_lag7	1.000	0.002	0.210	0.836	0.996	1.005	
Humidity_lag8	1.003	0.002	1.280	0.201	0.998	1.007	
Humidity_lag9	1.000	0.002	-0.130	0.894	0.995	1.004	
Humidity_lag10	1.001	0.002	0.410	0.680	0.997	1.005	
Humidity_lag11	0.998	0.002	-0.900	0.370	0.994	1.002	
Humidity_lag12	1.000	0.002	0.060	0.949	0.996	1.004	
Humidity_lag13	1.001	0.002	0.640	0.520	0.998	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.068	0.038	1.840	0.066	0.996	1.145	*
Flu_lag0	1.002	0.032	0.070	0.945	0.941	1.068	
Flu_lag1	0.959	0.031	-1.270	0.204	0.900	1.023	
Flu_lag2	0.922	0.030	-2.500	0.012	0.865	0.982	**
Flu_lag3	1.014	0.033	0.420	0.674	0.951	1.081	
Flu_lag4	1.021	0.033	0.640	0.520	0.958	1.088	
Flu_lag5	0.965	0.032	-1.080	0.278	0.905	1.029	
Flu_lag6	1.058	0.035	1.720	0.086	0.992	1.129	*
Flu_lag7	1.019	0.034	0.560	0.573	0.955	1.087	
Flu_lag8	1.027	0.034	0.810	0.419	0.963	1.095	
Flu_lag9	1.023	0.034	0.690	0.491	0.959	1.091	
Flu_lag10	1.025	0.033	0.750	0.452	0.961	1.092	
Flu_lag11	0.983	0.032	-0.520	0.605	0.922	1.048	
Flu_lag12	1.002	0.032	0.060	0.955	0.941	1.067	
cos_1	1.794	0.167	6.280	0.000	1.495	2.153	***
cos_2	0.929	0.022	-3.130	0.002	0.887	0.973	***
cos_3	1.173	0.027	6.950	0.000	1.121	1.227	***
cos_4	1.090	0.024	3.920	0.000	1.044	1.139	***
sin_1	1.108	0.040	2.830	0.005	1.032	1.190	***
sin_2	0.947	0.023	-2.190	0.028	0.902	0.994	**
sin_3	1.175	0.027	6.910	0.000	1.123	1.230	***
sin_4	0.855	0.018	-7.230	0.000	0.820	0.892	***

Constant	3.447	1.782	2.390	0.017	1.251	9.496	**
lnalpha	-3.339	0.266	.b	.b	-3.860	-2.818	

Mean dependent var	5.244	SD dependent var	3.375
Pseudo r-squared	.	Number of obs	1082
Chi-square	783.485	Prob > chi2	0.000
Akaike crit. (AIC)	4965.174	Bayesian crit. (BIC)	5244.422

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg younger no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/8) irr

Table 3.24 Results of time-series age-stratified model of associations between daily respiratory ED visits among older children (5-16 years old) and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	1.026	0.071	0.370	0.709	0.896	1.175	
NO_2_lag1	0.989	0.066	-0.160	0.870	0.867	1.128	
NO_2_lag2	**1.074**	**0.039**	**1.970**	**0.048**	**1.001**	**1.152**	**
NO_2_lag3	1.000	0.049	0.000	0.997	0.909	1.100	
NO_2_lag4	**1.074**	**0.039**	**1.970**	**0.048**	**1.001**	**1.152**	**
NO_2_lag5	1.006	0.069	0.090	0.929	0.879	1.152	
NO_2_lag6	**1.074**	**0.039**	**1.970**	**0.048**	**1.001**	**1.152**	**
NO_2_lag7	1.048	0.074	0.670	0.506	0.912	1.204	
NO_2_lag8	0.987	0.051	-0.250	0.805	0.893	1.092	
NO_2_lag9	1.000	0.049	0.000	0.997	0.909	1.100	
NO_2_lag10	**1.074**	**0.039**	**1.970**	**0.048**	**1.001**	**1.152**	**
NO_2_lag11	0.889	0.060	-1.730	0.083	0.779	1.015	*
NO_2_lag12	0.975	0.065	-0.380	0.703	0.855	1.112	
NO_2_lag13	0.987	0.051	-0.250	0.805	0.893	1.092	
NO_2_lag14	0.939	0.060	-0.970	0.330	0.828	1.065	
Temperature_lag0	1.009	0.009	0.970	0.333	0.991	1.026	
Temperature_lag1	0.999	0.012	-0.100	0.920	0.975	1.023	
Temperature_lag2	1.013	0.013	1.060	0.288	0.989	1.039	
Temperature_lag3	1.001	0.012	0.060	0.952	0.977	1.025	
Temperature_lag4	1.009	0.013	0.730	0.465	0.985	1.034	
Temperature_lag5	0.984	0.012	-1.290	0.199	0.961	1.008	
Temperature_lag6	1.007	0.012	0.560	0.573	0.983	1.032	
Temperature_lag7	0.998	0.012	-0.160	0.876	0.974	1.022	
Temperature_lag8	1.024	0.013	1.960	0.050	1.000	1.049	**
Temperature_lag9	0.990	0.012	-0.830	0.406	0.967	1.014	
Temperature_lag10	1.006	0.009	0.680	0.494	0.989	1.024	
Humidity_lag0	0.998	0.003	-0.730	0.467	0.993	1.003	
Humidity_lag1	1.002	0.003	0.680	0.498	0.996	1.009	

Humidity_lag2	0.997	0.003	-0.940	0.346	0.990	1.003	
Humidity_lag3	1.003	0.003	0.950	0.343	0.997	1.010	
Humidity_lag4	1.003	0.003	0.880	0.379	0.996	1.009	
Humidity_lag5	0.997	0.003	-0.930	0.351	0.991	1.003	
Humidity_lag6	1.005	0.003	1.520	0.128	0.999	1.011	
Humidity_lag7	0.996	0.003	-1.110	0.265	0.990	1.003	
Humidity_lag8	1.003	0.003	1.020	0.308	0.997	1.010	
Humidity_lag9	1.002	0.003	0.590	0.558	0.996	1.008	
Humidity_lag10	1.002	0.003	0.610	0.544	0.996	1.008	
Humidity_lag11	1.002	0.003	0.710	0.480	0.996	1.008	
Humidity_lag12	0.999	0.003	-0.370	0.712	0.993	1.005	
Humidity_lag13	0.998	0.002	-0.730	0.466	0.993	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.178	0.070	2.780	0.005	1.050	1.323	***
Flu_lag0	0.971	0.052	-0.540	0.586	0.874	1.079	
Flu_lag1	1.105	0.060	1.840	0.065	0.994	1.229	*
Flu_lag2	1.020	0.055	0.360	0.716	0.917	1.134	
Flu_lag3	1.034	0.056	0.610	0.541	0.930	1.149	
Flu_lag4	1.000	0.054	0.000	0.998	0.900	1.111	
Flu_lag5	0.926	0.051	-1.400	0.161	0.832	1.031	
Flu_lag6	1.038	0.056	0.690	0.488	0.934	1.154	
Flu_lag7	1.111	0.060	1.950	0.051	0.999	1.235	*
Flu_lag8	1.020	0.055	0.360	0.715	0.918	1.134	
Flu_lag9	0.979	0.053	-0.400	0.691	0.880	1.089	
Flu_lag10	0.923	0.050	-1.470	0.141	0.829	1.027	
Flu_lag11	0.895	0.049	-2.040	0.041	0.804	0.996	**
Flu_lag12	0.932	0.050	-1.310	0.189	0.838	1.035	
cos_1	1.367	0.205	2.080	0.037	1.019	1.835	**
cos_2	0.745	0.027	-8.100	0.000	0.694	0.800	***
cos_3	1.181	0.040	4.870	0.000	1.105	1.263	***
cos_4	1.104	0.037	2.960	0.003	1.034	1.179	***
sin_1	1.096	0.064	1.560	0.119	0.977	1.230	
sin_2	0.894	0.033	-3.060	0.002	0.832	0.960	***
sin_3	1.332	0.045	8.460	0.000	1.247	1.424	***
sin_4	0.830	0.026	-5.860	0.000	0.779	0.883	***
Constant	1.768	1.368	0.740	0.461	0.388	8.052	
lnalpha	-2.625	0.293	.b	.b	-3.199	-2.051	
Mean dependent var	2.299		SD dependent var		2.016		
Pseudo r-squared	.		Number of obs		1082		
Chi-square	394.918		Prob > chi2		0.000		
Akaike crit. (AIC)	3967.778		Bayesian crit. (BIC)		4261.986		

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg older no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/5) irr

Table 3.25 Results of time-series age-stratified model of associations between daily respiratory ED visits among younger children (0-4 years old) and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.042	0.044	0.990	0.324	0.960	1.131	
O_3_lag1	0.954	0.041	-1.100	0.272	0.878	1.037	
O_3_lag2	1.057	0.036	1.610	0.107	0.988	1.130	
O_3_lag3	1.006	0.036	0.160	0.875	0.938	1.078	
O_3_lag4	**0.890**	**0.051**	**-2.020**	**0.044**	**0.795**	**0.997**	**
O_3_lag5	1.057	0.036	1.610	0.107	0.988	1.130	
O_3_lag6	1.006	0.036	0.160	0.875	0.938	1.078	
O_3_lag7	0.954	0.041	-1.100	0.272	0.878	1.037	
O_3_lag8	1.042	0.044	0.990	0.324	0.960	1.131	
O_3_lag9	1.094	0.064	1.540	0.123	0.976	1.227	
O_3_lag10	1.006	0.036	0.160	0.875	0.938	1.078	
O_3_lag11	1.057	0.036	1.610	0.107	0.988	1.130	
Temperature_lag0	1.004	0.005	0.790	0.430	0.994	1.013	
Temperature_lag1	0.995	0.007	-0.760	0.446	0.982	1.008	
Temperature_lag2	1.006	0.007	0.870	0.383	0.993	1.020	
Temperature_lag3	0.989	0.007	-1.590	0.111	0.976	1.003	
Temperature_lag4	1.008	0.007	1.200	0.229	0.995	1.022	
Temperature_lag5	1.000	0.007	-0.010	0.993	0.987	1.013	
Temperature_lag6	0.995	0.007	-0.770	0.439	0.982	1.008	
Temperature_lag7	1.004	0.007	0.550	0.584	0.990	1.018	
Temperature_lag8	0.998	0.007	-0.280	0.778	0.985	1.012	
Temperature_lag9	1.010	0.007	1.450	0.148	0.997	1.023	
Temperature_lag10	0.994	0.005	-1.240	0.215	0.985	1.003	
Humidity_lag0	1.002	0.002	0.850	0.395	0.998	1.005	
Humidity_lag1	0.997	0.002	-1.090	0.274	0.993	1.002	
Humidity_lag2	1.003	0.002	1.180	0.238	0.998	1.007	
Humidity_lag3	0.999	0.002	-0.640	0.520	0.994	1.003	
Humidity_lag4	0.999	0.002	-0.340	0.735	0.995	1.004	
Humidity_lag5	1.002	0.002	0.720	0.471	0.997	1.006	
Humidity_lag6	0.997	0.002	-1.430	0.154	0.992	1.001	
Humidity_lag7	1.000	0.002	-0.040	0.967	0.995	1.004	
Humidity_lag8	1.003	0.002	1.460	0.145	0.999	1.008	
Humidity_lag9	1.000	0.002	0.130	0.897	0.996	1.005	
Humidity_lag10	1.001	0.002	0.490	0.626	0.997	1.005	
Humidity_lag11	1.000	0.002	-0.190	0.853	0.995	1.004	
Humidity_lag12	1.001	0.002	0.380	0.701	0.997	1.005	

Humidity_lag13	1.001	0.002	0.400	0.687	0.997	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.046	0.034	1.380	0.168	0.981	1.115	
Flu_lag0	0.986	0.032	-0.440	0.664	0.926	1.050	
Flu_lag1	0.968	0.032	-1.010	0.312	0.908	1.031	
Flu_lag2	0.916	0.030	-2.710	0.007	0.859	0.976	***
Flu_lag3	1.017	0.033	0.520	0.606	0.954	1.084	
Flu_lag4	1.025	0.033	0.770	0.443	0.962	1.093	
Flu_lag5	0.970	0.032	-0.930	0.354	0.910	1.034	
Flu_lag6	1.051	0.035	1.520	0.130	0.985	1.122	
Flu_lag7	1.025	0.034	0.750	0.454	0.961	1.094	
Flu_lag8	1.025	0.033	0.760	0.448	0.962	1.093	
Flu_lag9	1.018	0.033	0.540	0.590	0.954	1.086	
Flu_lag10	1.033	0.034	1.000	0.315	0.969	1.102	
Flu_lag11	0.983	0.032	-0.540	0.587	0.922	1.047	
Flu_lag12	0.998	0.032	-0.070	0.943	0.937	1.063	
cos_1	1.859	0.167	6.900	0.000	1.559	2.217	***
cos_2	0.932	0.023	-2.910	0.004	0.889	0.977	***
cos_3	1.178	0.027	7.030	0.000	1.125	1.233	***
cos_4	1.084	0.025	3.570	0.000	1.037	1.133	***
sin_1	1.104	0.038	2.900	0.004	1.033	1.180	***
sin_2	0.935	0.023	-2.710	0.007	0.890	0.981	***
sin_3	1.189	0.030	6.880	0.000	1.132	1.250	***
sin_4	0.852	0.018	-7.420	0.000	0.816	0.888	***
Constant	6.102	1.891	5.840	0.000	3.324	11.202	***
lnalpha	-3.344	0.267	.b	.b	-3.867	-2.820	

Mean dependent var	5.242	SD dependent var	3.374
Pseudo r-squared	.	Number of obs	1083
Chi-square	782.231	Prob > chi2	0.000
Akaike crit. (AIC)	4968.900	Bayesian crit. (BIC)	5243.212

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg younger o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/6) irr

Table 3.26 Results of time-series age-stratified model of associations between daily respiratory ED visits among older children (5-16 years old) and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	0.942	0.043	-1.310	0.189	0.862	1.030	
O_3_lag1	**1.152**	**0.080**	**2.030**	**0.042**	**1.005**	**1.320**	**
O_3_lag2	0.942	0.043	-1.310	0.189	0.862	1.030	
O_3_lag3	0.942	0.043	-1.310	0.189	0.862	1.030	

O_3_lag4	0.871	0.079	-1.510	0.130	0.729	1.041	
O_3_lag5	**1.152**	**0.080**	**2.030**	**0.042**	**1.005**	**1.320**	**
O_3_lag6	0.953	0.031	-1.460	0.145	0.893	1.017	
O_3_lag7	0.953	0.031	-1.460	0.145	0.893	1.017	
O_3_lag8	0.953	0.031	-1.460	0.145	0.893	1.017	
O_3_lag9	0.953	0.031	-1.460	0.145	0.893	1.017	
O_3_lag10	0.909	0.086	-1.010	0.314	0.755	1.094	
O_3_lag11	1.144	0.107	1.440	0.149	0.953	1.374	
Temperature_lag0	1.009	0.009	1.020	0.306	0.992	1.026	
Temperature_lag1	1.000	0.012	-0.010	0.995	0.977	1.023	
Temperature_lag2	1.012	0.012	0.950	0.341	0.988	1.036	
Temperature_lag3	1.001	0.012	0.060	0.950	0.977	1.025	
Temperature_lag4	1.010	0.012	0.790	0.431	0.986	1.034	
Temperature_lag5	0.985	0.012	-1.280	0.201	0.962	1.008	
Temperature_lag6	1.008	0.012	0.670	0.506	0.985	1.032	
Temperature_lag7	0.995	0.012	-0.450	0.650	0.971	1.018	
Temperature_lag8	1.023	0.012	1.900	0.058	0.999	1.048	*
Temperature_lag9	0.993	0.012	-0.610	0.542	0.970	1.016	
Temperature_lag10	1.000	0.009	0.030	0.972	0.984	1.017	
Humidity_lag0	0.998	0.003	-0.870	0.385	0.992	1.003	
Humidity_lag1	1.004	0.003	1.090	0.277	0.997	1.010	
Humidity_lag2	0.996	0.003	-1.130	0.258	0.990	1.003	
Humidity_lag3	1.001	0.003	0.440	0.663	0.995	1.008	
Humidity_lag4	1.001	0.003	0.160	0.872	0.994	1.007	
Humidity_lag5	0.998	0.003	-0.610	0.540	0.991	1.004	
Humidity_lag6	1.005	0.003	1.400	0.162	0.998	1.011	
Humidity_lag7	0.995	0.003	-1.510	0.131	0.989	1.001	
Humidity_lag8	1.002	0.003	0.740	0.457	0.996	1.009	
Humidity_lag9	1.001	0.003	0.410	0.682	0.995	1.008	
Humidity_lag10	1.000	0.003	-0.150	0.880	0.993	1.006	
Humidity_lag11	1.004	0.003	1.250	0.212	0.998	1.010	
Humidity_lag12	1.000	0.003	-0.050	0.959	0.994	1.006	
Humidity_lag13	0.999	0.002	-0.380	0.703	0.994	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.189	0.057	3.590	0.000	1.082	1.307	***
Flu_lag0	0.962	0.051	-0.730	0.468	0.866	1.068	
Flu_lag1	1.102	0.059	1.810	0.070	0.992	1.225	*
Flu_lag2	1.012	0.054	0.220	0.824	0.911	1.125	
Flu_lag3	1.038	0.056	0.700	0.487	0.934	1.153	
Flu_lag4	1.000	0.053	0.000	0.997	0.901	1.111	
Flu_lag5	0.933	0.051	-1.280	0.199	0.839	1.037	
Flu_lag6	1.052	0.057	0.940	0.346	0.947	1.169	

Flu_lag7	1.122	0.061	2.130	0.033	1.009	1.247	**
Flu_lag8	1.035	0.056	0.630	0.528	0.931	1.150	
Flu_lag9	0.974	0.053	-0.490	0.624	0.875	1.083	
Flu_lag10	0.933	0.051	-1.270	0.205	0.839	1.038	
Flu_lag11	0.896	0.049	-2.030	0.042	0.805	0.996	**
Flu_lag12	0.937	0.050	-1.220	0.224	0.843	1.041	
cos_1	1.264	0.188	1.580	0.115	0.944	1.693	
cos_2	0.738	0.028	-8.110	0.000	0.686	0.795	***
cos_3	1.159	0.040	4.270	0.000	1.083	1.240	***
cos_4	1.106	0.038	2.960	0.003	1.035	1.182	***
sin_1	1.070	0.059	1.240	0.216	0.961	1.192	
sin_2	0.911	0.034	-2.530	0.011	0.847	0.979	**
sin_3	1.311	0.048	7.430	0.000	1.221	1.408	***
sin_4	0.830	0.027	-5.840	0.000	0.779	0.883	***
Constant	0.717	0.336	-0.710	0.477	0.286	1.796	
lnalpha	-2.645	0.299	.b	.b	-3.231	-2.059	

Mean dependent var	2.296	SD dependent var	2.016
Pseudo r-squared	.	Number of obs	1083
Chi-square	396.366	Prob > chi2	0.000
Akaike crit. (AIC)	3961.867	Bayesian crit. (BIC)	4236.179

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg older o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/6) irr

Table 3.27 Results of time-series age-stratified model of associations between daily respiratory ED visits among younger children (0-4 years old) and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.985	0.013	-1.070	0.283	0.959	1.012	
$PM_{2.5}$_lag1	0.985	0.013	-1.070	0.283	0.959	1.012	
$PM_{2.5}$_lag2	0.989	0.033	-0.330	0.739	0.926	1.056	
$PM_{2.5}$_lag3	0.985	0.013	-1.070	0.283	0.959	1.012	
$PM_{2.5}$_lag4	1.006	0.034	0.190	0.852	0.941	1.076	
$PM_{2.5}$_lag5	0.983	0.036	-0.460	0.647	0.914	1.057	
$PM_{2.5}$_lag6	1.025	0.035	0.720	0.473	0.958	1.096	
$PM_{2.5}$_lag7	0.985	0.013	-1.070	0.283	0.959	1.012	
Temperature_lag0	1.005	0.005	1.040	0.300	0.996	1.015	
Temperature_lag1	0.993	0.007	-1.030	0.304	0.980	1.006	
Temperature_lag2	1.007	0.007	1.040	0.298	0.994	1.021	
Temperature_lag3	0.991	0.007	-1.350	0.178	0.977	1.004	
Temperature_lag4	1.006	0.007	0.850	0.396	0.992	1.020	
Temperature_lag5	0.999	0.007	-0.190	0.848	0.985	1.012	

Temperature_lag6	0.996	0.007	-0.580	0.560	0.983	1.010	
Temperature_lag7	1.003	0.007	0.470	0.638	0.990	1.017	
Temperature_lag8	0.996	0.007	-0.580	0.560	0.983	1.009	
Temperature_lag9	1.010	0.007	1.570	0.117	0.997	1.024	
Temperature_lag10	0.994	0.005	-1.330	0.183	0.985	1.003	
Humidity_lag0	1.001	0.002	0.630	0.527	0.998	1.005	
Humidity_lag1	0.998	0.002	-0.860	0.389	0.994	1.002	
Humidity_lag2	1.002	0.002	0.980	0.328	0.998	1.007	
Humidity_lag3	0.999	0.002	-0.590	0.557	0.994	1.003	
Humidity_lag4	1.000	0.002	0.170	0.866	0.996	1.005	
Humidity_lag5	1.001	0.002	0.350	0.730	0.996	1.005	
Humidity_lag6	0.997	0.002	-1.500	0.134	0.992	1.001	
Humidity_lag7	1.001	0.002	0.390	0.694	0.996	1.005	
Humidity_lag8	1.002	0.002	0.960	0.336	0.998	1.006	
Humidity_lag9	0.999	0.002	-0.440	0.663	0.995	1.003	
Humidity_lag10	1.001	0.002	0.540	0.588	0.997	1.005	
Humidity_lag11	0.998	0.002	-0.750	0.450	0.994	1.003	
Humidity_lag12	1.001	0.002	0.240	0.807	0.996	1.005	
Humidity_lag13	1.001	0.002	0.530	0.593	0.998	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.046	0.034	1.380	0.169	0.981	1.115	
Flu_lag0	0.994	0.032	-0.170	0.863	0.933	1.060	
Flu_lag1	0.960	0.031	-1.260	0.208	0.900	1.023	
Flu_lag2	0.916	0.030	-2.690	0.007	0.860	0.977	***
Flu_lag3	1.019	0.033	0.590	0.556	0.956	1.087	
Flu_lag4	1.018	0.033	0.540	0.588	0.955	1.085	
Flu_lag5	0.968	0.032	-0.990	0.324	0.907	1.033	
Flu_lag6	1.063	0.035	1.840	0.065	0.996	1.134	*
Flu_lag7	1.023	0.034	0.680	0.498	0.958	1.092	
Flu_lag8	1.026	0.034	0.770	0.442	0.962	1.094	
Flu_lag9	1.028	0.034	0.830	0.409	0.963	1.096	
Flu_lag10	1.030	0.034	0.910	0.364	0.966	1.098	
Flu_lag11	0.978	0.032	-0.670	0.501	0.918	1.043	
Flu_lag12	1.001	0.032	0.020	0.981	0.939	1.066	
cos_1	1.722	0.116	8.090	0.000	1.510	1.964	***
cos_2	0.931	0.022	-2.980	0.003	0.888	0.976	***
cos_3	1.177	0.027	7.080	0.000	1.125	1.231	***
cos_4	1.081	0.025	3.390	0.001	1.034	1.131	***
sin_1	1.111	0.038	3.120	0.002	1.040	1.187	***
sin_2	0.948	0.023	-2.240	0.025	0.904	0.993	**
sin_3	1.167	0.028	6.430	0.000	1.113	1.223	***
sin_4	0.856	0.019	-7.120	0.000	0.820	0.894	***

Constant	4.924	0.939	8.360	0.000	3.388	7.156	***
lnalpha	-3.278	0.253	.b	.b	-3.774	-2.782	

Mean dependent var	5.242	SD dependent var	3.374
Pseudo r-squared	.	Number of obs	1083
Chi-square	766.646	Prob > chi2	0.000
Akaike crit. (AIC)	4975.205	Bayesian crit. (BIC)	5244.530

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg younger pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.28 Results of time-series age-stratified model of associations between daily respiratory ED visits among older children (5-16 years old) and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.985	0.049	-0.300	0.761	0.894	1.085	
$PM_{2.5}$_lag1	0.952	0.053	-0.880	0.381	0.853	1.062	
$PM_{2.5}$_lag2	0.980	0.053	-0.380	0.703	0.882	1.089	
$PM_{2.5}$_lag3	1.043	0.041	1.060	0.287	0.965	1.127	
$PM_{2.5}$_lag4	0.929	0.052	-1.320	0.188	0.832	1.037	
$PM_{2.5}$_lag5	1.043	0.041	1.060	0.287	0.965	1.127	
$PM_{2.5}$_lag6	0.965	0.025	-1.380	0.167	0.918	1.015	
$PM_{2.5}$_lag7	0.965	0.025	-1.380	0.167	0.918	1.015	
Temperature_lag0	1.010	0.009	1.120	0.264	0.993	1.027	
Temperature_lag1	1.003	0.012	0.280	0.776	0.980	1.028	
Temperature_lag2	1.010	0.013	0.770	0.443	0.985	1.035	
Temperature_lag3	1.004	0.013	0.280	0.779	0.979	1.028	
Temperature_lag4	1.008	0.012	0.620	0.534	0.984	1.032	
Temperature_lag5	0.984	0.012	-1.330	0.185	0.960	1.008	
Temperature_lag6	1.011	0.012	0.920	0.357	0.987	1.036	
Temperature_lag7	0.993	0.012	-0.550	0.582	0.970	1.017	
Temperature_lag8	1.023	0.012	1.920	0.055	1.000	1.048	*
Temperature_lag9	0.993	0.012	-0.570	0.567	0.971	1.016	
Temperature_lag10	0.998	0.008	-0.190	0.852	0.982	1.015	
Humidity_lag0	0.999	0.003	-0.410	0.681	0.994	1.004	
Humidity_lag1	1.002	0.003	0.650	0.514	0.996	1.009	
Humidity_lag2	0.997	0.003	-1.000	0.316	0.990	1.003	
Humidity_lag3	1.002	0.003	0.710	0.478	0.996	1.009	
Humidity_lag4	1.003	0.003	0.980	0.329	0.997	1.010	
Humidity_lag5	0.996	0.003	-1.310	0.191	0.989	1.002	
Humidity_lag6	1.006	0.003	1.820	0.069	1.000	1.012	*
Humidity_lag7	0.995	0.003	-1.470	0.142	0.989	1.002	
Humidity_lag8	1.003	0.003	0.870	0.383	0.996	1.009	

Humidity_lag9	1.002	0.003	0.740	0.457	0.996	1.009	
Humidity_lag10	1.001	0.003	0.270	0.788	0.995	1.007	
Humidity_lag11	1.002	0.003	0.750	0.456	0.996	1.008	
Humidity_lag12	1.000	0.003	-0.140	0.890	0.994	1.005	
Humidity_lag13	0.999	0.002	-0.520	0.605	0.994	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.165	0.057	3.120	0.002	1.059	1.283	***
Flu_lag0	0.962	0.052	-0.730	0.467	0.866	1.068	
Flu_lag1	1.093	0.059	1.650	0.099	0.983	1.214	*
Flu_lag2	1.015	0.055	0.290	0.776	0.914	1.128	
Flu_lag3	1.040	0.056	0.720	0.469	0.936	1.155	
Flu_lag4	0.994	0.053	-0.120	0.905	0.894	1.104	
Flu_lag5	0.941	0.051	-1.130	0.260	0.846	1.046	
Flu_lag6	1.051	0.056	0.920	0.357	0.946	1.167	
Flu_lag7	1.109	0.060	1.920	0.055	0.998	1.232	*
Flu_lag8	1.033	0.056	0.610	0.541	0.930	1.148	
Flu_lag9	0.977	0.053	-0.440	0.663	0.878	1.086	
Flu_lag10	0.924	0.050	-1.450	0.147	0.830	1.028	
Flu_lag11	0.899	0.049	-1.960	0.050	0.808	1.000	*
Flu_lag12	0.936	0.050	-1.240	0.216	0.842	1.040	
cos_1	1.392	0.160	2.870	0.004	1.111	1.744	***
cos_2	0.756	0.028	-7.650	0.000	0.703	0.812	***
cos_3	1.173	0.039	4.750	0.000	1.098	1.252	***
cos_4	1.068	0.037	1.900	0.058	0.998	1.142	*
sin_1	1.061	0.057	1.090	0.277	0.954	1.179	
sin_2	0.916	0.032	-2.480	0.013	0.855	0.982	**
sin_3	1.303	0.045	7.630	0.000	1.217	1.394	***
sin_4	0.832	0.027	-5.770	0.000	0.781	0.886	***
Constant	1.441	0.435	1.210	0.226	0.798	2.603	
lnalpha	-2.665	0.306	.b	.b	-3.264	-2.066	

Mean dependent var	2.296	SD dependent var	2.016
Pseudo r-squared	.	Number of obs	1083
Chi-square	396.405	Prob > chi2	0.000
Akaike crit. (AIC)	3963.684	Bayesian crit. (BIC)	4237.996

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg older pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/2) irr

Table 3.29 Results of time-series age-stratified model of associations between daily respiratory ED visits among younger children (0-4 years old) and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	1.012	0.014	0.850	0.394	0.985	1.039	

SO_2_lag1	0.998	0.019	-0.100	0.920	0.962	1.036	
SO_2_lag2	1.012	0.014	0.850	0.394	0.985	1.039	
SO_2_lag3	1.024	0.020	1.230	0.218	0.986	1.063	
SO_2_lag4	1.003	0.011	0.270	0.784	0.982	1.024	
SO_2_lag5	1.007	0.010	0.670	0.501	0.987	1.027	
SO_2_lag6	1.003	0.011	0.270	0.784	0.982	1.024	
SO_2_lag7	1.007	0.010	0.670	0.501	0.987	1.027	
SO_2_lag8	1.003	0.011	0.270	0.784	0.982	1.024	
SO_2_lag9	1.007	0.010	0.670	0.501	0.987	1.027	
Temperature_lag0	1.000	0.005	0.080	0.932	0.990	1.011	
Temperature_lag1	0.995	0.007	-0.750	0.453	0.980	1.009	
Temperature_lag2	1.005	0.008	0.710	0.479	0.990	1.021	
Temperature_lag3	0.989	0.008	-1.480	0.138	0.974	1.004	
Temperature_lag4	0.999	0.008	-0.130	0.895	0.984	1.014	
Temperature_lag5	1.005	0.008	0.630	0.529	0.990	1.020	
Temperature_lag6	1.000	0.008	0.030	0.977	0.985	1.015	
Temperature_lag7	1.002	0.008	0.200	0.842	0.987	1.017	
Temperature_lag8	0.997	0.007	-0.450	0.654	0.982	1.011	
Temperature_lag9	1.012	0.007	1.680	0.093	0.998	1.026	*
Temperature_lag10	0.995	0.005	-0.960	0.336	0.985	1.005	
Humidity_lag0	1.000	0.002	-0.100	0.923	0.996	1.004	
Humidity_lag1	0.997	0.003	-1.070	0.286	0.992	1.002	
Humidity_lag2	1.003	0.003	1.180	0.239	0.998	1.008	
Humidity_lag3	0.998	0.003	-0.720	0.472	0.993	1.003	
Humidity_lag4	1.001	0.003	0.460	0.644	0.996	1.007	
Humidity_lag5	0.998	0.003	-0.800	0.421	0.993	1.003	
Humidity_lag6	0.997	0.003	-0.930	0.351	0.992	1.003	
Humidity_lag7	1.002	0.003	0.890	0.375	0.997	1.008	
Humidity_lag8	1.001	0.003	0.510	0.609	0.996	1.007	
Humidity_lag9	0.999	0.003	-0.540	0.591	0.993	1.004	
Humidity_lag10	1.002	0.003	0.630	0.528	0.996	1.007	
Humidity_lag11	0.998	0.003	-0.840	0.404	0.993	1.003	
Humidity_lag12	1.001	0.003	0.400	0.690	0.996	1.006	
Humidity_lag13	0.997	0.002	-1.250	0.211	0.993	1.001	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.051	0.041	1.270	0.203	0.973	1.136	
Flu_lag0	1.020	0.038	0.520	0.600	0.948	1.098	
Flu_lag1	0.920	0.035	-2.210	0.027	0.855	0.991	**
Flu_lag2	0.873	0.032	-3.680	0.000	0.812	0.938	***
Flu_lag3	1.041	0.039	1.050	0.293	0.966	1.121	
Flu_lag4	0.994	0.038	-0.150	0.880	0.923	1.071	
Flu_lag5	0.950	0.036	-1.360	0.175	0.882	1.023	

Flu_lag6	1.045	0.040	1.120	0.261	0.968	1.127	
Flu_lag7	1.061	0.041	1.530	0.127	0.983	1.146	
Flu_lag8	1.049	0.040	1.270	0.202	0.974	1.130	
Flu_lag9	1.058	0.041	1.470	0.140	0.982	1.141	
Flu_lag10	1.084	0.041	2.160	0.031	1.007	1.166	**
Flu_lag11	1.008	0.038	0.220	0.828	0.937	1.085	
Flu_lag12	0.991	0.037	-0.260	0.798	0.922	1.065	
cos_1	1.807	0.132	8.070	0.000	1.565	2.086	***
cos_2	0.938	0.029	-2.030	0.042	0.882	0.998	**
cos_3	1.183	0.036	5.600	0.000	1.116	1.255	***
cos_4	1.089	0.031	2.990	0.003	1.030	1.152	***
sin_1	1.078	0.046	1.770	0.077	0.992	1.172	*
sin_2	0.925	0.030	-2.390	0.017	0.869	0.986	**
sin_3	1.104	0.034	3.190	0.001	1.039	1.173	***
sin_4	0.902	0.025	-3.670	0.000	0.853	0.953	***
Constant	11.720	5.286	5.460	0.000	4.843	28.366	***
lnalpha	-4.253	0.727	.b	.b	-5.677	-2.828	

Mean dependent var	5.326	SD dependent var	3.571
Pseudo r-squared	.	Number of obs	674
Chi-square	710.746	Prob > chi2	0.000
Akaike crit. (AIC)	3067.212	Bayesian crit. (BIC)	3310.927

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg younger so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/5) irr

Table 3.30 Results of time-series age-stratified model of associations between daily respiratory ED visits among older children (5-16 years old) and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.955	0.027	-1.610	0.107	0.903	1.010	
SO_2_lag1	1.023	0.016	1.390	0.166	0.991	1.055	
SO_2_lag2	1.017	0.021	0.810	0.417	0.977	1.059	
SO_2_lag3	0.986	0.020	-0.700	0.486	0.949	1.025	
SO_2_lag4	1.017	0.021	0.810	0.417	0.977	1.059	
SO_2_lag5	0.986	0.020	-0.700	0.486	0.949	1.025	
SO_2_lag6	1.023	0.016	1.390	0.166	0.991	1.055	
SO_2_lag7	1.023	0.016	1.390	0.166	0.991	1.055	
SO_2_lag8	**1.043**	**0.020**	**2.200**	**0.028**	**1.005**	**1.082**	**
SO_2_lag9	**1.043**	**0.020**	**2.200**	**0.028**	**1.005**	**1.082**	**
Temperature_lag0	1.007	0.011	0.650	0.518	0.986	1.029	
Temperature_lag1	1.004	0.015	0.260	0.797	0.975	1.033	
Temperature_lag2	1.020	0.015	1.290	0.197	0.990	1.050	

Temperature_lag3	1.001	0.015	0.040	0.967	0.971	1.031	
Temperature_lag4	1.007	0.015	0.510	0.612	0.979	1.037	
Temperature_lag5	0.982	0.014	-1.280	0.202	0.954	1.010	
Temperature_lag6	0.996	0.014	-0.280	0.777	0.968	1.025	
Temperature_lag7	1.002	0.014	0.110	0.916	0.974	1.030	
Temperature_lag8	1.019	0.014	1.310	0.189	0.991	1.047	
Temperature_lag9	1.003	0.014	0.220	0.822	0.976	1.031	
Temperature_lag10	0.996	0.010	-0.440	0.662	0.976	1.015	
Humidity_lag0	0.998	0.003	-0.700	0.486	0.991	1.004	
Humidity_lag1	1.002	0.004	0.550	0.580	0.994	1.011	
Humidity_lag2	0.998	0.004	-0.530	0.595	0.990	1.006	
Humidity_lag3	1.004	0.004	0.910	0.361	0.996	1.012	
Humidity_lag4	1.001	0.004	0.330	0.740	0.993	1.010	
Humidity_lag5	0.997	0.004	-0.770	0.439	0.988	1.005	
Humidity_lag6	1.006	0.004	1.510	0.131	0.998	1.015	
Humidity_lag7	0.991	0.004	-2.150	0.031	0.983	0.999	**
Humidity_lag8	1.005	0.004	1.280	0.202	0.997	1.014	
Humidity_lag9	1.002	0.004	0.490	0.621	0.994	1.011	
Humidity_lag10	1.001	0.004	0.130	0.900	0.992	1.009	
Humidity_lag11	1.003	0.004	0.870	0.383	0.996	1.011	
Humidity_lag12	1.000	0.004	-0.020	0.988	0.992	1.008	
Humidity_lag13	1.002	0.003	0.700	0.482	0.996	1.009	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.101	0.069	1.520	0.128	0.973	1.245	
Flu_lag0	0.870	0.060	-2.030	0.042	0.761	0.995	**
Flu_lag1	1.048	0.072	0.680	0.499	0.916	1.199	
Flu_lag2	1.043	0.071	0.620	0.538	0.912	1.193	
Flu_lag3	1.066	0.073	0.940	0.347	0.933	1.219	
Flu_lag4	1.028	0.070	0.410	0.683	0.900	1.174	
Flu_lag5	0.958	0.066	-0.620	0.534	0.836	1.097	
Flu_lag6	1.056	0.073	0.780	0.434	0.922	1.209	
Flu_lag7	1.101	0.076	1.390	0.166	0.961	1.261	
Flu_lag8	1.072	0.073	1.010	0.311	0.937	1.226	
Flu_lag9	1.035	0.072	0.500	0.619	0.904	1.185	
Flu_lag10	0.908	0.062	-1.410	0.158	0.793	1.038	
Flu_lag11	0.884	0.060	-1.820	0.069	0.774	1.010	*
Flu_lag12	0.880	0.060	-1.870	0.061	0.771	1.006	*
cos_1	1.336	0.177	2.180	0.029	1.030	1.732	**
cos_2	0.802	0.038	-4.660	0.000	0.731	0.880	***
cos_3	1.067	0.047	1.480	0.140	0.979	1.163	
cos_4	1.049	0.047	1.070	0.286	0.961	1.146	
sin_1	1.108	0.076	1.490	0.137	0.968	1.269	
sin_2	0.842	0.041	-3.540	0.000	0.766	0.926	***
sin_3	1.339	0.060	6.530	0.000	1.227	1.461	***

sin_4	0.837	0.035	-4.240	0.000	0.770	0.908	***
Constant	1.997	1.424	0.970	0.332	0.493	8.081	
lnalpha	-3.163	0.619	.b	.b	-4.375	-1.950	

Mean dependent var	2.018	SD dependent var	1.703
Pseudo r-squared	.	Number of obs	674
Chi-square	169.489	Prob > chi2	0.000
Akaike crit. (AIC)	2379.030	Bayesian crit. (BIC)	2622.745

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg older so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/5) irr

3.2.5 Results of time-series wildfire and non-wildfire models

Tables 3.31 to 3.35 present the results of the wildfire season model and Tables 36 to 40 show the results of the non-wildfire season model for the five air pollutants and selected lags over the study period. IRRs and 95% confidence intervals for daily respiratory ED visits during wildfire seasons and non-wildfire seasons are shown for a one unit increase in the natural log of air pollutants concentrations. In other words, expected daily respiratory ED visits among children increased by [(IRR-1) * 100] % when air pollutant concentration increased (e-1) times after adjusting for other variables (e: Euler's number. The value is approximately 2.71828). During wildfire seasons, the daily respiratory ED visits among children were significantly, positively associated with 2- and 6-day lag exposures to CO, with the same IRR of 1.196 (95%CI: 1.020-1.403). Also, significant evidence of positive associations between daily respiratory ED visits among children and 0-, 5-, 6-, and 10-day lag exposures to NO_2, with the same IRR of 1.080 (95%CI: 1.005-1.160) for 0, 5 and 10-day lag exposures, and 1.147 (95%CI: 1.024-1.285) for 6-day lag exposures. For O_3, 5- and 11-day lag exposures were found to be positively associated with daily respiratory ED visits among children, with the same IRR of 1.120 (95%CI: 0.997-1.256). Meanwhile, 0-, 2-, and 6-day lag exposures of $PM_{2.5}$ were positively associated with daily respiratory ED visits among children, with the same IRR of 1.056 (95%CI: 1.004-1.112). There was no significant association between daily respiratory ED visits among children and exposure to SO_2 in the wildfire season in Edmonton.

During non-wildfire seasons, 4- and 8-day lag exposures of NO_2, 1- and 5-day lag exposures of O_3, and 1- and 4-day lag exposures of SO_2 were found to be positively associated with daily respiratory visits among children, with IRR of 1.073 (95%CI: 1.001-1.15), 1.101 (95%CI: 1.01-

1.2), and 1.033 (95%CI: 1.003-1.064) for NO_2, O_3, and SO_2, respectively. Significant associations for exposure to CO and $PM_{2.5}$ were not found in non-wildfire season models.

For wildfire season models, AIC in CO and NO_2 models were smaller than in the baseline model, and BIC were larger than in the baseline model. Both AIC and BIC in O_3 and $PM_{2.5}$ models were larger than in the baseline model. Both AIC and BIC in SO_2 models were smaller than in the baseline models. Results of the wildfire season baseline model is presented in Appendix 2 Table A 2.6. For non-wildfire season models, both AIC and BIC in models of CO, NO_2, O_3 and $PM_{2.5}$ were larger than in the baseline model. Both AIC and BIC in SO_2 model were smaller than in the baseline models. Results of the non-wildfire season baseline model are presented in Appendix 2 Table A 2.7.

Table 3.31 Results of time-series wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.892	0.067	-1.530	0.125	0.770	1.032	
CO_lag1	1.053	0.075	0.730	0.467	0.916	1.212	
CO_lag2	**1.196**	**0.097**	**2.200**	**0.028**	**1.020**	**1.403**	**
CO_lag3	0.838	0.094	-1.570	0.115	0.673	1.044	
CO_lag4	0.892	0.067	-1.530	0.125	0.770	1.032	
CO_lag5	0.908	0.062	-1.400	0.161	0.794	1.039	
CO_lag6	**1.196**	**0.097**	**2.200**	**0.028**	**1.020**	**1.403**	**
CO_lag7	0.869	0.090	-1.360	0.174	0.709	1.064	
CO_lag8	1.053	0.075	0.730	0.467	0.916	1.212	
CO_lag9	0.908	0.062	-1.400	0.161	0.794	1.039	
Temperature_lag0	1.022	0.011	2.030	0.042	1.001	1.043	**
Temperature_lag1	0.986	0.014	-1.030	0.303	0.959	1.013	
Temperature_lag2	1.009	0.012	0.750	0.455	0.986	1.033	
Temperature_lag3	0.993	0.012	-0.590	0.557	0.970	1.017	
Temperature_lag4	1.011	0.012	0.940	0.345	0.988	1.035	
Temperature_lag5	0.985	0.011	-1.350	0.177	0.963	1.007	
Temperature_lag6	1.005	0.008	0.660	0.511	0.990	1.021	
Humidity_lag0	1.002	0.003	0.640	0.523	0.997	1.007	
Humidity_lag1	0.999	0.003	-0.430	0.665	0.994	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.153	0.049	3.330	0.001	1.060	1.253	***
Flu_lag0	0.928	0.054	-1.280	0.200	0.828	1.040	
Flu_lag1	1.002	0.057	0.040	0.966	0.896	1.122	
Flu_lag2	0.998	0.058	-0.030	0.976	0.892	1.118	
Flu_lag3	0.894	0.052	-1.920	0.055	0.797	1.002	*

Flu_lag4	1.018	0.059	0.310	0.758	0.908	1.142	
Flu_lag5	0.897	0.053	-1.830	0.067	0.798	1.008	*
Flu_lag6	0.966	0.056	-0.600	0.550	0.862	1.082	
Flu_lag7	1.052	0.060	0.890	0.375	0.941	1.176	
Flu_lag8	0.989	0.057	-0.190	0.848	0.884	1.106	
Flu_lag9	0.925	0.054	-1.330	0.184	0.824	1.038	
Flu_lag10	0.986	0.057	-0.240	0.807	0.880	1.105	
Flu_lag11	1.016	0.057	0.280	0.783	0.909	1.135	
Flu_lag12	1.032	0.057	0.570	0.567	0.926	1.151	
Flu_lag13	1.016	0.057	0.280	0.783	0.909	1.135	
Flu_lag14	1.114	0.063	1.930	0.054	0.998	1.244	*
Flu_lag15	1.152	0.066	2.470	0.014	1.030	1.288	**
Flu_lag16	0.953	0.056	-0.830	0.405	0.849	1.068	
Flu_lag17	1.005	0.058	0.080	0.934	0.897	1.126	
cos_1	0.925	7.031	-0.010	0.992	0.000	2.715E+06	
cos_2	0.982	4.713	0.000	0.997	0.000	1.197E+04	
cos_3	1.982	4.107	0.330	0.741	0.034	114.987	
cos_4	1.726	0.847	1.110	0.266	0.659	4.517	
sin_1	5.220	3.152	2.740	0.006	1.598	17.047	***
sin_2	7.762	6.055	2.630	0.009	1.682	35.810	***
sin_3	5.756	3.076	3.270	0.001	2.019	16.406	***
sin_4	1.566	0.302	2.330	0.020	1.073	2.284	**
Constant	2.584	11.352	0.220	0.829	0.000	1.418E+04	
lnalpha	-3.734	0.439	.b	.b	-4.594	-2.875	

Mean dependent var	6.501	SD dependent var	4.208
Pseudo r-squared	.	Number of obs	549
Chi-square	598.379	Prob > chi2	0.000
Akaike crit. (AIC)	2671.840	Bayesian crit. (BIC)	2861.396

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.32 Results of time-series wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	**1.080**	**0.040**	**2.100**	**0.036**	**1.005**	**1.160**	**
NO_2_lag1	0.979	0.034	-0.620	0.535	0.915	1.047	
NO_2_lag2	1.051	0.040	1.310	0.192	0.976	1.131	
NO_2_lag3	1.039	0.047	0.850	0.397	0.951	1.135	
NO_2_lag4	0.979	0.034	-0.620	0.535	0.915	1.047	
NO_2_lag5	**1.080**	**0.040**	**2.100**	**0.036**	**1.005**	**1.160**	**
NO_2_lag6	**1.147**	**0.067**	**2.360**	**0.018**	**1.024**	**1.285**	**

NO_2_lag7	0.920	0.055	-1.380	0.167	0.817	1.035	
NO_2_lag8	1.039	0.047	0.850	0.397	0.951	1.135	
NO_2_lag9	1.051	0.040	1.310	0.192	0.976	1.131	
NO_2_lag10	**1.080**	**0.040**	**2.100**	**0.036**	**1.005**	**1.160**	**
NO_2_lag11	0.948	0.054	-0.930	0.351	0.848	1.060	
NO_2_lag12	0.940	0.053	-1.110	0.268	0.841	1.049	
NO_2_lag13	0.979	0.034	-0.620	0.535	0.915	1.047	
Temperature_lag0	1.019	0.011	1.770	0.076	0.998	1.040	*
Temperature_lag1	0.994	0.014	-0.450	0.656	0.967	1.021	
Temperature_lag2	1.007	0.012	0.540	0.589	0.983	1.031	
Temperature_lag3	0.992	0.012	-0.670	0.502	0.968	1.016	
Temperature_lag4	1.012	0.012	1.010	0.314	0.989	1.036	
Temperature_lag5	0.975	0.011	-2.140	0.032	0.953	0.998	**
Temperature_lag6	1.014	0.008	1.740	0.083	0.998	1.031	*
Humidity_lag0	1.001	0.003	0.360	0.721	0.996	1.006	
Humidity_lag1	1.000	0.003	-0.010	0.992	0.995	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.172	0.058	3.180	0.001	1.063	1.292	***
Flu_lag0	0.932	0.055	-1.190	0.233	0.831	1.046	
Flu_lag1	1.000	0.059	0.000	0.999	0.892	1.121	
Flu_lag2	0.981	0.057	-0.340	0.736	0.875	1.099	
Flu_lag3	0.898	0.052	-1.850	0.065	0.800	1.007	*
Flu_lag4	1.004	0.059	0.070	0.942	0.894	1.128	
Flu_lag5	0.890	0.053	-1.960	0.050	0.792	1.000	*
Flu_lag6	0.927	0.054	-1.290	0.197	0.827	1.040	
Flu_lag7	1.024	0.058	0.410	0.682	0.916	1.144	
Flu_lag8	0.975	0.056	-0.440	0.658	0.871	1.091	
Flu_lag9	0.942	0.055	-1.020	0.309	0.840	1.057	
Flu_lag10	0.964	0.056	-0.640	0.525	0.859	1.080	
Flu_lag11	0.987	0.056	-0.240	0.811	0.882	1.103	
Flu_lag12	1.026	0.057	0.460	0.643	0.920	1.145	
Flu_lag13	1.013	0.057	0.220	0.824	0.907	1.131	
Flu_lag14	1.082	0.061	1.400	0.162	0.969	1.208	
Flu_lag15	1.138	0.065	2.250	0.024	1.017	1.273	**
Flu_lag16	0.949	0.056	-0.900	0.370	0.846	1.064	
Flu_lag17	1.002	0.058	0.040	0.968	0.894	1.124	
cos_1	0.116	0.888	-0.280	0.779	0.000	3.979E+05	
cos_2	0.297	1.440	-0.250	0.802	0.000	3.981E+03	
cos_3	1.260	2.635	0.110	0.912	0.021	75.910	
cos_4	1.633	0.807	0.990	0.321	0.620	4.303	
sin_1	5.420	3.268	2.800	0.005	1.662	17.671	***
sin_2	7.854	6.128	2.640	0.008	1.702	36.246	***

sin_3	5.999	3.199	3.360	0.001	2.110	17.059	***
sin_4	1.584	0.304	2.390	0.017	1.087	2.307	**
Constant	4.528	19.979	0.340	0.732	0.001	2.579E+04	
lnalpha	-3.692	0.417	.b	.b	-4.509	-2.876	
Mean dependent var	6.501		SD dependent var	4.208			
Pseudo r-squared	.		Number of obs	549			
Chi-square	602.696		Prob > chi2	0.000			
Akaike crit. (AIC)	2671.643		Bayesian crit. (BIC)	2869.815			

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/6) irr

Table 3.33 Results of time-series wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.026	0.069	0.380	0.701	0.900	1.170	
O_3_lag1	0.936	0.059	-1.040	0.297	0.827	1.060	
O_3_lag2	0.994	0.054	-0.110	0.913	0.893	1.107	
O_3_lag3	1.026	0.069	0.380	0.701	0.900	1.170	
O_3_lag4	0.980	0.062	-0.320	0.752	0.866	1.109	
O_3_lag5	**1.120**	**0.066**	**1.920**	**0.045**	**0.997**	**1.256**	**
O_3_lag6	0.994	0.054	-0.110	0.913	0.893	1.107	
O_3_lag7	1.057	0.096	0.610	0.540	0.885	1.264	
O_3_lag8	0.994	0.054	-0.110	0.913	0.893	1.107	
O_3_lag9	0.980	0.062	-0.320	0.752	0.866	1.109	
O_3_lag10	0.936	0.059	-1.040	0.297	0.827	1.060	
O_3_lag11	**1.120**	**0.066**	**1.920**	**0.045**	**0.997**	**1.256**	**
Temperature_lag0	1.020	0.011	1.870	0.062	0.999	1.041	*
Temperature_lag1	0.992	0.014	-0.550	0.582	0.966	1.020	
Temperature_lag2	1.009	0.013	0.730	0.468	0.985	1.034	
Temperature_lag3	0.990	0.012	-0.780	0.435	0.967	1.015	
Temperature_lag4	1.011	0.012	0.880	0.378	0.987	1.036	
Temperature_lag5	0.978	0.012	-1.850	0.064	0.955	1.001	*
Temperature_lag6	1.008	0.009	0.850	0.393	0.990	1.025	
Humidity_lag0	1.002	0.003	0.700	0.484	0.997	1.007	
Humidity_lag1	0.999	0.003	-0.270	0.784	0.994	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.157	0.049	3.460	0.001	1.065	1.256	***
Flu_lag0	0.924	0.055	-1.340	0.180	0.823	1.037	
Flu_lag1	0.992	0.058	-0.140	0.886	0.885	1.111	
Flu_lag2	0.956	0.056	-0.770	0.443	0.851	1.073	

Flu_lag3	0.910	0.054	-1.580	0.113	0.810	1.023	
Flu_lag4	1.017	0.061	0.280	0.779	0.905	1.143	
Flu_lag5	0.894	0.054	-1.850	0.065	0.794	1.007	*
Flu_lag6	0.938	0.056	-1.070	0.285	0.835	1.054	
Flu_lag7	1.039	0.060	0.650	0.513	0.927	1.163	
Flu_lag8	0.976	0.058	-0.410	0.681	0.869	1.096	
Flu_lag9	0.925	0.056	-1.300	0.194	0.822	1.041	
Flu_lag10	0.948	0.057	-0.890	0.376	0.843	1.067	
Flu_lag11	0.987	0.057	-0.230	0.817	0.880	1.106	
Flu_lag12	1.021	0.059	0.370	0.714	0.913	1.143	
Flu_lag13	1.006	0.058	0.100	0.919	0.898	1.127	
Flu_lag14	1.082	0.062	1.370	0.172	0.967	1.211	
Flu_lag15	1.129	0.066	2.070	0.039	1.006	1.268	**
Flu_lag16	0.942	0.056	-1.000	0.315	0.838	1.059	
Flu_lag17	0.998	0.059	-0.030	0.980	0.889	1.121	
cos_1	2.998	23.490	0.140	0.889	0.000	1.398E+07	
cos_2	1.995	9.865	0.140	0.889	0.000	3.226E+04	
cos_3	2.672	5.701	0.460	0.645	0.041	175.006	
cos_4	1.869	0.942	1.240	0.215	0.696	5.021	
sin_1	6.734	4.190	3.060	0.002	1.989	22.800	***
sin_2	11.022	8.926	2.960	0.003	2.254	53.899	***
sin_3	7.553	4.204	3.630	0.000	2.537	22.485	***
sin_4	1.740	0.350	2.760	0.006	1.173	2.579	***
Constant	13.165	61.229	0.550	0.579	0.001	1.197E+05	
lnalpha	-3.533	0.370	.b	.b	-4.257	-2.808	

Mean dependent var	6.501	SD dependent var	4.208
Pseudo r-squared	.	Number of obs	549
Chi-square	569.605	Prob > chi2	0.000
Akaike crit. (AIC)	2684.136	Bayesian crit. (BIC)	2873.692

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/6) irr

Table 3.34 Results of time-series wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	**1.056**	**0.027**	**2.110**	**0.035**	**1.004**	**1.112**	**
$PM_{2.5}$_lag1	0.957	0.028	-1.480	0.138	0.904	1.014	
$PM_{2.5}$_lag2	**1.056**	**0.027**	**2.110**	**0.035**	**1.004**	**1.112**	**
$PM_{2.5}$_lag3	0.976	0.046	-0.510	0.607	0.889	1.071	
$PM_{2.5}$_lag4	0.919	0.044	-1.780	0.075	0.838	1.008	*

$PM_{2.5}$_lag5	1.007	0.045	0.150	0.883	0.922	1.098	
$PM_{2.5}$_lag6	**1.056**	**0.027**	**2.110**	**0.035**	**1.004**	**1.112**	**
$PM_{2.5}$_lag7	0.957	0.028	-1.480	0.138	0.904	1.014	
Temperature_lag0	1.013	0.011	1.180	0.238	0.992	1.034	
Temperature_lag1	0.995	0.014	-0.320	0.746	0.968	1.023	
Temperature_lag2	1.007	0.012	0.550	0.579	0.983	1.031	
Temperature_lag3	0.992	0.012	-0.680	0.498	0.968	1.016	
Temperature_lag4	1.016	0.012	1.300	0.192	0.992	1.041	
Temperature_lag5	0.983	0.012	-1.450	0.146	0.960	1.006	
Temperature_lag6	1.005	0.008	0.640	0.520	0.989	1.022	
Humidity_lag0	1.001	0.003	0.300	0.768	0.996	1.006	
Humidity_lag1	1.000	0.003	0.170	0.863	0.995	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.163	0.049	3.550	0.000	1.070	1.263	***
Flu_lag0	0.922	0.054	-1.380	0.167	0.822	1.035	
Flu_lag1	0.993	0.058	-0.120	0.902	0.886	1.112	
Flu_lag2	0.976	0.056	-0.430	0.670	0.871	1.093	
Flu_lag3	0.901	0.053	-1.780	0.075	0.803	1.010	*
Flu_lag4	1.006	0.060	0.100	0.921	0.896	1.130	
Flu_lag5	0.901	0.054	-1.740	0.082	0.802	1.013	*
Flu_lag6	0.947	0.055	-0.930	0.354	0.845	1.062	
Flu_lag7	1.043	0.060	0.730	0.466	0.932	1.166	
Flu_lag8	0.988	0.057	-0.210	0.836	0.883	1.106	
Flu_lag9	0.930	0.055	-1.240	0.217	0.828	1.044	
Flu_lag10	0.968	0.057	-0.550	0.584	0.863	1.086	
Flu_lag11	1.011	0.058	0.190	0.850	0.904	1.131	
Flu_lag12	1.036	0.058	0.630	0.527	0.928	1.157	
Flu_lag13	1.005	0.057	0.080	0.933	0.899	1.124	
Flu_lag14	1.091	0.062	1.540	0.123	0.977	1.219	
Flu_lag15	1.151	0.066	2.430	0.015	1.027	1.288	**
Flu_lag16	0.956	0.056	-0.770	0.442	0.852	1.073	
Flu_lag17	0.993	0.058	-0.110	0.910	0.886	1.114	
cos_1	1.917	14.767	0.080	0.933	0.000	6.930E+06	
cos_2	1.570	7.641	0.090	0.926	0.000	2.182E+04	
cos_3	2.441	5.127	0.430	0.671	0.040	149.703	
cos_4	1.830	0.909	1.220	0.224	0.691	4.846	
sin_1	6.257	3.825	3.000	0.003	1.888	20.737	***
sin_2	9.696	7.656	2.880	0.004	2.063	45.576	***
sin_3	6.811	3.683	3.550	0.000	2.360	19.656	***
sin_4	1.663	0.323	2.620	0.009	1.136	2.435	***
Constant	6.153	27.397	0.410	0.683	0.001	3.793E+04	
lnalpha	-3.568	0.380	.b	.b	-4.314	-2.822	

Mean dependent var	6.501	SD dependent var	4.208
Pseudo r-squared	.	Number of obs	549
Chi-square	575.857	Prob > chi2	0.000
Akaike crit. (AIC)	2678.485	Bayesian crit. (BIC)	2863.733

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count pm25lag* temperaturelag* humiditylag* i.holidayweekedn flulag* cos* sin*, constraints(1/3) irr

Table 3.35 Results of time-series wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.994	0.018	-0.350	0.727	0.959	1.030	
Temperature_lag0	1.026	0.012	2.280	0.022	1.004	1.049	**
Temperature_lag1	0.986	0.015	-0.930	0.353	0.957	1.016	
Temperature_lag2	1.006	0.014	0.470	0.637	0.980	1.034	
Temperature_lag3	0.991	0.013	-0.660	0.507	0.966	1.017	
Temperature_lag4	1.010	0.013	0.780	0.436	0.985	1.035	
Temperature_lag5	0.982	0.012	-1.480	0.140	0.959	1.006	
Temperature_lag6	1.010	0.008	1.170	0.242	0.993	1.027	
Humidity_lag0	1.003	0.003	0.930	0.353	0.997	1.008	
Humidity_lag1	0.999	0.003	-0.480	0.630	0.993	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.153	0.051	3.190	0.001	1.056	1.258	***
Flu_lag0	0.949	0.061	-0.810	0.418	0.838	1.076	
Flu_lag1	0.999	0.064	-0.010	0.993	0.882	1.132	
Flu_lag2	0.971	0.061	-0.460	0.643	0.859	1.099	
Flu_lag3	0.900	0.056	-1.680	0.093	0.796	1.018	*
Flu_lag4	1.008	0.062	0.120	0.901	0.893	1.137	
Flu_lag5	0.898	0.058	-1.680	0.093	0.791	1.018	*
Flu_lag6	0.915	0.058	-1.390	0.163	0.808	1.037	
Flu_lag7	1.060	0.065	0.960	0.338	0.941	1.195	
Flu_lag8	0.981	0.060	-0.320	0.752	0.870	1.106	
Flu_lag9	0.941	0.059	-0.970	0.330	0.832	1.064	
Flu_lag10	0.957	0.061	-0.690	0.492	0.845	1.084	
Flu_lag11	0.984	0.060	-0.270	0.786	0.873	1.108	
Flu_lag12	1.032	0.063	0.510	0.612	0.915	1.164	
Flu_lag13	1.042	0.064	0.670	0.505	0.924	1.174	
Flu_lag14	1.084	0.066	1.330	0.184	0.962	1.220	
Flu_lag15	1.137	0.071	2.050	0.041	1.005	1.286	**
Flu_lag16	0.948	0.060	-0.840	0.402	0.838	1.074	
Flu_lag17	0.984	0.062	-0.250	0.802	0.870	1.114	

cos_1	1.824	14.958	0.070	0.942	0.000	1.738E+07	
cos_2	1.508	7.813	0.080	0.937	0.000	3.871E+04	
cos_3	2.396	5.357	0.390	0.696	0.030	191.701	
cos_4	1.849	0.978	1.160	0.245	0.656	5.212	
sin_1	5.748	3.690	2.720	0.006	1.633	20.231	***
sin_2	8.636	7.167	2.600	0.009	1.698	43.929	***
sin_3	6.348	3.602	3.260	0.001	2.088	19.301	***
sin_4	1.623	0.330	2.380	0.017	1.089	2.419	**
Constant	5.408	25.612	0.360	0.722	0.001	5.808E+04	
lnalpha	-3.354	0.337	.b	.b	-4.015	-2.693	
Mean dependent var	6.414		SD dependent var		4.224		
Pseudo r-squared	0.129		Number of obs		510		
Chi-square	357.466		Prob > chi2		0.000		
Akaike crit. (AIC)	2494.976		Bayesian crit. (BIC)		2660.118		

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table 3.36 Results of time-series non-wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.880	0.068	-1.640	0.100	0.756	1.025	
CO_lag1	0.944	0.079	-0.690	0.492	0.800	1.113	
CO_lag2	1.004	0.085	0.050	0.959	0.852	1.185	
CO_lag3	1.072	0.085	0.870	0.383	0.917	1.253	
Temperature_lag0	1.004	0.005	0.780	0.437	0.994	1.013	
Temperature_lag1	0.995	0.006	-0.730	0.465	0.983	1.008	
Temperature_lag2	1.004	0.007	0.590	0.554	0.991	1.017	
Temperature_lag3	0.995	0.006	-0.810	0.417	0.983	1.007	
Temperature_lag4	1.005	0.006	0.870	0.384	0.993	1.018	
Temperature_lag5	1.000	0.006	-0.030	0.977	0.988	1.012	
Temperature_lag6	0.998	0.006	-0.360	0.717	0.986	1.010	
Temperature_lag7	0.998	0.006	-0.390	0.698	0.986	1.009	
Temperature_lag8	1.007	0.004	1.700	0.090	0.999	1.016	*
Humidity_lag0	1.000	0.002	-0.040	0.970	0.996	1.004	
Humidity_lag1	0.997	0.003	-1.000	0.319	0.992	1.003	
Humidity_lag2	1.001	0.003	0.250	0.805	0.995	1.006	
Humidity_lag3	0.999	0.002	-0.540	0.589	0.995	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.037	0.037	1.010	0.312	0.967	1.112	
Flu_lag0	0.996	0.032	-0.130	0.900	0.936	1.060	

Flu_lag1	0.976	0.032	-0.750	0.452	0.916	1.040	
Flu_lag2	0.915	0.029	-2.780	0.006	0.859	0.974	***
Flu_lag3	1.063	0.034	1.900	0.057	0.998	1.133	*
Flu_lag4	0.995	0.032	-0.150	0.880	0.934	1.060	
Flu_lag5	0.971	0.031	-0.900	0.366	0.912	1.035	
Flu_lag6	1.091	0.036	2.650	0.008	1.023	1.164	***
Flu_lag7	1.028	0.034	0.820	0.414	0.963	1.097	
Flu_lag8	1.023	0.034	0.700	0.482	0.960	1.091	
Flu_lag9	1.035	0.034	1.060	0.291	0.971	1.103	
Flu_lag10	1.006	0.032	0.190	0.851	0.944	1.072	
Flu_lag11	0.951	0.031	-1.560	0.119	0.892	1.013	
Flu_lag12	0.963	0.031	-1.200	0.232	0.904	1.025	
cos_1	0.000	0.000	-2.310	0.021	0.000	0.090	**
cos_2	2.681E+04	1.156E+05	2.360	0.018	5.722	1.256E+08	**
cos_3	0.014	0.027	-2.290	0.022	0.000	0.540	**
cos_4	2.756	1.190	2.350	0.019	1.182	6.425	**
sin_1	0.591	0.360	-0.860	0.389	0.179	1.953	
sin_2	2.247	1.777	1.020	0.306	0.477	10.586	
sin_3	0.583	0.315	-1.000	0.317	0.202	1.678	
sin_4	1.177	0.221	0.870	0.387	0.814	1.702	
Constant	8.996E+04	3.565E+05	2.880	0.004	38.113	2.123E+08	***
lnalpha	-3.817	0.383	.b	.b	-4.568	-3.066	

Mean dependent var	8.602	SD dependent var	3.653
Pseudo r-squared	0.047	Number of obs	535
Chi-square	133.943	Prob > chi2	0.000
Akaike crit. (AIC)	2809.902	Bayesian crit. (BIC)	2985.475

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table 3.37 Results of time-series non-wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	0.937	0.032	-1.930	0.054	0.877	1.001	*
NO_2_lag1	0.960	0.033	-1.200	0.231	0.897	1.027	
NO_2_lag2	1.011	0.048	0.230	0.817	0.921	1.110	
NO_2_lag3	0.937	0.032	-1.930	0.054	0.877	1.001	*
NO_2_lag4	**1.073**	**0.038**	**2.000**	**0.046**	**1.001**	**1.150**	**
NO_2_lag5	1.020	0.048	0.420	0.678	0.929	1.119	
NO_2_lag6	0.960	0.033	-1.200	0.231	0.897	1.027	

NO_2_lag7	0.991	0.033	-0.270	0.790	0.929	1.057	
NO_2_lag8	**1.073**	**0.038**	**2.000**	**0.046**	**1.001**	**1.150**	**
NO_2_lag9	0.920	0.042	-1.820	0.069	0.841	1.007	*
NO_2_lag10	0.991	0.033	-0.270	0.790	0.929	1.057	
Temperature_lag0	1.004	0.005	0.830	0.405	0.995	1.013	
Temperature_lag1	0.994	0.007	-0.950	0.344	0.981	1.007	
Temperature_lag2	1.008	0.007	1.170	0.240	0.995	1.021	
Temperature_lag3	0.991	0.006	-1.360	0.175	0.979	1.004	
Temperature_lag4	1.005	0.006	0.800	0.423	0.993	1.018	
Temperature_lag5	1.002	0.006	0.350	0.727	0.990	1.015	
Temperature_lag6	0.998	0.006	-0.370	0.712	0.986	1.010	
Temperature_lag7	0.994	0.006	-0.940	0.346	0.982	1.006	
Temperature_lag8	1.010	0.005	2.300	0.021	1.002	1.019	**
Humidity_lag0	0.999	0.002	-0.270	0.791	0.995	1.004	
Humidity_lag1	0.997	0.003	-1.030	0.304	0.992	1.002	
Humidity_lag2	1.001	0.003	0.430	0.668	0.996	1.006	
Humidity_lag3	0.998	0.002	-0.910	0.361	0.994	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.038	0.038	1.040	0.300	0.967	1.114	
Flu_lag0	0.994	0.032	-0.180	0.855	0.934	1.058	
Flu_lag1	0.976	0.031	-0.760	0.447	0.916	1.039	
Flu_lag2	0.924	0.029	-2.470	0.013	0.868	0.984	**
Flu_lag3	1.052	0.034	1.570	0.116	0.987	1.121	
Flu_lag4	0.997	0.032	-0.080	0.934	0.936	1.062	
Flu_lag5	0.971	0.031	-0.910	0.365	0.912	1.034	
Flu_lag6	1.088	0.036	2.590	0.010	1.021	1.160	***
Flu_lag7	1.020	0.034	0.590	0.553	0.956	1.089	
Flu_lag8	1.037	0.034	1.120	0.261	0.973	1.106	
Flu_lag9	1.035	0.034	1.050	0.294	0.971	1.103	
Flu_lag10	1.001	0.032	0.020	0.981	0.940	1.066	
Flu_lag11	0.953	0.031	-1.480	0.139	0.895	1.016	
Flu_lag12	0.969	0.031	-0.980	0.328	0.911	1.032	
cos_1	0.000	0.000	-2.020	0.043	0.000	0.648	**
cos_2	9.277E+03	4.062E+04	2.090	0.037	1.738	4.951E+07	**
cos_3	0.023	0.043	-2.020	0.044	0.001	0.900	**
cos_4	2.472	1.084	2.060	0.039	1.046	5.838	**
sin_1	0.544	0.333	-0.990	0.320	0.164	1.804	
sin_2	2.526	2.005	1.170	0.243	0.533	11.969	
sin_3	0.541	0.292	-1.140	0.255	0.187	1.559	
sin_4	1.210	0.228	1.010	0.311	0.837	1.751	
Constant	2.248E+04	9.292E+04	2.420	0.015	6.810	7.419E+07	**

lnalpha	-3.894	0.408	.b	.b	-4.692	-3.095

Mean dependent var	8.602	SD dependent var	3.653
Pseudo r-squared	.	Number of obs	535
Chi-square	160.847	Prob > chi2	0.000
Akaike crit. (AIC)	2808.654	Bayesian crit. (BIC)	2997.074

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count no2lag* temperaturelag* humiditylag* i.holidayweekend lnflulag* cos* sin*, constraints(1/4) irr

Table 3.38 Results of time-series non-wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	1.015	0.055	0.280	0.776	0.914	1.129	
O_3_lag1	**1.101**	**0.048**	**2.180**	**0.029**	**1.010**	**1.200**	**
O_3_lag2	1.039	0.063	0.630	0.529	0.923	1.169	
O_3_lag3	0.993	0.061	-0.120	0.908	0.881	1.120	
O_3_lag4	0.908	0.051	-1.720	0.086	0.814	1.014	*
O_3_lag5	**1.101**	**0.048**	**2.180**	**0.029**	**1.010**	**1.200**	**
O_3_lag6	0.949	0.052	-0.940	0.345	0.852	1.058	
O_3_lag7	0.987	0.058	-0.230	0.819	0.880	1.107	
O_3_lag8	1.062	0.057	1.120	0.262	0.956	1.178	
Temperature_lag0	1.003	0.005	0.740	0.458	0.994	1.013	
Temperature_lag1	0.996	0.006	-0.580	0.561	0.984	1.009	
Temperature_lag2	1.005	0.006	0.700	0.483	0.992	1.017	
Temperature_lag3	0.992	0.006	-1.190	0.236	0.980	1.005	
Temperature_lag4	1.010	0.006	1.540	0.123	0.997	1.022	
Temperature_lag5	0.998	0.006	-0.380	0.704	0.985	1.010	
Temperature_lag6	0.998	0.006	-0.370	0.710	0.985	1.010	
Temperature_lag7	0.999	0.006	-0.170	0.863	0.987	1.011	
Temperature_lag8	1.007	0.004	1.670	0.096	0.999	1.016	*
Humidity_lag0	1.000	0.002	0.000	0.999	0.996	1.005	
Humidity_lag1	0.999	0.003	-0.220	0.825	0.994	1.005	
Humidity_lag2	1.001	0.003	0.200	0.844	0.995	1.006	
Humidity_lag3	0.999	0.002	-0.440	0.657	0.994	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.043	0.037	1.180	0.238	0.972	1.119	
Flu_lag0	0.994	0.032	-0.200	0.839	0.933	1.058	
Flu_lag1	0.979	0.031	-0.660	0.507	0.919	1.043	
Flu_lag2	0.910	0.029	-2.930	0.003	0.855	0.969	***
Flu_lag3	1.059	0.034	1.760	0.079	0.993	1.129	*

Flu_lag4	1.005	0.032	0.170	0.868	0.944	1.071	
Flu_lag5	0.960	0.031	-1.250	0.211	0.901	1.023	
Flu_lag6	1.085	0.036	2.460	0.014	1.017	1.157	**
Flu_lag7	1.035	0.035	1.040	0.299	0.970	1.105	
Flu_lag8	1.023	0.033	0.690	0.492	0.959	1.090	
Flu_lag9	1.029	0.034	0.890	0.372	0.966	1.097	
Flu_lag10	1.015	0.033	0.460	0.648	0.953	1.081	
Flu_lag11	0.951	0.031	-1.550	0.121	0.893	1.013	
Flu_lag12	0.961	0.031	-1.250	0.212	0.903	1.023	
cos_1	0.000	0.000	-2.310	0.021	0.000	0.089	**
cos_2	2.860E+04	1.239E+05	2.370	0.018	5.872	1.393E+08	**
cos_3	0.014	0.027	-2.280	0.022	0.000	0.549	**
cos_4	2.728	1.190	2.300	0.021	1.160	6.413	**
sin_1	0.587	0.355	-0.880	0.379	0.179	1.924	
sin_2	2.193	1.714	1.000	0.315	0.474	10.150	
sin_3	0.594	0.317	-0.980	0.329	0.209	1.689	
sin_4	1.176	0.219	0.870	0.383	0.817	1.694	
Constant	1.596E+05	6.296E+05	3.040	0.002	70.157	3.633E+08	***
lnalpha	-3.903	0.413	.b	.b	-4.711	-3.094	

Mean dependent var	8.602	SD dependent var	3.653
Pseudo r-squared	.	Number of obs	535
Chi-square	160.635	Prob > chi2	0.000
Akaike crit. (AIC)	2811.823	Bayesian crit. (BIC)	3004.525

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/5) irr

Table 3.39 Results of time-series non-wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.933	0.034	-1.900	0.057	0.868	1.002	*
$PM_{2.5}$_lag1	1.002	0.042	0.040	0.966	0.923	1.088	
$PM_{2.5}$_lag2	0.959	0.040	-0.980	0.326	0.883	1.042	
$PM_{2.5}$_lag3	1.072	0.041	1.810	0.070	0.994	1.156	*
Temperature_lag0	1.003	0.005	0.550	0.583	0.993	1.012	
Temperature_lag1	0.996	0.007	-0.610	0.545	0.983	1.009	
Temperature_lag2	1.003	0.007	0.410	0.685	0.990	1.016	
Temperature_lag3	0.994	0.006	-0.900	0.371	0.982	1.007	
Temperature_lag4	1.007	0.006	1.170	0.241	0.995	1.020	
Temperature_lag5	0.999	0.006	-0.110	0.915	0.987	1.011	

Temperature_lag6	0.998	0.006	-0.400	0.687	0.986	1.010	
Temperature_lag7	0.997	0.006	-0.440	0.658	0.986	1.009	
Temperature_lag8	1.008	0.004	1.890	0.059	1.000	1.017	*
Humidity_lag0	1.001	0.002	0.520	0.601	0.997	1.006	
Humidity_lag1	0.998	0.003	-0.860	0.391	0.992	1.003	
Humidity_lag2	1.001	0.003	0.390	0.694	0.996	1.007	
Humidity_lag3	0.998	0.002	-1.040	0.300	0.993	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.037	0.037	1.040	0.301	0.968	1.112	
Flu_lag0	0.993	0.032	-0.210	0.831	0.933	1.057	
Flu_lag1	0.975	0.031	-0.770	0.439	0.916	1.039	
Flu_lag2	0.916	0.029	-2.750	0.006	0.860	0.975	***
Flu_lag3	1.059	0.034	1.770	0.077	0.994	1.128	*
Flu_lag4	0.999	0.032	-0.040	0.972	0.938	1.064	
Flu_lag5	0.967	0.031	-1.030	0.304	0.908	1.031	
Flu_lag6	1.094	0.036	2.730	0.006	1.026	1.166	***
Flu_lag7	1.032	0.034	0.940	0.346	0.967	1.101	
Flu_lag8	1.029	0.034	0.880	0.379	0.965	1.097	
Flu_lag9	1.036	0.034	1.100	0.273	0.972	1.105	
Flu_lag10	1.003	0.032	0.090	0.929	0.941	1.068	
Flu_lag11	0.949	0.031	-1.620	0.106	0.891	1.011	
Flu_lag12	0.959	0.031	-1.300	0.193	0.901	1.021	
cos_1	0.000	0.000	-2.300	0.021	0.000	0.097	**
cos_2	2.578E+04	1.113E+05	2.350	0.019	5.453	1.219E+08	**
cos_3	0.015	0.027	-2.290	0.022	0.000	0.546	**
cos_4	2.770	1.196	2.360	0.018	1.188	6.458	**
sin_1	0.586	0.362	-0.870	0.387	0.175	1.966	
sin_2	2.267	1.817	1.020	0.307	0.471	10.908	
sin_3	0.580	0.317	-1.000	0.319	0.198	1.693	
sin_4	1.180	0.225	0.870	0.386	0.812	1.715	
Constant	1.028E+05	4.064E+05	2.920	0.003	44.577	2.373E+08	***
lnalpha	-3.838	0.389	.b	.b	-4.601	-3.075	

Mean dependent var	8.602	SD dependent var	3.653
Pseudo r-squared	0.048	Number of obs	535.000
Chi-square	136.192	Prob > chi2	0.000
Akaike crit. (AIC)	2807.652	Bayesian crit. (BIC)	2983.225

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table 3.40 Results of time-series non-wildfire model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.983	0.015	-1.140	0.254	0.955	1.012	
SO_2_lag1	**1.033**	**0.016**	**2.170**	**0.030**	**1.003**	**1.064**	**
SO_2_lag2	1.026	0.015	1.740	0.083	0.997	1.056	*
SO_2_lag3	0.997	0.010	-0.330	0.740	0.977	1.016	
SO_2_lag4	**1.033**	**0.016**	**2.170**	**0.030**	**1.003**	**1.064**	**
SO_2_lag5	0.983	0.015	-1.140	0.254	0.955	1.012	
SO_2_lag6	0.997	0.010	-0.330	0.740	0.977	1.016	
SO_2_lag7	0.997	0.010	-0.330	0.740	0.977	1.016	
SO_2_lag8	1.013	0.020	0.640	0.520	0.974	1.054	
SO_2_lag9	0.997	0.010	-0.330	0.740	0.977	1.016	
SO_2_lag10	1.026	0.015	1.740	0.083	0.997	1.056	*
Temperature_lag0	1.002	0.005	0.460	0.642	0.992	1.012	
Temperature_lag1	0.991	0.007	-1.280	0.199	0.978	1.005	
Temperature_lag2	1.010	0.007	1.410	0.159	0.996	1.023	
Temperature_lag3	0.988	0.007	-1.750	0.080	0.975	1.001	*
Temperature_lag4	1.002	0.007	0.280	0.777	0.989	1.015	
Temperature_lag5	1.006	0.007	0.910	0.364	0.993	1.019	
Temperature_lag6	1.000	0.006	0.050	0.959	0.988	1.013	
Temperature_lag7	0.996	0.006	-0.690	0.493	0.983	1.008	
Temperature_lag8	1.008	0.005	1.800	0.072	0.999	1.018	*
Humidity_lag0	0.997	0.002	-1.230	0.220	0.993	1.002	
Humidity_lag1	1.000	0.003	0.150	0.883	0.995	1.006	
Humidity_lag2	1.001	0.003	0.420	0.673	0.996	1.007	
Humidity_lag3	0.999	0.002	-0.380	0.703	0.995	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.071	0.043	1.720	0.086	0.990	1.159	*
Flu_lag0	0.986	0.034	-0.410	0.680	0.921	1.055	
Flu_lag1	0.939	0.032	-1.830	0.068	0.878	1.005	*
Flu_lag2	0.920	0.032	-2.410	0.016	0.860	0.985	**
Flu_lag3	1.076	0.038	2.080	0.038	1.004	1.153	**
Flu_lag4	1.016	0.035	0.460	0.642	0.949	1.088	
Flu_lag5	0.993	0.035	-0.200	0.839	0.926	1.064	
Flu_lag6	1.066	0.038	1.800	0.071	0.994	1.144	*
Flu_lag7	1.097	0.040	2.560	0.010	1.022	1.178	**
Flu_lag8	1.037	0.037	1.030	0.302	0.968	1.112	
Flu_lag9	1.065	0.038	1.750	0.081	0.992	1.142	*
Flu_lag10	1.019	0.036	0.530	0.593	0.950	1.093	
Flu_lag11	0.982	0.035	-0.520	0.600	0.916	1.052	
Flu_lag12	0.908	0.032	-2.750	0.006	0.847	0.973	***
cos_1	0.000	0.000	-3.500	0.000	0.000	0.000	***

cos_2	6.925E+08	3.928E+09	3.590	0.000	1.028E+04	4.666E+13	***
cos_3	0.000	0.000	-3.630	0.000	0.000	0.018	***
cos_4	8.374	4.562	3.900	0.000	2.879	24.360	***
sin_1	0.815	0.732	-0.230	0.819	0.140	4.734	
sin_2	1.362	1.590	0.260	0.791	0.138	13.421	
sin_3	0.775	0.608	-0.320	0.746	0.167	3.606	
sin_4	1.122	0.297	0.430	0.665	0.667	1.885	
Constant	1.728E+09	9.075E+09	4.050	0.000	5.839E+04	5.111E+13	***
lnalpha	-6.209	4.218	.b	.b	-14.476	2.057	
Mean dependent var	8.846		SD dependent var		3.686		
Pseudo r-squared	.		Number of obs		371.000		
Chi-square	169.496		Prob > chi2		0.000		
Akaike crit. (AIC)	1937.720		Bayesian crit. (BIC)		2102.201		

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/6) irr

3.2.6 Results of time-series yearly models

Tables 3.41 to 3.45, tables 3.46 to 3.50, and tables 3.51 to 3.55 present the adjusted results of time-series models for the years 2016, 2017, and 2018, respectively. IRRs and 95% confidence intervals for daily respiratory ED visits among children were shown for a one unit increase in the natural log of air pollutants concentrations. In other words, expected daily respiratory ED visits among children increased by [(IRR-1) * 100] % when air pollutant concentration increased (e-1) times after adjusting for other variables (e: Euler's number. The value is approximately 2.71828).

In 2016, evidence of the positive associations between daily respiratory ED visits among children and 6-, 8-, and 13-day lag exposures to NO_2 was found, with the same estimated IRR of 1.09 (95%CI: 1.013-1.174). Seven-day lag exposure to NO_2 was found to be negatively associated with daily respiratory ED visits among children, with an IRR of 0.792 (95%CI: 0.697-0.901). The model shows strong evidence of significant increases in daily respiratory ED visits among children with increasing O_3 concentrations for 5-day lag exposure (IRR of 1.198, 95%CI: 1.018-1.409). Meanwhile, 6-day lag exposure to O_3 was found to be negatively associated with daily respiratory ED visits among children, with an estimated IRR of 0.844 (95%CI: 0.727-0.978). There was no significant association between daily respiratory ED visits among children and exposures to CO, $PM_{2.5}$ and SO_2 in 2016 models.

For 2016 yearly models, AIC in CO and O_3 models were smaller than in the baseline model, and BIC were larger than in the baseline model. Both AIC and BIC in $PM_{2.5}$ models were larger than in the baseline model. Both AIC and BIC in NO_2 and SO_2 models were smaller than in the baseline models. Results of the 2016 yearly baseline model is presented in Appendix 2 Table A 2.8.
In 2017, 2- and 4-day lag exposures to NO_2 were positively associated with daily respiratory ED visits among children, and the same IRR for the two lags was 1.119 (95%CI: 1.011-1.239). Meanwhile, daily respiratory ED visits among children were negatively associated with 4-day lag exposure to O_3, with an estimated IRR of 0.800 (95%CI: 0.681-0.94). Evidence of significant associations between daily respiratory ED visits and exposure to CO, $PM_{2.5}$, and SO_2 in 2017 models were not found.

For 2017 yearly models, both AIC and BIC in models of CO, NO_2, and $PM_{2.5}$ were larger than in the baseline model. AIC in O_3 models were smaller than in the baseline model, and BIC were larger than in the baseline model. Both AIC and BIC in SO_2 model were smaller than in the baseline models. Results of the 2017 yearly baseline model is presented in Appendix 2 Table A 2.9.

In 2018, results show strong evidence of positive associations between daily respiratory ED visits among children and 4- and 9-day lag exposures to SO_2, with the same IRR of 1.051 (95%CI: 1.009-1.096). There was no evidence of associations between daily respiratory ED visits and exposures to CO, NO_2, O_3, and $PM_{2.5}$ in 2018 models.

For 2018 yearly models, both AIC and BIC in models of CO, NO_2, O_3, and $PM_{2.5}$ were larger than in the baseline model. Both AIC and BIC in SO_2 model were smaller than in the baseline models. Results of the 2018 yearly baseline model are presented in Appendix 2 Table A 2.10.

Table 3.41 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.955	0.043	-1.020	0.307	0.875	1.043	
CO_lag1	0.929	0.104	-0.660	0.510	0.746	1.157	
CO_lag2	1.044	0.118	0.380	0.707	0.835	1.304	
CO_lag3	0.955	0.043	-1.020	0.307	0.875	1.043	
CO_lag4	0.955	0.043	-1.020	0.307	0.875	1.043	
CO_lag5	0.955	0.043	-1.020	0.307	0.875	1.043	
CO_lag6	1.153	0.098	1.670	0.095	0.975	1.363	*

CO_lag7	0.838	0.100	-1.480	0.139	0.663	1.059	
CO_lag8	1.153	0.098	1.670	0.095	0.975	1.363	*
CO_lag9	1.047	0.114	0.420	0.676	0.845	1.297	
CO_lag10	0.990	0.063	-0.160	0.875	0.873	1.122	
CO_lag11	0.990	0.063	-0.160	0.875	0.873	1.122	
CO_lag12	0.887	0.102	-1.040	0.297	0.707	1.111	
CO_lag13	1.084	0.126	0.690	0.490	0.862	1.362	
Temperature_lag0	1.023	0.008	2.760	0.006	1.007	1.040	***
Temperature_lag1	0.985	0.011	-1.420	0.156	0.964	1.006	
Temperature_lag2	1.027	0.011	2.570	0.010	1.006	1.048	**
Temperature_lag3	0.985	0.010	-1.430	0.152	0.965	1.005	
Temperature_lag4	1.006	0.010	0.600	0.546	0.986	1.027	
Temperature_lag5	1.008	0.010	0.800	0.425	0.989	1.028	
Temperature_lag6	1.006	0.010	0.610	0.542	0.986	1.026	
Temperature_lag7	1.008	0.010	0.790	0.432	0.989	1.027	
Temperature_lag8	0.990	0.007	-1.390	0.166	0.976	1.004	
Humidity_lag0	1.000	0.003	0.040	0.972	0.995	1.006	
Humidity_lag1	0.997	0.003	-1.080	0.278	0.992	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.048	0.050	1.000	0.318	0.955	1.150	
Flu_lag0	0.894	0.048	-2.110	0.035	0.805	0.992	**
Flu_lag1	0.922	0.048	-1.560	0.119	0.833	1.021	
Flu_lag2	1.000	0.052	0.010	0.994	0.904	1.107	
Flu_lag3	1.023	0.053	0.440	0.662	0.925	1.131	
Flu_lag4	1.000	0.051	0.010	0.996	0.905	1.105	
Flu_lag5	0.980	0.049	-0.410	0.682	0.887	1.081	
Flu_lag6	1.069	0.054	1.330	0.184	0.969	1.180	
Flu_lag7	0.966	0.050	-0.670	0.502	0.873	1.069	
cos_1	2.859	0.503	5.970	0.000	2.025	4.035	***
cos_2	0.965	0.057	-0.610	0.544	0.860	1.083	
cos_3	1.237	0.046	5.680	0.000	1.150	1.332	***
cos_4	1.158	0.040	4.200	0.000	1.081	1.240	***
sin_1	1.099	0.118	0.890	0.376	0.892	1.356	
sin_2	1.008	0.048	0.180	0.858	0.919	1.106	
sin_3	1.224	0.047	5.310	0.000	1.136	1.318	***
sin_4	0.736	0.024	-9.390	0.000	0.690	0.784	***
Constant	6.404	3.512	3.390	0.001	2.186	18.759	***
lnalpha	-4.582	1.011	.b	.b	-6.565	-2.600	

Mean dependent var	7.555	SD dependent var	4.301
Pseudo r-squared	.	Number of obs	353
Chi-square	390.411	Prob > chi2	0.000
Akaike crit. (AIC)	1775.469	Bayesian crit. (BIC)	1926.261

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/5) irr

Table 3.42 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	1.035	0.063	0.570	0.569	0.918	1.167	
NO_2_lag1	0.962	0.045	-0.830	0.407	0.878	1.054	
NO_2_lag2	0.996	0.041	-0.100	0.919	0.919	1.079	
NO_2_lag3	1.016	0.044	0.360	0.718	0.933	1.106	
NO_2_lag4	0.929	0.042	-1.620	0.105	0.850	1.015	
NO_2_lag5	1.016	0.044	0.360	0.718	0.933	1.106	
NO_2_lag6	**1.090**	**0.041**	**2.290**	**0.022**	**1.013**	**1.174**	**
NO_2_lag7	**0.792**	**0.052**	**-3.560**	**0.000**	**0.697**	**0.901**	***
NO_2_lag8	**1.090**	**0.041**	**2.290**	**0.022**	**1.013**	**1.174**	**
NO_2_lag9	0.996	0.041	-0.100	0.919	0.919	1.079	
NO_2_lag10	0.962	0.045	-0.830	0.407	0.878	1.054	
NO_2_lag11	0.945	0.058	-0.920	0.360	0.838	1.066	
NO_2_lag12	0.911	0.057	-1.510	0.131	0.806	1.028	
NO_2_lag13	**1.090**	**0.041**	**2.290**	**0.022**	**1.013**	**1.174**	**
NO_2_lag14	0.929	0.042	-1.620	0.105	0.850	1.015	
Temperature_lag0	1.027	0.008	3.320	0.001	1.011	1.044	***
Temperature_lag1	0.982	0.010	-1.690	0.090	0.962	1.003	*
Temperature_lag2	1.031	0.010	3.020	0.002	1.011	1.051	***
Temperature_lag3	0.984	0.010	-1.580	0.115	0.965	1.004	
Temperature_lag4	1.009	0.010	0.910	0.362	0.989	1.030	
Temperature_lag5	1.000	0.010	-0.020	0.982	0.981	1.019	
Temperature_lag6	1.016	0.010	1.580	0.114	0.996	1.036	
Temperature_lag7	1.007	0.009	0.700	0.481	0.988	1.025	
Temperature_lag8	0.991	0.007	-1.290	0.196	0.978	1.005	
Humidity_lag0	1.002	0.003	0.870	0.383	0.997	1.008	
Humidity_lag1	0.997	0.003	-1.240	0.214	0.992	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.044	0.054	0.820	0.412	0.942	1.156	
Flu_lag0	0.889	0.045	-2.320	0.020	0.805	0.982	**
Flu_lag1	0.903	0.045	-2.060	0.040	0.819	0.995	**
Flu_lag2	0.986	0.050	-0.270	0.786	0.894	1.089	
Flu_lag3	0.998	0.049	-0.040	0.971	0.906	1.100	
Flu_lag4	0.982	0.048	-0.360	0.716	0.892	1.081	
Flu_lag5	0.958	0.047	-0.870	0.383	0.869	1.055	

Flu_lag6	1.038	0.050	0.770	0.441	0.944	1.142	
Flu_lag7	0.946	0.047	-1.130	0.257	0.858	1.042	
cos_1	4.037	0.833	6.760	0.000	2.694	6.048	***
cos_2	1.007	0.043	0.170	0.865	0.926	1.096	
cos_3	1.250	0.044	6.330	0.000	1.167	1.339	***
cos_4	1.172	0.038	4.920	0.000	1.100	1.249	***
sin_1	1.194	0.078	2.720	0.007	1.051	1.357	***
sin_2	1.091	0.052	1.840	0.066	0.994	1.197	*
sin_3	1.268	0.046	6.570	0.000	1.181	1.360	***
sin_4	0.747	0.023	-9.470	0.000	0.703	0.793	***
Constant	1.811	1.738	0.620	0.536	0.276	11.882	
lnalpha	-6.787	8.413	.b	.b	-23.276	9.702	

Mean dependent var	7.568	SD dependent var	4.300
Pseudo r-squared	.	Number of obs	352
Chi-square	436.604	Prob > chi2	0.000
Akaike crit. (AIC)	1750.400	Bayesian crit. (BIC)	1901.082

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/5) irr

Table 3.43 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	0.995	0.080	-0.060	0.952	0.849	1.166	
O_3_lag1	1.067	0.057	1.210	0.226	0.961	1.185	
O_3_lag2	1.026	0.040	0.650	0.516	0.950	1.107	
O_3_lag3	0.907	0.068	-1.310	0.191	0.784	1.050	
O_3_lag4	0.869	0.071	-1.730	0.084	0.741	1.019	*
O_3_lag5	**1.198**	**0.099**	**2.180**	**0.029**	**1.018**	**1.409**	**
O_3_lag6	**0.844**	**0.064**	**-2.250**	**0.024**	**0.727**	**0.978**	**
O_3_lag7	1.026	0.040	0.650	0.516	0.950	1.107	
O_3_lag8	1.026	0.040	0.650	0.516	0.950	1.107	
O_3_lag9	1.067	0.057	1.210	0.226	0.961	1.185	
Temperature_lag0	1.015	0.008	1.850	0.064	0.999	1.030	*
Temperature_lag1	0.993	0.010	-0.650	0.514	0.973	1.014	
Temperature_lag2	1.014	0.010	1.430	0.152	0.995	1.034	
Temperature_lag3	0.990	0.010	-0.990	0.320	0.970	1.010	
Temperature_lag4	1.017	0.011	1.650	0.100	0.997	1.038	*
Temperature_lag5	1.000	0.010	0.000	0.997	0.980	1.021	
Temperature_lag6	1.008	0.010	0.750	0.455	0.988	1.028	
Temperature_lag7	1.009	0.010	0.930	0.350	0.990	1.028	
Temperature_lag8	0.990	0.007	-1.480	0.139	0.976	1.003	

Humidity_lag0	1.000	0.003	-0.080	0.936	0.994	1.006	
Humidity_lag1	0.997	0.003	-1.070	0.287	0.991	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.031	0.046	0.690	0.493	0.944	1.126	
Flu_lag0	0.910	0.048	-1.800	0.071	0.821	1.008	*
Flu_lag1	0.967	0.049	-0.650	0.513	0.875	1.069	
Flu_lag2	1.010	0.051	0.190	0.847	0.914	1.116	
Flu_lag3	1.052	0.052	1.030	0.305	0.955	1.159	
Flu_lag4	1.059	0.052	1.170	0.244	0.962	1.166	
Flu_lag5	0.984	0.049	-0.330	0.744	0.892	1.085	
Flu_lag6	1.089	0.054	1.720	0.085	0.988	1.201	*
Flu_lag7	0.982	0.050	-0.350	0.725	0.889	1.085	
cos_1	2.422	0.377	5.690	0.000	1.786	3.286	***
cos_2	0.917	0.035	-2.270	0.023	0.851	0.988	**
cos_3	1.234	0.044	5.970	0.000	1.152	1.323	***
cos_4	1.145	0.040	3.890	0.000	1.069	1.225	***
sin_1	1.016	0.057	0.290	0.772	0.910	1.136	
sin_2	0.979	0.038	-0.550	0.582	0.907	1.057	
sin_3	1.179	0.039	4.950	0.000	1.105	1.259	***
sin_4	0.725	0.023	-10.190	0.000	0.682	0.771	***
Constant	6.508	3.490	3.490	0.000	2.275	18.618	***
lnalpha	-4.599	1.020	.b	.b	-6.598	-2.600	

Mean dependent var	7.538	SD dependent var	4.284
Pseudo r-squared	.	Number of obs	357
Chi-square	392.109	Prob > chi2	0.000
Akaike crit. (AIC)	1789.575	Bayesian crit. (BIC)	1933.051

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.44 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.987	0.023	-0.570	0.568	0.942	1.033	
$PM_{2.5}$_lag1	0.987	0.023	-0.570	0.568	0.942	1.033	
$PM_{2.5}$_lag2	0.943	0.036	-1.560	0.119	0.876	1.015	
$PM_{2.5}$_lag3	1.016	0.034	0.470	0.638	0.952	1.084	
$PM_{2.5}$_lag4	0.987	0.023	-0.570	0.568	0.942	1.033	
$PM_{2.5}$_lag5	1.016	0.034	0.470	0.638	0.952	1.084	
$PM_{2.5}$_lag6	0.943	0.036	-1.560	0.119	0.876	1.015	
Temperature_lag0	1.017	0.008	2.060	0.039	1.001	1.033	**

Temperature_lag1	0.994	0.011	-0.590	0.554	0.973	1.015	
Temperature_lag2	1.020	0.010	2.000	0.046	1.000	1.040	**
Temperature_lag3	0.985	0.010	-1.530	0.126	0.966	1.004	
Temperature_lag4	1.011	0.010	1.070	0.286	0.991	1.031	
Temperature_lag5	1.007	0.010	0.720	0.469	0.988	1.028	
Temperature_lag6	1.004	0.010	0.410	0.684	0.984	1.024	
Temperature_lag7	1.007	0.010	0.710	0.475	0.988	1.026	
Temperature_lag8	0.990	0.007	-1.380	0.169	0.977	1.004	
Humidity_lag0	1.000	0.003	0.070	0.946	0.995	1.006	
Humidity_lag1	0.997	0.003	-0.920	0.357	0.992	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.016	0.047	0.350	0.730	0.929	1.111	
Flu_lag0	0.918	0.048	-1.630	0.103	0.828	1.017	
Flu_lag1	0.967	0.049	-0.660	0.508	0.876	1.068	
Flu_lag2	1.024	0.052	0.460	0.647	0.926	1.131	
Flu_lag3	1.063	0.053	1.220	0.222	0.964	1.171	
Flu_lag4	1.046	0.052	0.900	0.369	0.949	1.152	
Flu_lag5	1.004	0.050	0.080	0.933	0.910	1.108	
Flu_lag6	1.071	0.054	1.380	0.168	0.971	1.182	
Flu_lag7	0.977	0.050	-0.450	0.652	0.884	1.080	
cos_1	2.409	0.312	6.800	0.000	1.869	3.104	***
cos_2	0.923	0.037	-2.010	0.044	0.855	0.998	**
cos_3	1.224	0.043	5.760	0.000	1.143	1.312	***
cos_4	1.115	0.038	3.180	0.001	1.043	1.193	***
sin_1	1.019	0.057	0.330	0.738	0.913	1.137	
sin_2	0.965	0.038	-0.910	0.364	0.894	1.042	
sin_3	1.176	0.039	4.880	0.000	1.102	1.255	***
sin_4	0.736	0.024	-9.490	0.000	0.691	0.784	***
Constant	8.420	1.776	10.100	0.000	5.569	12.730	***
lnalpha	-4.193	0.717	.b	.b	-5.597	-2.788	

Mean dependent var	7.525	SD dependent var	4.284
Pseudo r-squared	.	Number of obs	358
Chi-square	363.326	Prob > chi2	0.000
Akaike crit. (AIC)	1800.467	Bayesian crit. (BIC)	1928.524

**** p<.01, ** p<.05, * p<.1*

H&W: holiday and weekend

xi: nbreg count pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.45 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig

SO_2_lag0	1.017	0.020	0.860	0.390	0.979	1.057	
SO_2_lag1	0.990	0.017	-0.600	0.546	0.958	1.023	
SO_2_lag2	0.977	0.021	-1.080	0.282	0.936	1.019	
SO_2_lag3	0.990	0.017	-0.600	0.546	0.958	1.023	
SO_2_lag4	0.965	0.028	-1.250	0.212	0.912	1.021	
SO_2_lag5	0.981	0.029	-0.650	0.517	0.926	1.040	
SO_2_lag6	0.977	0.021	-1.080	0.282	0.936	1.019	
SO_2_lag7	0.990	0.017	-0.600	0.546	0.958	1.023	
SO_2_lag8	1.049	0.030	1.680	0.093	0.992	1.110	*
SO_2_lag9	1.017	0.020	0.860	0.390	0.979	1.057	
Temperature_lag0	1.012	0.009	1.320	0.186	0.994	1.031	
Temperature_lag1	0.993	0.012	-0.580	0.562	0.971	1.016	
Temperature_lag2	1.025	0.011	2.200	0.027	1.003	1.048	**
Temperature_lag3	0.989	0.011	-0.990	0.324	0.966	1.011	
Temperature_lag4	1.011	0.012	0.960	0.338	0.989	1.034	
Temperature_lag5	1.010	0.011	0.890	0.373	0.988	1.033	
Temperature_lag6	1.001	0.012	0.090	0.929	0.978	1.024	
Temperature_lag7	1.013	0.011	1.150	0.251	0.991	1.035	
Temperature_lag8	0.985	0.008	-1.760	0.079	0.970	1.002	*
Humidity_lag0	0.998	0.003	-0.510	0.612	0.991	1.005	
Humidity_lag1	0.999	0.004	-0.320	0.749	0.992	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	0.996	0.056	-0.070	0.942	0.891	1.113	
Flu_lag0	0.971	0.064	-0.440	0.659	0.854	1.105	
Flu_lag1	0.923	0.060	-1.230	0.217	0.812	1.048	
Flu_lag2	1.083	0.068	1.280	0.202	0.958	1.225	
Flu_lag3	1.096	0.067	1.510	0.131	0.973	1.236	
Flu_lag4	1.105	0.066	1.690	0.091	0.984	1.242	*
Flu_lag5	0.972	0.059	-0.460	0.646	0.863	1.096	
Flu_lag6	1.066	0.067	1.010	0.312	0.942	1.205	
Flu_lag7	0.979	0.063	-0.330	0.740	0.864	1.110	
cos_1	2.371	0.400	5.110	0.000	1.703	3.300	***
cos_2	0.933	0.047	-1.360	0.175	0.845	1.031	
cos_3	1.195	0.059	3.590	0.000	1.084	1.316	***
cos_4	1.151	0.055	2.940	0.003	1.048	1.264	***
sin_1	0.964	0.065	-0.540	0.589	0.845	1.100	
sin_2	1.000	0.063	-0.010	0.996	0.884	1.130	
sin_3	1.197	0.055	3.930	0.000	1.094	1.310	***
sin_4	0.703	0.030	-8.360	0.000	0.647	0.763	***
Constant	4.268	2.961	2.090	0.036	1.096	16.626	**
lnalpha	-14.829	498.021	.b	.b	-990.933	961.274	
Mean dependent var	7.528		SD dependent var	4.239			
Pseudo r-squared	.		Number of obs	216			

Chi-square	267.156	Prob > chi2	0.000
Akaike crit. (AIC)	1101.262	Bayesian crit. (BIC)	1222.772

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/4) irr

Table 3.46 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	1.051	0.078	0.670	0.501	0.909	1.215	
CO_lag1	0.984	0.077	-0.210	0.836	0.844	1.147	
CO_lag2	1.175	0.102	1.850	0.064	0.990	1.394	*
CO_lag3	0.974	0.114	-0.230	0.820	0.774	1.224	
CO_lag4	1.175	0.102	1.850	0.064	0.990	1.394	*
CO_lag5	0.984	0.077	-0.210	0.836	0.844	1.147	
CO_lag6	0.888	0.095	-1.100	0.271	0.720	1.097	
CO_lag7	1.051	0.078	0.670	0.501	0.909	1.215	
Temperature_lag0	1.000	0.009	-0.030	0.978	0.982	1.018	
Temperature_lag1	1.008	0.012	0.620	0.535	0.984	1.032	
Temperature_lag2	0.988	0.011	-1.100	0.270	0.968	1.009	
Temperature_lag3	1.005	0.007	0.700	0.485	0.991	1.019	
Humidity_lag0	1.002	0.003	0.660	0.509	0.996	1.008	
Humidity_lag1	1.000	0.003	-0.010	0.995	0.994	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.084	0.053	1.640	0.100	0.985	1.194	
Flu_lag0	0.993	0.056	-0.130	0.899	0.890	1.108	
Flu_lag1	0.993	0.055	-0.130	0.897	0.891	1.107	
Flu_lag2	1.031	0.056	0.570	0.570	0.927	1.147	
Flu_lag3	1.006	0.054	0.110	0.914	0.905	1.118	
Flu_lag4	1.020	0.055	0.370	0.709	0.919	1.133	
Flu_lag5	0.867	0.048	-2.600	0.009	0.778	0.965	***
Flu_lag6	1.008	0.055	0.150	0.880	0.906	1.122	
Flu_lag7	1.048	0.058	0.850	0.393	0.941	1.167	
Flu_lag8	1.007	0.057	0.120	0.905	0.902	1.124	
Flu_lag9	1.012	0.056	0.210	0.834	0.908	1.128	
Flu_lag10	1.099	0.061	1.700	0.090	0.985	1.226	*
Flu_lag11	1.014	0.056	0.240	0.807	0.909	1.130	
Flu_lag12	1.056	0.059	0.970	0.330	0.947	1.177	
cos_1	1.261	0.141	2.080	0.038	1.013	1.569	**
cos_2	0.930	0.046	-1.470	0.141	0.845	1.024	
cos_3	1.118	0.058	2.160	0.031	1.010	1.237	**
cos_4	1.157	0.043	3.890	0.000	1.075	1.246	***

sin_1	0.940	0.040	-1.450	0.147	0.865	1.022	
sin_2	0.928	0.034	-2.040	0.042	0.864	0.997	**
sin_3	1.291	0.046	7.200	0.000	1.204	1.384	***
sin_4	0.869	0.028	-4.360	0.000	0.816	0.925	***
Constant	8.139	3.603	4.740	0.000	3.418	19.384	***
lnalpha	-3.522	0.411	.b	.b	-4.327	-2.717	

Mean dependent var	7.397	SD dependent var	3.897
Pseudo r-squared	.	Number of obs	353
Chi-square	207.005	Prob > chi2	0.000
Akaike crit. (AIC)	1805.730	Bayesian crit. (BIC)	1941.057

**** p<.01, ** p<.05, * p<.1*

H&W: holiday and weekend

xi: nbreg count colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,constraints(1/3) irr

Table 3.47 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	1.052	0.049	1.090	0.274	0.961	1.152	
NO_2_lag1	0.896	0.058	-1.700	0.090	0.789	1.017	*
NO_2_lag2	**1.119**	**0.058**	**2.180**	**0.029**	**1.011**	**1.239**	**
NO_2_lag3	0.952	0.066	-0.710	0.481	0.831	1.091	
NO_2_lag4	**1.119**	**0.058**	**2.180**	**0.029**	**1.011**	**1.239**	**
NO_2_lag5	1.052	0.049	1.090	0.274	0.961	1.152	
NO_2_lag6	0.940	0.061	-0.960	0.339	0.828	1.067	
NO_2_lag7	1.022	0.067	0.330	0.739	0.899	1.162	
Temperature_lag0	1.005	0.009	0.530	0.597	0.987	1.024	
Temperature_lag1	1.003	0.013	0.260	0.797	0.979	1.028	
Temperature_lag2	0.991	0.011	-0.850	0.395	0.970	1.012	
Temperature_lag3	1.002	0.007	0.320	0.746	0.988	1.017	
Humidity_lag0	1.003	0.003	0.920	0.355	0.997	1.009	
Humidity_lag1	1.000	0.003	-0.030	0.972	0.994	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.083	0.057	1.500	0.132	0.976	1.201	
Flu_lag0	0.991	0.055	-0.160	0.872	0.888	1.106	
Flu_lag1	0.988	0.054	-0.220	0.828	0.887	1.101	
Flu_lag2	1.040	0.056	0.720	0.469	0.935	1.157	
Flu_lag3	1.006	0.054	0.120	0.906	0.906	1.118	
Flu_lag4	1.024	0.055	0.440	0.659	0.922	1.138	
Flu_lag5	0.871	0.048	-2.510	0.012	0.782	0.970	**
Flu_lag6	1.027	0.056	0.490	0.627	0.923	1.143	
Flu_lag7	1.050	0.057	0.900	0.370	0.944	1.169	

Flu_lag8	0.997	0.056	-0.050	0.959	0.893	1.113	
Flu_lag9	1.015	0.056	0.270	0.787	0.911	1.131	
Flu_lag10	1.083	0.060	1.440	0.150	0.972	1.208	
Flu_lag11	1.017	0.056	0.300	0.766	0.912	1.133	
Flu_lag12	1.059	0.058	1.040	0.300	0.950	1.180	
cos_1	1.215	0.198	1.200	0.232	0.883	1.672	
cos_2	0.927	0.047	-1.490	0.135	0.840	1.024	
cos_3	1.125	0.056	2.360	0.018	1.020	1.240	**
cos_4	1.146	0.040	3.870	0.000	1.070	1.228	***
sin_1	0.941	0.041	-1.390	0.163	0.864	1.025	
sin_2	0.942	0.031	-1.830	0.067	0.883	1.004	*
sin_3	1.281	0.043	7.400	0.000	1.199	1.367	***
sin_4	0.871	0.028	-4.320	0.000	0.817	0.927	***
Constant	9.620	7.801	2.790	0.005	1.963	47.140	***
lnalpha	-3.575	0.430	.b	.b	-4.417	-2.733	

Mean dependent var	7.397	SD dependent var	3.897
Pseudo r-squared	.	Number of obs	353
Chi-square	212.023	Prob > chi2	0.000
Akaike crit. (AIC)	1804.661	Bayesian crit. (BIC)	1943.854

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/2) irr

Table 3.48 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	0.852	0.081	-1.690	0.091	0.708	1.026	*
O_3_lag1	0.919	0.051	-1.520	0.127	0.824	1.024	
O_3_lag2	0.943	0.088	-0.630	0.526	0.786	1.131	
O_3_lag3	0.919	0.051	-1.520	0.127	0.824	1.024	
O_3_lag4	**0.800**	**0.066**	**-2.710**	**0.007**	**0.681**	**0.940**	***
O_3_lag5	0.887	0.073	-1.450	0.146	0.755	1.043	
O_3_lag6	0.966	0.046	-0.720	0.470	0.881	1.060	
O_3_lag7	1.032	0.086	0.380	0.706	0.877	1.215	
O_3_lag8	0.921	0.075	-1.010	0.315	0.785	1.081	
O_3_lag9	0.966	0.046	-0.720	0.470	0.881	1.060	
O_3_lag10	0.990	0.078	-0.130	0.896	0.848	1.156	
O_3_lag11	1.076	0.062	1.270	0.203	0.961	1.204	
O_3_lag12	0.966	0.046	-0.720	0.470	0.881	1.060	
O_3_lag13	0.892	0.072	-1.410	0.159	0.761	1.046	
O_3_lag14	0.919	0.051	-1.520	0.127	0.824	1.024	

O_3_lag15	1.076	0.062	1.270	0.203	0.961	1.204	
Temperature_lag0	0.989	0.009	-1.220	0.221	0.972	1.006	
Temperature_lag1	1.013	0.013	1.040	0.296	0.989	1.038	
Temperature_lag2	0.987	0.011	-1.200	0.230	0.965	1.009	
Temperature_lag3	1.010	0.007	1.350	0.178	0.995	1.025	
Humidity_lag0	0.999	0.003	-0.310	0.759	0.993	1.005	
Humidity_lag1	0.997	0.003	-0.880	0.376	0.991	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.122	0.054	2.400	0.016	1.021	1.232	**
Flu_lag0	1.019	0.058	0.340	0.737	0.912	1.138	
Flu_lag1	1.019	0.055	0.340	0.730	0.916	1.133	
Flu_lag2	1.053	0.058	0.940	0.347	0.946	1.172	
Flu_lag3	1.023	0.056	0.410	0.682	0.918	1.140	
Flu_lag4	1.034	0.055	0.620	0.533	0.931	1.147	
Flu_lag5	0.876	0.047	-2.450	0.014	0.788	0.974	**
Flu_lag6	1.002	0.053	0.040	0.970	0.904	1.111	
Flu_lag7	1.048	0.056	0.880	0.381	0.944	1.163	
Flu_lag8	1.028	0.056	0.510	0.609	0.924	1.145	
Flu_lag9	1.055	0.058	0.970	0.332	0.947	1.175	
Flu_lag10	1.108	0.061	1.870	0.062	0.995	1.234	*
Flu_lag11	1.028	0.056	0.510	0.610	0.924	1.145	
Flu_lag12	1.073	0.057	1.320	0.186	0.967	1.190	
cos_1	0.897	0.121	-0.810	0.419	0.688	1.168	
cos_2	0.886	0.048	-2.250	0.025	0.797	0.985	**
cos_3	1.084	0.059	1.490	0.136	0.975	1.205	
cos_4	1.127	0.039	3.460	0.001	1.053	1.205	***
sin_1	0.997	0.037	-0.080	0.934	0.928	1.071	
sin_2	0.976	0.032	-0.750	0.451	0.916	1.040	
sin_3	1.228	0.040	6.290	0.000	1.152	1.310	***
sin_4	0.843	0.028	-5.190	0.000	0.790	0.899	***
Constant	0.270	0.225	-1.570	0.116	0.053	1.379	
lnalpha	-4.226	0.771	.b	.b	-5.737	-2.716	

Mean dependent var	7.371	SD dependent var	3.898
Pseudo r-squared	.	Number of obs	350
Chi-square	257.016	Prob > chi2	0.000
Akaike crit. (AIC)	1776.745	Bayesian crit. (BIC)	1934.920

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count o3lag* temperaturelag* humiditylag* i.holiday flulag* cos* sin*, constraints(1/5) irr

Table 3.49 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.994	0.026	-0.230	0.816	0.945	1.045	
$PM_{2.5}$_lag1	0.994	0.026	-0.230	0.816	0.945	1.045	
$PM_{2.5}$_lag2	1.049	0.040	1.260	0.206	0.974	1.130	
$PM_{2.5}$_lag3	0.943	0.048	-1.160	0.248	0.853	1.042	
$PM_{2.5}$_lag4	1.049	0.040	1.260	0.206	0.974	1.130	
$PM_{2.5}$_lag5	0.946	0.042	-1.250	0.212	0.867	1.032	
$PM_{2.5}$_lag6	0.990	0.025	-0.400	0.689	0.943	1.039	
$PM_{2.5}$_lag7	0.990	0.025	-0.400	0.689	0.943	1.039	
Temperature_lag0	1.003	0.009	0.340	0.735	0.985	1.022	
Temperature_lag1	1.005	0.013	0.370	0.710	0.980	1.030	
Temperature_lag2	0.991	0.011	-0.820	0.411	0.970	1.012	
Temperature_lag3	1.004	0.007	0.560	0.574	0.990	1.018	
Humidity_lag0	1.002	0.003	0.820	0.414	0.997	1.009	
Humidity_lag1	1.000	0.003	0.020	0.983	0.994	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.093	0.053	1.850	0.064	0.995	1.201	*
Flu_lag0	0.973	0.055	-0.490	0.625	0.871	1.087	
Flu_lag1	0.979	0.054	-0.390	0.700	0.878	1.091	
Flu_lag2	1.023	0.055	0.430	0.670	0.920	1.138	
Flu_lag3	1.007	0.054	0.120	0.904	0.905	1.119	
Flu_lag4	1.011	0.054	0.210	0.837	0.910	1.124	
Flu_lag5	0.863	0.048	-2.650	0.008	0.774	0.962	***
Flu_lag6	1.001	0.055	0.010	0.992	0.899	1.114	
Flu_lag7	1.052	0.058	0.920	0.359	0.944	1.172	
Flu_lag8	0.989	0.056	-0.200	0.839	0.886	1.104	
Flu_lag9	1.018	0.057	0.320	0.748	0.913	1.135	
Flu_lag10	1.084	0.061	1.450	0.148	0.972	1.210	
Flu_lag11	1.009	0.056	0.160	0.877	0.904	1.125	
Flu_lag12	1.061	0.059	1.060	0.289	0.951	1.182	
cos_1	1.373	0.118	3.700	0.000	1.160	1.623	***
cos_2	0.949	0.048	-1.040	0.300	0.860	1.048	
cos_3	1.139	0.057	2.600	0.009	1.033	1.256	***
cos_4	1.132	0.042	3.330	0.001	1.052	1.219	***
sin_1	0.961	0.036	-1.050	0.294	0.893	1.035	
sin_2	0.953	0.035	-1.320	0.187	0.887	1.024	
sin_3	1.262	0.044	6.670	0.000	1.178	1.351	***
sin_4	0.873	0.028	-4.210	0.000	0.819	0.930	***
Constant	6.191	1.590	7.100	0.000	3.742	10.243	***
lnalpha	-3.474	0.395	.b	.b	-4.248	-2.699	

Mean dependent var	7.397	SD dependent var	3.897
Pseudo r-squared	.	Number of obs	353
Chi-square	203.098	Prob > chi2	0.000
Akaike crit. (AIC)	1807.985	Bayesian crit. (BIC)	1943.312

**** p<.01, ** p<.05, * p<.1*

H&W: holiday and weekend

xi: nbreg count pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.50 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	0.975	0.020	-1.210	0.226	0.936	1.016	
Temperature_lag0	1.006	0.010	0.610	0.540	0.987	1.025	
Temperature_lag1	1.007	0.013	0.540	0.592	0.982	1.033	
Temperature_lag2	0.985	0.011	-1.420	0.156	0.964	1.006	
Temperature_lag3	1.005	0.007	0.680	0.497	0.991	1.020	
Humidity_lag0	1.003	0.003	0.870	0.387	0.997	1.009	
Humidity_lag1	1.000	0.003	-0.050	0.960	0.994	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.095	0.054	1.820	0.069	0.993	1.207	*
Flu_lag0	0.982	0.058	-0.310	0.758	0.875	1.102	
Flu_lag1	0.971	0.056	-0.500	0.618	0.867	1.089	
Flu_lag2	1.024	0.059	0.420	0.674	0.916	1.146	
Flu_lag3	1.023	0.058	0.400	0.689	0.916	1.142	
Flu_lag4	1.024	0.057	0.430	0.667	0.919	1.141	
Flu_lag5	0.861	0.049	-2.620	0.009	0.769	0.963	***
Flu_lag6	0.999	0.057	-0.010	0.993	0.893	1.119	
Flu_lag7	1.043	0.060	0.740	0.460	0.932	1.167	
Flu_lag8	1.006	0.058	0.100	0.921	0.898	1.126	
Flu_lag9	1.011	0.058	0.200	0.844	0.904	1.132	
Flu_lag10	1.065	0.062	1.090	0.277	0.951	1.193	
Flu_lag11	1.018	0.058	0.310	0.756	0.910	1.138	
Flu_lag12	1.049	0.061	0.830	0.407	0.937	1.175	
cos_1	1.369	0.120	3.570	0.000	1.152	1.626	***
cos_2	0.956	0.048	-0.890	0.374	0.867	1.055	
cos_3	1.135	0.058	2.470	0.014	1.026	1.255	**
cos_4	1.140	0.041	3.630	0.000	1.062	1.224	***
sin_1	0.969	0.038	-0.790	0.427	0.897	1.047	
sin_2	0.947	0.033	-1.570	0.116	0.886	1.014	
sin_3	1.263	0.044	6.720	0.000	1.180	1.351	***
sin_4	0.876	0.029	-3.960	0.000	0.821	0.935	***

Constant	4.562	1.305	5.310	0.000	2.604	7.992	***
lnalpha	-3.370	0.377	.b	.b	-4.109	-2.632	

Mean dependent var	7.287	SD dependent var	3.865
Pseudo r-squared	0.084	Number of obs	334
Chi-square	151.340	Prob > chi2	0.000
Akaike crit. (AIC)	1705.344	Bayesian crit. (BIC)	1823.489

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count so2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*,irr

Table 3.51 Results of time-series yearly models of associations between daily respiratory ED visits among children under 17 ages and exposure to CO in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CO_lag0	0.858	0.100	-1.310	0.190	0.682	1.079	
CO_lag1	0.943	0.074	-0.750	0.451	0.809	1.099	
CO_lag2	1.114	0.068	1.770	0.076	0.989	1.255	*
CO_lag3	0.984	0.117	-0.130	0.896	0.779	1.244	
CO_lag4	0.899	0.112	-0.850	0.396	0.704	1.149	
CO_lag5	0.832	0.098	-1.550	0.120	0.660	1.049	
CO_lag6	1.114	0.068	1.770	0.076	0.989	1.255	*
CO_lag7	1.114	0.068	1.770	0.076	0.989	1.255	*
CO_lag8	0.943	0.074	-0.750	0.451	0.809	1.099	
Temperature_lag0	1.016	0.008	1.900	0.057	1.000	1.032	*
Temperature_lag1	0.978	0.010	-2.170	0.030	0.959	0.998	**
Temperature_lag2	1.011	0.011	1.000	0.316	0.990	1.032	
Temperature_lag3	0.994	0.011	-0.550	0.580	0.973	1.015	
Temperature_lag4	1.013	0.011	1.240	0.214	0.992	1.034	
Temperature_lag5	0.990	0.010	-1.020	0.308	0.970	1.010	
Temperature_lag6	1.002	0.010	0.180	0.857	0.982	1.022	
Temperature_lag7	0.995	0.010	-0.530	0.599	0.976	1.014	
Temperature_lag8	1.013	0.010	1.360	0.173	0.994	1.032	
Temperature_lag9	1.002	0.009	0.260	0.796	0.985	1.020	
Temperature_lag10	1.002	0.007	0.260	0.792	0.989	1.015	
Humidity_lag0	1.001	0.003	0.500	0.618	0.996	1.006	
Humidity_lag1	1.001	0.003	0.420	0.672	0.995	1.007	
Humidity_lag2	1.001	0.003	0.460	0.643	0.996	1.007	
Humidity_lag3	1.000	0.003	0.150	0.884	0.995	1.006	
Humidity_lag4	1.003	0.003	0.910	0.363	0.997	1.009	
Humidity_lag5	0.997	0.003	-1.260	0.208	0.992	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.145	0.055	2.800	0.005	1.042	1.259	***
Flu_lag0	1.031	0.053	0.590	0.553	0.932	1.140	

Flu_lag1	1.008	0.052	0.150	0.880	0.911	1.115	
Flu_lag2	0.864	0.044	-2.860	0.004	0.782	0.955	***
Flu_lag3	1.042	0.054	0.790	0.428	0.942	1.152	
Flu_lag4	0.989	0.051	-0.210	0.831	0.893	1.095	
Flu_lag5	1.004	0.051	0.080	0.937	0.908	1.110	
Flu_lag6	1.103	0.059	1.840	0.066	0.994	1.224	*
Flu_lag7	1.095	0.057	1.740	0.083	0.988	1.214	*
Flu_lag8	1.003	0.054	0.060	0.951	0.903	1.114	
Flu_lag9	1.005	0.055	0.100	0.922	0.903	1.119	
Flu_lag10	0.968	0.053	-0.590	0.555	0.871	1.077	
Flu_lag11	0.975	0.053	-0.470	0.638	0.876	1.085	
Flu_lag12	0.993	0.053	-0.130	0.896	0.894	1.103	
Flu_lag13	1.000	0.054	0.000	0.999	0.900	1.111	
Flu_lag14	0.964	0.051	-0.690	0.487	0.868	1.070	
Flu_lag15	0.984	0.053	-0.310	0.760	0.886	1.093	
cos_1	1.667	0.445	1.920	0.055	0.988	2.813	*
cos_2	0.800	0.065	-2.730	0.006	0.682	0.939	***
cos_3	1.192	0.049	4.270	0.000	1.100	1.293	***
cos_4	1.001	0.051	0.010	0.990	0.905	1.107	
sin_1	1.269	0.088	3.450	0.001	1.108	1.454	***
sin_2	0.907	0.047	-1.900	0.057	0.820	1.003	*
sin_3	1.193	0.088	2.400	0.017	1.033	1.377	**
sin_4	0.901	0.046	-2.030	0.042	0.814	0.996	**
Constant	3.356	1.236	3.290	0.001	1.631	6.908	***
lnalpha	-4.266	0.814	.b	.b	-5.861	-2.670	

Mean dependent var	7.314	SD dependent var	3.736
Pseudo r-squared	.	Number of obs	350.000
Chi-square	234.115	Prob > chi2	0.000
Akaike crit. (AIC)	1796.381	Bayesian crit. (BIC)	1989.278

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count colag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/3) irr

Table 3.52 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to NO_2 in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2_lag0	0.954	0.047	-0.970	0.333	0.867	1.050	
NO_2_lag1	0.947	0.037	-1.400	0.161	0.876	1.022	
NO_2_lag2	0.947	0.037	-1.400	0.161	0.876	1.022	
NO_2_lag3	0.959	0.067	-0.600	0.550	0.836	1.100	
NO_2_lag4	1.003	0.039	0.070	0.946	0.928	1.083	
NO_2_lag5	0.920	0.040	-1.890	0.059	0.844	1.003	*

NO_2_lag6	1.057	0.071	0.830	0.408	0.927	1.206	
NO_2_lag7	0.916	0.043	-1.860	0.063	0.835	1.005	*
NO_2_lag8	0.927	0.061	-1.140	0.253	0.814	1.056	
NO_2_lag9	0.954	0.047	-0.970	0.333	0.867	1.050	
NO_2_lag10	1.003	0.039	0.070	0.946	0.928	1.083	
NO_2_lag11	0.947	0.037	-1.400	0.161	0.876	1.022	
NO_2_lag12	0.916	0.043	-1.860	0.063	0.835	1.005	*
NO_2_lag13	0.920	0.040	-1.890	0.059	0.844	1.003	*
NO_2_lag14	1.003	0.039	0.070	0.946	0.928	1.083	
Temperature_lag0	1.014	0.008	1.720	0.085	0.998	1.031	*
Temperature_lag1	0.985	0.010	-1.450	0.146	0.965	1.005	
Temperature_lag2	1.015	0.011	1.340	0.179	0.993	1.036	
Temperature_lag3	0.990	0.011	-0.980	0.329	0.969	1.011	
Temperature_lag4	1.010	0.011	0.990	0.323	0.990	1.032	
Temperature_lag5	0.986	0.011	-1.310	0.190	0.966	1.007	
Temperature_lag6	1.010	0.010	0.940	0.345	0.990	1.031	
Temperature_lag7	0.998	0.010	-0.210	0.837	0.978	1.018	
Temperature_lag8	1.012	0.010	1.260	0.207	0.993	1.032	
Temperature_lag9	1.000	0.009	0.040	0.971	0.983	1.018	
Temperature_lag10	1.003	0.007	0.480	0.632	0.990	1.017	
Humidity_lag0	1.001	0.003	0.280	0.778	0.996	1.006	
Humidity_lag1	1.002	0.003	0.720	0.469	0.996	1.008	
Humidity_lag2	1.001	0.003	0.280	0.780	0.995	1.007	
Humidity_lag3	0.999	0.003	-0.170	0.864	0.994	1.005	
Humidity_lag4	1.002	0.003	0.820	0.412	0.997	1.008	
Humidity_lag5	0.997	0.003	-0.960	0.335	0.992	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.140	0.056	2.660	0.008	1.035	1.256	***
Flu_lag0	1.034	0.052	0.660	0.509	0.937	1.141	
Flu_lag1	1.020	0.052	0.400	0.689	0.924	1.127	
Flu_lag2	0.868	0.044	-2.820	0.005	0.787	0.958	***
Flu_lag3	1.040	0.053	0.770	0.443	0.941	1.148	
Flu_lag4	0.990	0.051	-0.200	0.841	0.895	1.094	
Flu_lag5	0.993	0.051	-0.140	0.891	0.899	1.097	
Flu_lag6	1.089	0.058	1.620	0.106	0.982	1.208	
Flu_lag7	1.069	0.056	1.290	0.199	0.965	1.185	
Flu_lag8	0.993	0.053	-0.140	0.890	0.894	1.102	
Flu_lag9	0.996	0.054	-0.070	0.941	0.896	1.108	
Flu_lag10	0.967	0.052	-0.620	0.535	0.870	1.075	
Flu_lag11	0.959	0.052	-0.780	0.437	0.862	1.066	
Flu_lag12	0.976	0.052	-0.460	0.645	0.878	1.084	
Flu_lag13	0.980	0.053	-0.370	0.708	0.882	1.089	
Flu_lag14	0.942	0.050	-1.120	0.264	0.849	1.046	

Flu_lag15	0.958	0.051	-0.810	0.418	0.864	1.063	
cos_1	2.991	0.996	3.290	0.001	1.558	5.744	***
cos_2	0.806	0.063	-2.760	0.006	0.691	0.939	***
cos_3	1.184	0.043	4.700	0.000	1.104	1.271	***
cos_4	1.044	0.044	1.030	0.304	0.961	1.135	
sin_1	1.521	0.139	4.590	0.000	1.272	1.820	***
sin_2	0.926	0.047	-1.500	0.133	0.839	1.024	
sin_3	1.143	0.075	2.040	0.042	1.005	1.301	**
sin_4	0.870	0.043	-2.820	0.005	0.790	0.959	***
Constant	0.282	0.285	-1.250	0.210	0.039	2.037	
lnalpha	-4.329	0.855	.b	.b	-6.004	-2.654	

Mean dependent var	7.314	SD dependent var	3.736
Pseudo r-squared	.	Number of obs	350
Chi-square	241.283	Prob > chi2	0.000
Akaike crit. (AIC)	1796.107	Bayesian crit. (BIC)	1996.719

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count no2lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/7) irr

Table 3.53 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to O_3 in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
O_3_lag0	0.955	0.083	-0.530	0.595	0.805	1.132	
O_3_lag1	0.908	0.084	-1.030	0.301	0.757	1.090	
O_3_lag2	0.968	0.092	-0.340	0.735	0.804	1.166	
O_3_lag3	0.951	0.090	-0.530	0.596	0.790	1.145	
O_3_lag4	0.922	0.087	-0.860	0.388	0.767	1.109	
O_3_lag5	0.989	0.095	-0.120	0.906	0.820	1.193	
O_3_lag6	0.949	0.082	-0.610	0.543	0.801	1.124	
O_3_lag7	0.996	0.061	-0.070	0.941	0.884	1.122	
O_3_lag8	0.930	0.078	-0.870	0.385	0.789	1.096	
O_3_lag9	0.908	0.080	-1.100	0.273	0.763	1.080	
O_3_lag10	1.015	0.086	0.180	0.856	0.860	1.199	
O_3_lag11	0.996	0.061	-0.070	0.941	0.884	1.122	
Temperature_lag0	1.013	0.008	1.660	0.097	0.998	1.030	*
Temperature_lag1	0.983	0.010	-1.690	0.091	0.963	1.003	*
Temperature_lag2	1.012	0.011	1.150	0.248	0.992	1.033	
Temperature_lag3	0.992	0.011	-0.740	0.462	0.971	1.013	
Temperature_lag4	1.011	0.011	1.000	0.316	0.990	1.032	
Temperature_lag5	0.991	0.010	-0.890	0.371	0.970	1.011	
Temperature_lag6	1.008	0.010	0.760	0.449	0.988	1.028	

Temperature_lag7	0.994	0.010	-0.580	0.564	0.974	1.014	
Temperature_lag8	1.009	0.010	0.940	0.345	0.990	1.029	
Temperature_lag9	1.004	0.009	0.450	0.650	0.986	1.023	
Temperature_lag10	1.000	0.007	0.040	0.971	0.987	1.014	
Humidity_lag0	1.001	0.003	0.210	0.835	0.995	1.006	
Humidity_lag1	1.002	0.003	0.560	0.576	0.996	1.008	
Humidity_lag2	1.000	0.003	0.130	0.899	0.994	1.007	
Humidity_lag3	0.999	0.003	-0.430	0.668	0.992	1.005	
Humidity_lag4	1.002	0.003	0.740	0.461	0.996	1.009	
Humidity_lag5	0.997	0.003	-1.180	0.239	0.991	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.157	0.055	3.050	0.002	1.054	1.271	***
Flu_lag0	1.019	0.053	0.350	0.723	0.920	1.127	
Flu_lag1	1.004	0.052	0.080	0.937	0.907	1.111	
Flu_lag2	0.849	0.044	-3.170	0.001	0.768	0.939	***
Flu_lag3	1.023	0.053	0.430	0.667	0.924	1.132	
Flu_lag4	0.983	0.052	-0.320	0.751	0.887	1.090	
Flu_lag5	1.002	0.052	0.040	0.966	0.905	1.110	
Flu_lag6	1.096	0.059	1.700	0.089	0.986	1.218	*
Flu_lag7	1.079	0.057	1.430	0.152	0.973	1.196	
Flu_lag8	0.991	0.054	-0.170	0.866	0.891	1.102	
Flu_lag9	0.999	0.055	-0.010	0.989	0.897	1.113	
Flu_lag10	0.963	0.053	-0.690	0.492	0.865	1.072	
Flu_lag11	0.964	0.052	-0.670	0.504	0.867	1.073	
Flu_lag12	0.993	0.053	-0.140	0.888	0.894	1.102	
Flu_lag13	0.999	0.053	-0.020	0.986	0.900	1.109	
Flu_lag14	0.957	0.051	-0.830	0.408	0.862	1.062	
Flu_lag15	0.974	0.052	-0.490	0.625	0.877	1.082	
cos_1	1.539	0.373	1.780	0.075	0.958	2.474	*
cos_2	0.782	0.062	-3.110	0.002	0.670	0.913	***
cos_3	1.129	0.044	3.080	0.002	1.045	1.219	***
cos_4	1.045	0.045	1.020	0.309	0.960	1.138	
sin_1	1.535	0.162	4.070	0.000	1.249	1.886	***
sin_2	0.879	0.044	-2.570	0.010	0.796	0.970	**
sin_3	1.184	0.074	2.700	0.007	1.047	1.339	***
sin_4	0.908	0.042	-2.080	0.037	0.829	0.994	**
Constant	0.996	0.634	-0.010	0.995	0.286	3.469	
lnalpha	-4.220	0.774	.b	.b	-5.737	-2.702	

Mean dependent var	7.314	SD dependent var	3.736
Pseudo r-squared	.	Number of obs	350
Chi-square	233.304	Prob > chi2	0.000
Akaike crit. (AIC)	1805.972	Bayesian crit. (BIC)	2018.158

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count o3lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/1) irr

Table 3.54 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to $PM_{2.5}$ in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$_lag0	0.976	0.022	-1.090	0.274	0.935	1.019	
$PM_{2.5}$_lag1	0.987	0.036	-0.370	0.714	0.919	1.059	
$PM_{2.5}$_lag2	0.976	0.022	-1.090	0.274	0.935	1.019	
$PM_{2.5}$_lag3	1.025	0.053	0.480	0.634	0.926	1.135	
$PM_{2.5}$_lag4	0.942	0.051	-1.120	0.263	0.848	1.046	
$PM_{2.5}$_lag5	1.013	0.050	0.270	0.790	0.919	1.117	
$PM_{2.5}$_lag6	0.976	0.022	-1.090	0.274	0.935	1.019	
$PM_{2.5}$_lag7	0.976	0.022	-1.090	0.274	0.935	1.019	
$PM_{2.5}$_lag8	0.987	0.036	-0.370	0.714	0.919	1.059	
$PM_{2.5}$_lag9	1.036	0.047	0.790	0.429	0.948	1.133	
Temperature_lag0	1.013	0.008	1.560	0.118	0.997	1.029	
Temperature_lag1	0.984	0.010	-1.550	0.120	0.965	1.004	
Temperature_lag2	1.010	0.010	0.950	0.340	0.990	1.031	
Temperature_lag3	0.993	0.011	-0.620	0.533	0.972	1.015	
Temperature_lag4	1.011	0.011	1.000	0.319	0.990	1.032	
Temperature_lag5	0.991	0.010	-0.900	0.368	0.971	1.011	
Temperature_lag6	1.007	0.010	0.650	0.513	0.987	1.027	
Temperature_lag7	0.996	0.010	-0.380	0.705	0.977	1.016	
Temperature_lag8	1.010	0.010	1.000	0.319	0.991	1.029	
Temperature_lag9	1.002	0.009	0.250	0.800	0.985	1.020	
Temperature_lag10	1.002	0.007	0.350	0.724	0.989	1.016	
Humidity_lag0	1.002	0.003	0.770	0.442	0.997	1.007	
Humidity_lag1	1.002	0.003	0.580	0.562	0.996	1.008	
Humidity_lag2	1.001	0.003	0.480	0.628	0.996	1.007	
Humidity_lag3	0.999	0.003	-0.270	0.787	0.993	1.005	
Humidity_lag4	1.004	0.003	1.330	0.184	0.998	1.010	
Humidity_lag5	0.997	0.003	-1.010	0.312	0.992	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.135	0.055	2.620	0.009	1.032	1.248	***
Flu_lag0	1.025	0.053	0.470	0.635	0.926	1.135	
Flu_lag1	1.015	0.053	0.280	0.779	0.916	1.123	
Flu_lag2	0.853	0.044	-3.110	0.002	0.771	0.943	***
Flu_lag3	1.029	0.054	0.550	0.581	0.929	1.141	
Flu_lag4	0.976	0.052	-0.460	0.642	0.879	1.083	
Flu_lag5	0.996	0.052	-0.070	0.942	0.899	1.104	
Flu_lag6	1.089	0.059	1.580	0.114	0.980	1.211	
Flu_lag7	1.070	0.057	1.260	0.207	0.963	1.188	

Flu_lag8	0.992	0.054	-0.140	0.886	0.891	1.104	
Flu_lag9	0.999	0.056	-0.020	0.987	0.895	1.115	
Flu_lag10	0.958	0.053	-0.780	0.436	0.860	1.067	
Flu_lag11	0.962	0.053	-0.690	0.487	0.864	1.072	
Flu_lag12	0.984	0.054	-0.300	0.762	0.884	1.094	
Flu_lag13	0.995	0.054	-0.090	0.931	0.895	1.107	
Flu_lag14	0.954	0.051	-0.880	0.379	0.860	1.059	
Flu_lag15	0.970	0.052	-0.560	0.572	0.873	1.078	
cos_1	1.860	0.501	2.310	0.021	1.098	3.152	**
cos_2	0.823	0.069	-2.330	0.020	0.698	0.970	**
cos_3	1.201	0.048	4.630	0.000	1.112	1.298	***
cos_4	0.998	0.048	-0.050	0.963	0.907	1.097	
sin_1	1.354	0.108	3.780	0.000	1.157	1.584	***
sin_2	0.886	0.044	-2.450	0.014	0.804	0.976	**
sin_3	1.173	0.083	2.260	0.024	1.021	1.347	**
sin_4	0.892	0.044	-2.310	0.021	0.810	0.983	**
Constant	5.729	1.784	5.610	0.000	3.112	10.546	***
lnalpha	-4.087	0.690	.b	.b	-5.439	-2.735	

Mean dependent var	7.314	SD dependent var	3.736
Pseudo r-squared	.	Number of obs	350
Chi-square	227.718	Prob > chi2	0.000
Akaike crit. (AIC)	1800.108	Bayesian crit. (BIC)	1993.005

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count pm25lag* temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, constraints(1/4) irr

Table 3.55 Results of time-series yearly model of associations between daily respiratory ED visits among children under 17 ages and exposure to SO_2 in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2_lag0	1.012	0.017	0.680	0.497	0.979	1.045	
SO_2_lag1	1.012	0.017	0.680	0.497	0.979	1.045	
SO_2_lag2	0.993	0.023	-0.300	0.765	0.950	1.039	
SO_2_lag3	0.987	0.031	-0.410	0.681	0.927	1.050	
SO_2_lag4	**1.051**	**0.022**	**2.360**	**0.018**	**1.009**	**1.096**	**
SO_2_lag5	0.993	0.023	-0.300	0.765	0.950	1.039	
SO_2_lag6	1.012	0.017	0.680	0.497	0.979	1.045	
SO_2_lag7	0.970	0.028	-1.080	0.281	0.917	1.025	
SO_2_lag8	0.968	0.028	-1.140	0.254	0.916	1.024	
SO_2_lag9	**1.051**	**0.022**	**2.360**	**0.018**	**1.009**	**1.096**	**
Temperature_lag0	1.006	0.010	0.650	0.518	0.988	1.025	
Temperature_lag1	0.991	0.012	-0.760	0.446	0.967	1.015	
Temperature_lag2	1.013	0.013	1.010	0.312	0.988	1.039	

Temperature_lag3	0.989	0.013	-0.790	0.431	0.964	1.016	
Temperature_lag4	1.001	0.014	0.080	0.938	0.974	1.029	
Temperature_lag5	0.994	0.014	-0.470	0.641	0.967	1.021	
Temperature_lag6	1.007	0.013	0.490	0.626	0.980	1.033	
Temperature_lag7	1.001	0.013	0.060	0.950	0.976	1.026	
Temperature_lag8	1.011	0.011	1.020	0.305	0.990	1.034	
Temperature_lag9	1.005	0.010	0.460	0.643	0.985	1.026	
Temperature_lag10	1.000	0.008	-0.050	0.961	0.984	1.016	
Humidity_lag0	0.999	0.003	-0.220	0.826	0.993	1.006	
Humidity_lag1	1.002	0.004	0.590	0.554	0.995	1.009	
Humidity_lag2	1.000	0.004	-0.080	0.933	0.993	1.007	
Humidity_lag3	0.997	0.004	-0.730	0.467	0.990	1.005	
Humidity_lag4	1.004	0.004	1.100	0.270	0.997	1.011	
Humidity_lag5	0.998	0.003	-0.680	0.494	0.991	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.096	0.064	1.570	0.116	0.977	1.230	
Flu_lag0	1.004	0.066	0.060	0.950	0.883	1.142	
Flu_lag1	1.030	0.067	0.450	0.649	0.906	1.171	
Flu_lag2	0.865	0.058	-2.160	0.031	0.759	0.987	**
Flu_lag3	1.118	0.075	1.660	0.097	0.980	1.274	*
Flu_lag4	0.981	0.068	-0.280	0.779	0.857	1.123	
Flu_lag5	1.002	0.067	0.030	0.977	0.879	1.142	
Flu_lag6	1.107	0.078	1.440	0.150	0.964	1.272	
Flu_lag7	1.088	0.072	1.260	0.208	0.954	1.239	
Flu_lag8	1.075	0.074	1.060	0.290	0.940	1.230	
Flu_lag9	1.025	0.073	0.340	0.732	0.892	1.177	
Flu_lag10	1.019	0.069	0.280	0.779	0.893	1.164	
Flu_lag11	1.012	0.070	0.180	0.860	0.885	1.158	
Flu_lag12	0.941	0.063	-0.910	0.361	0.825	1.073	
Flu_lag13	1.015	0.070	0.220	0.825	0.887	1.162	
Flu_lag14	0.956	0.062	-0.700	0.486	0.841	1.086	
Flu_lag15	0.981	0.066	-0.290	0.775	0.859	1.120	
cos_1	1.615	0.624	1.240	0.215	0.757	3.445	
cos_2	0.761	0.111	-1.870	0.061	0.572	1.013	*
cos_3	1.199	0.067	3.270	0.001	1.076	1.338	***
cos_4	0.983	0.068	-0.250	0.802	0.858	1.125	
sin_1	1.284	0.163	1.960	0.050	1.000	1.647	**
sin_2	0.862	0.062	-2.060	0.040	0.749	0.993	**
sin_3	1.253	0.130	2.180	0.029	1.023	1.535	**
sin_4	0.936	0.063	-0.990	0.323	0.821	1.067	
Constant	7.814	6.390	2.510	0.012	1.574	38.806	**
lnalpha	-17.271	301.531	.b	.b	-608.260	573.719	

Mean dependent var	7.101	SD dependent var	3.551
Pseudo r-squared	.	Number of obs	228

Chi-square	182.324	Prob > chi2	0.000
Akaike crit. (AIC)	1153.395	Bayesian crit. (BIC)	1324.862

*** p<.01, ** p<.05, * p<.1

H&W: holiday and weekend

xi: nbreg count so2lag* temperaturelag* humiditylag* i.holiday flulag* cos* sin*, constraints(1/4) irr

3.2.7 Measures of model fit

Residual plots are commonly used to measure if seasonality and long-term trends are controlled well in time-series analysis[4]. Figure 3.4 shows the residual plots of the three-year models for five air pollutants. Figures 3.5 and 3.6 present residual plots of sex-stratified models for the five air pollutants. Figures 3.7 and 3.8 show residual plots of age-stratified models for the five air pollutants. Figures 3.9 and 3.10 show the residual plots of wildfire season models and non-wildfire season models for the five air pollutants. Figures 3.11, 3.12 and 3.13 present the residual plots of yearly models for the five air pollutants. The residuals of three-year models, sex-stratified male models, and age-stratified models were roughly randomly distributed, indicating that data fit the models well and that seasonality and long-term trends were controlled well using periodic functions (Fourier terms) over the three-year period. In contrast, sex-stratified female models, wildfire season models, non-wildfire season models, and yearly models had some patterns in the plots, so data did not fit those models as well, indicating residual confounding from seasonality and long-term trends in those models.

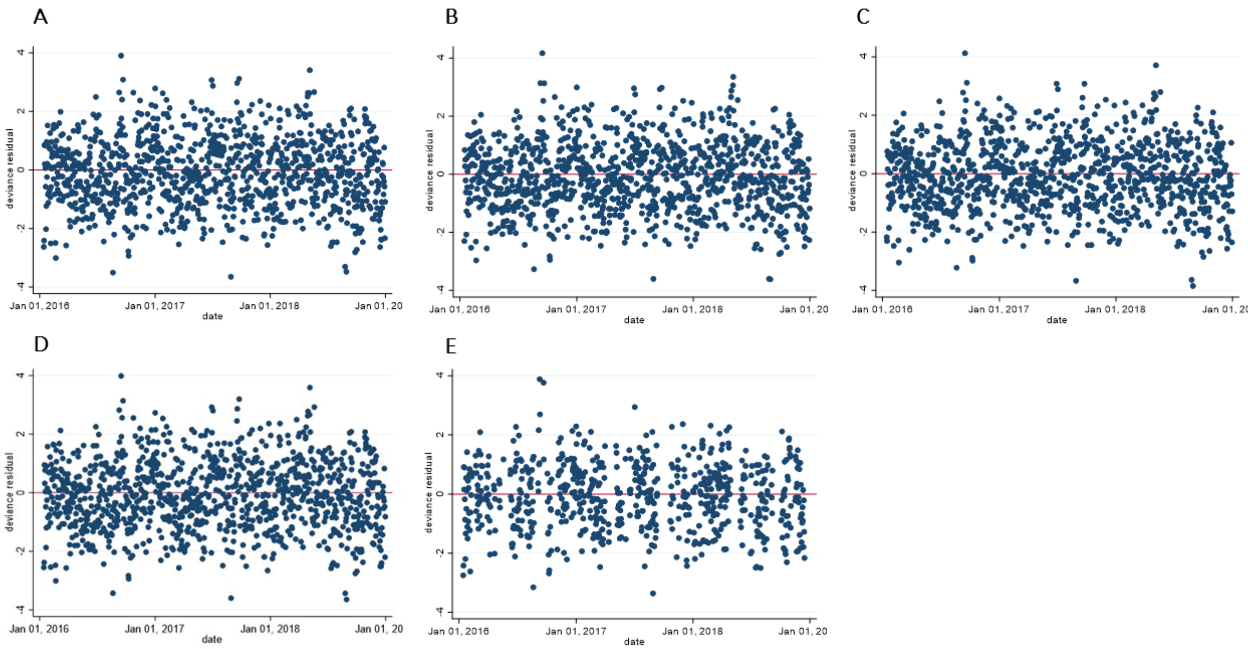


Figure 3.4 Residual plots of three-year models for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

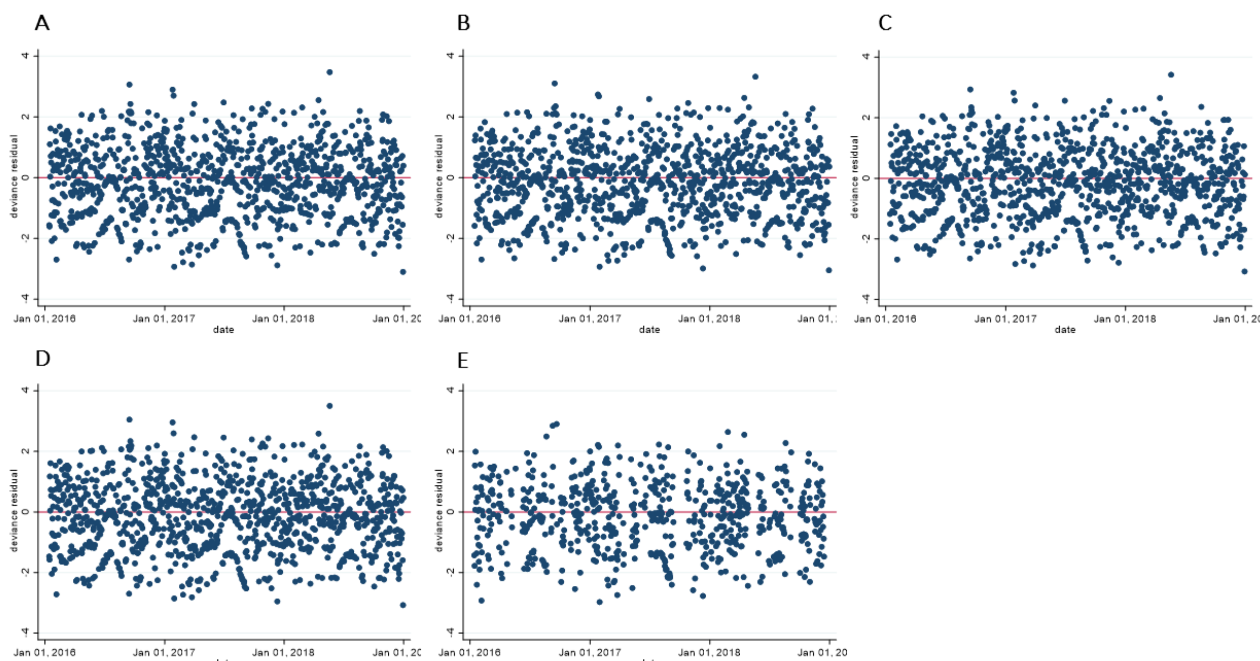


Figure 3.5 Residual plots of sex-stratified female models for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

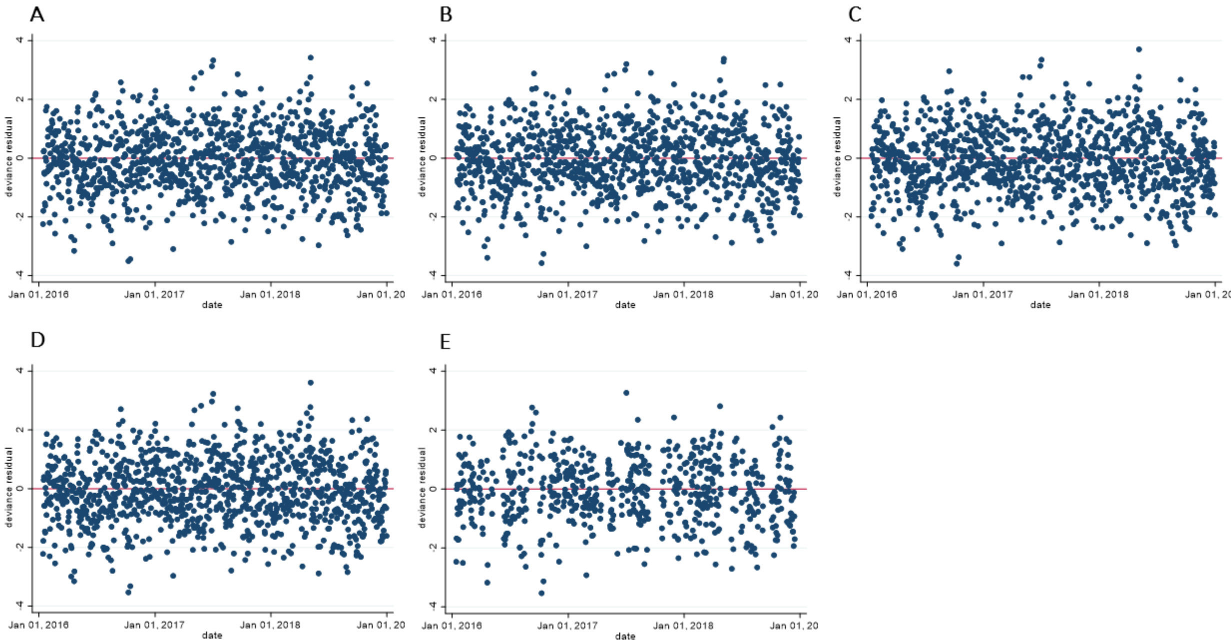


Figure 3.6 Residual plots of sex-stratified male models for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

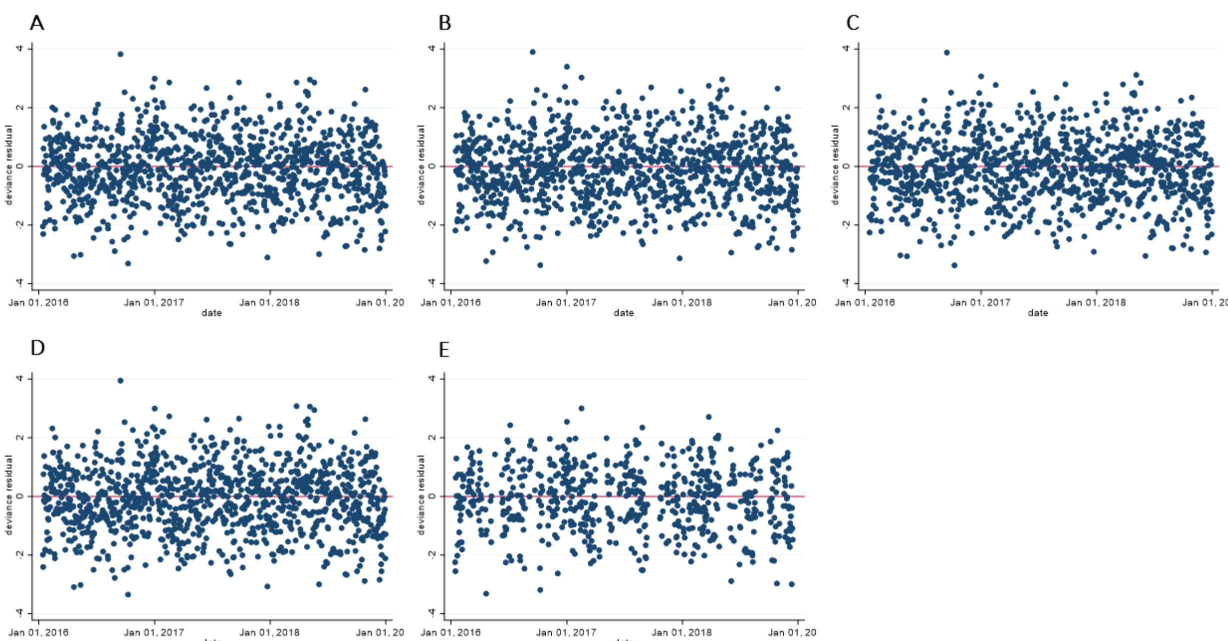


Figure 3.7 Residual plots of age-stratified models of 0 to 4 ages for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

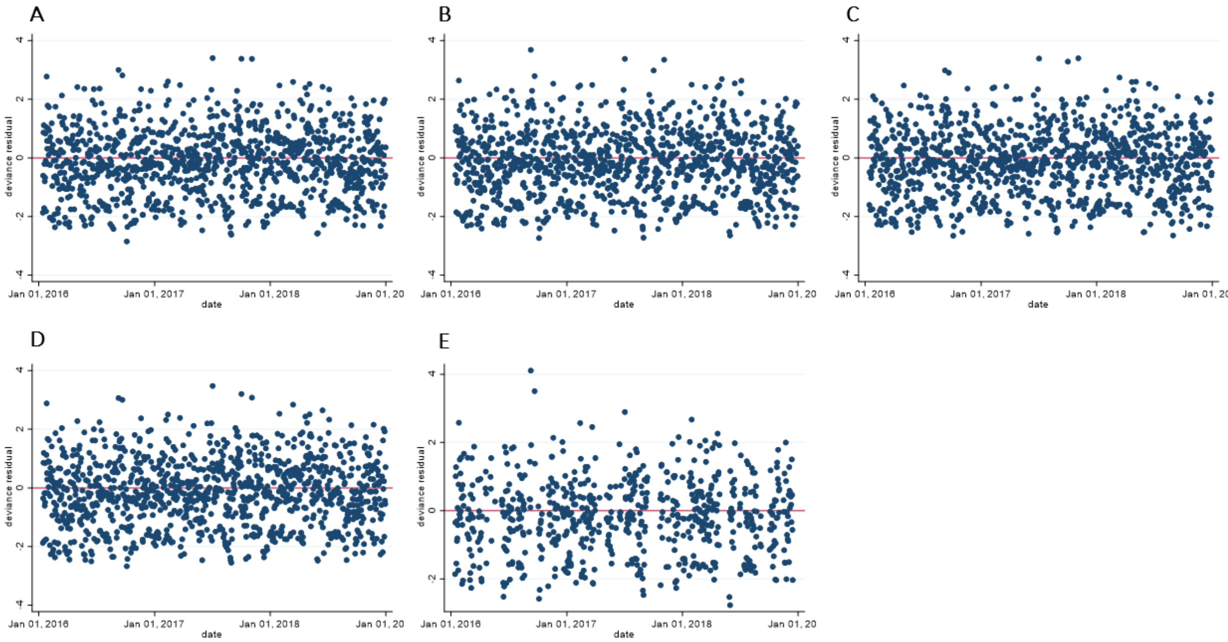


Figure 3.8 Residual plots of age-stratified models of 5-16 ages for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

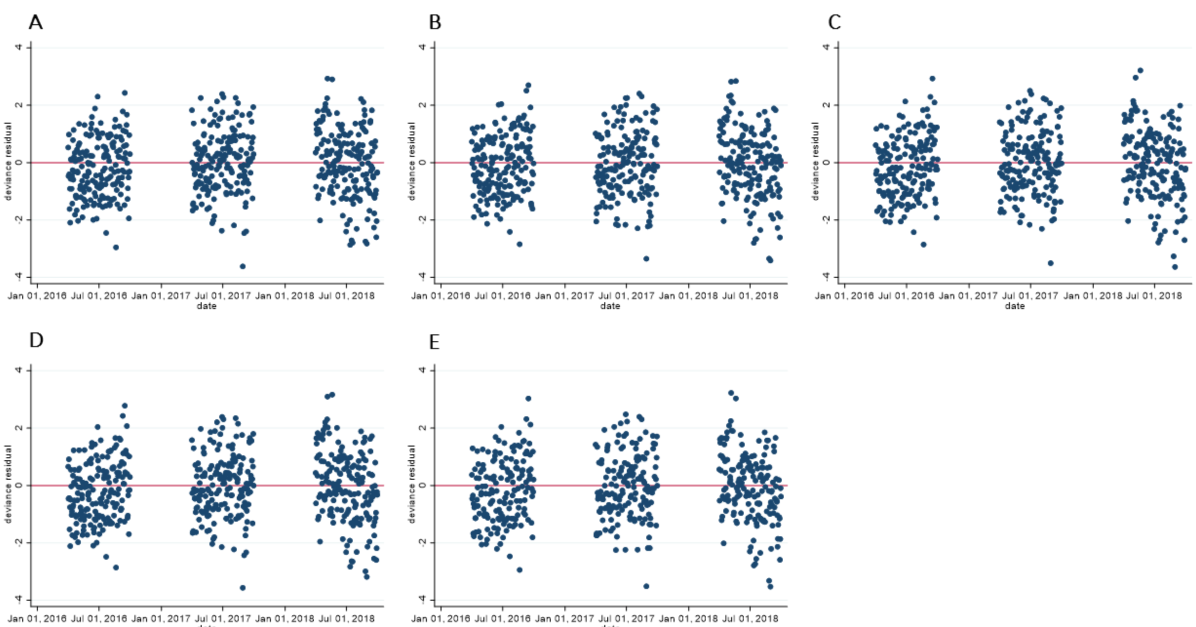


Figure 3.9 Residual plots of wildfire season models for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

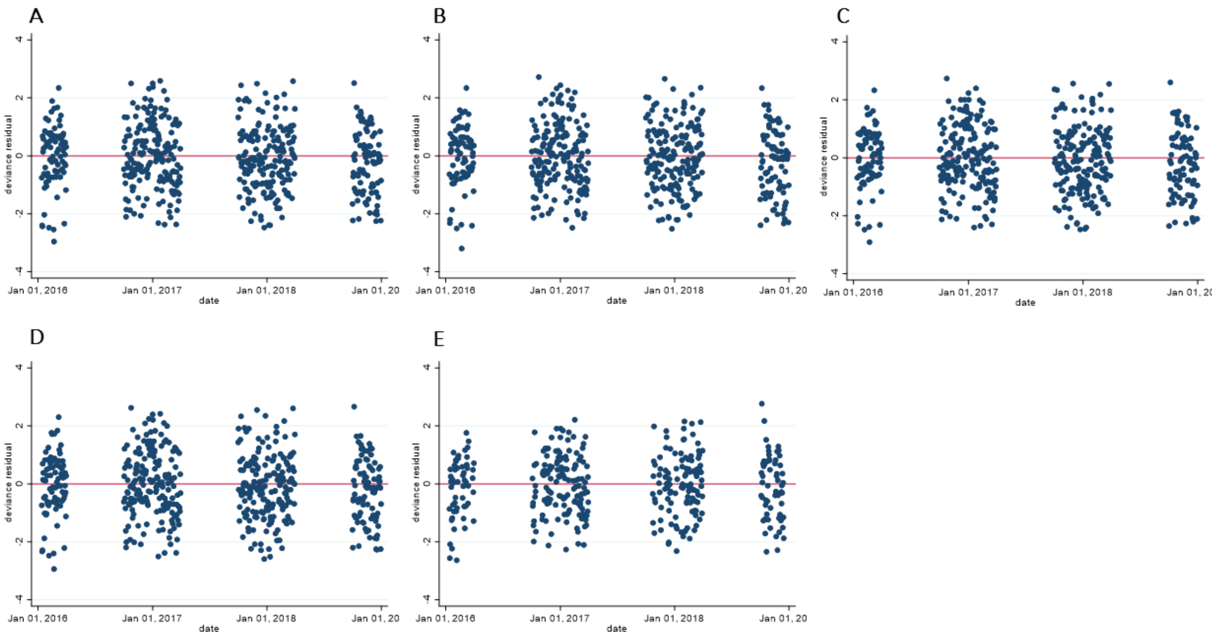


Figure 3.10 Residual plots of non-wildfire models for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

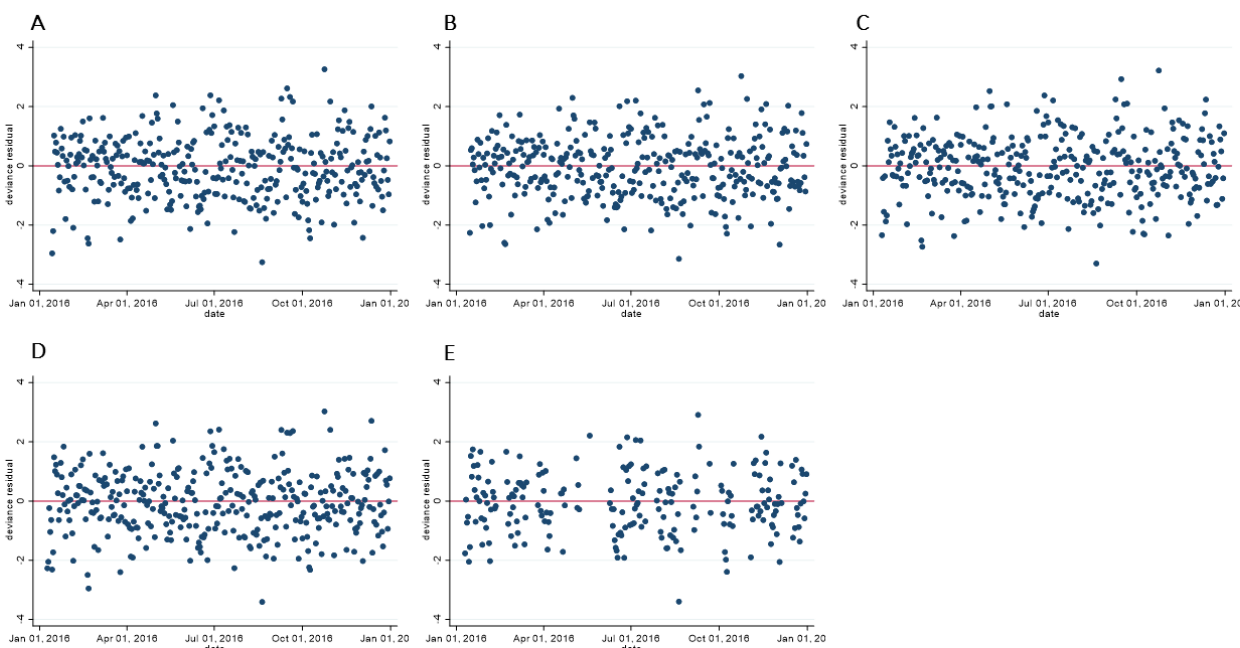


Figure 3.11 Residual plots of yearly models of 2016 for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

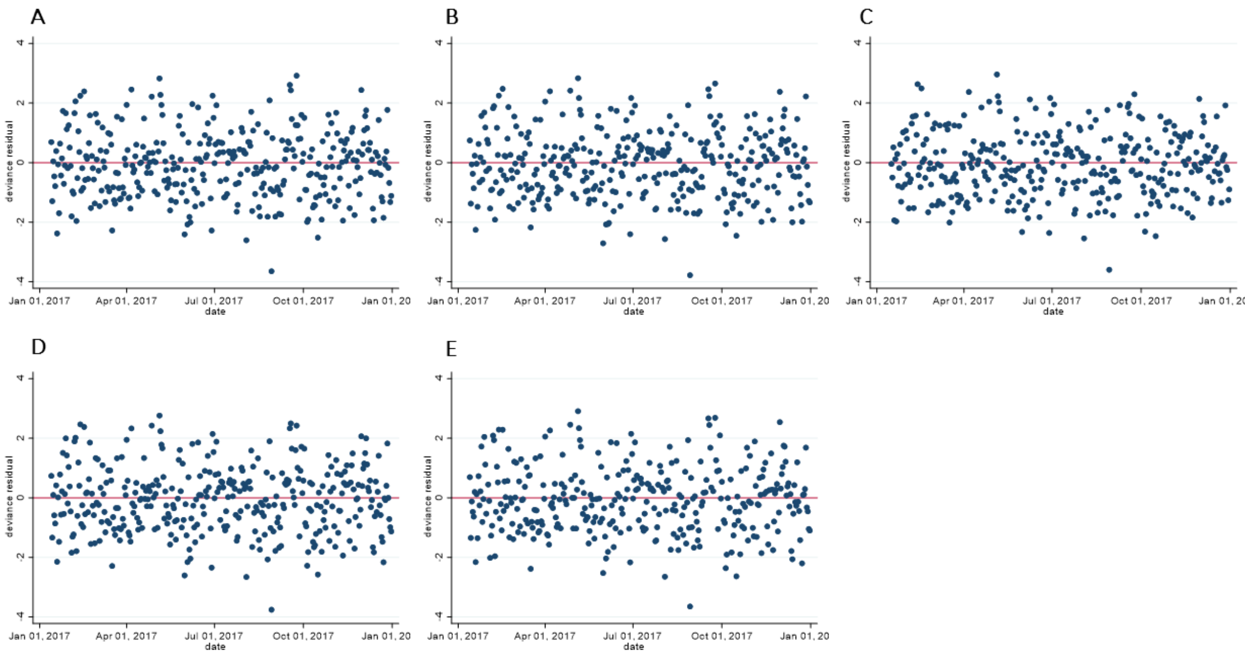


Figure 3.12 Residual plots of yearly models of 2017 for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

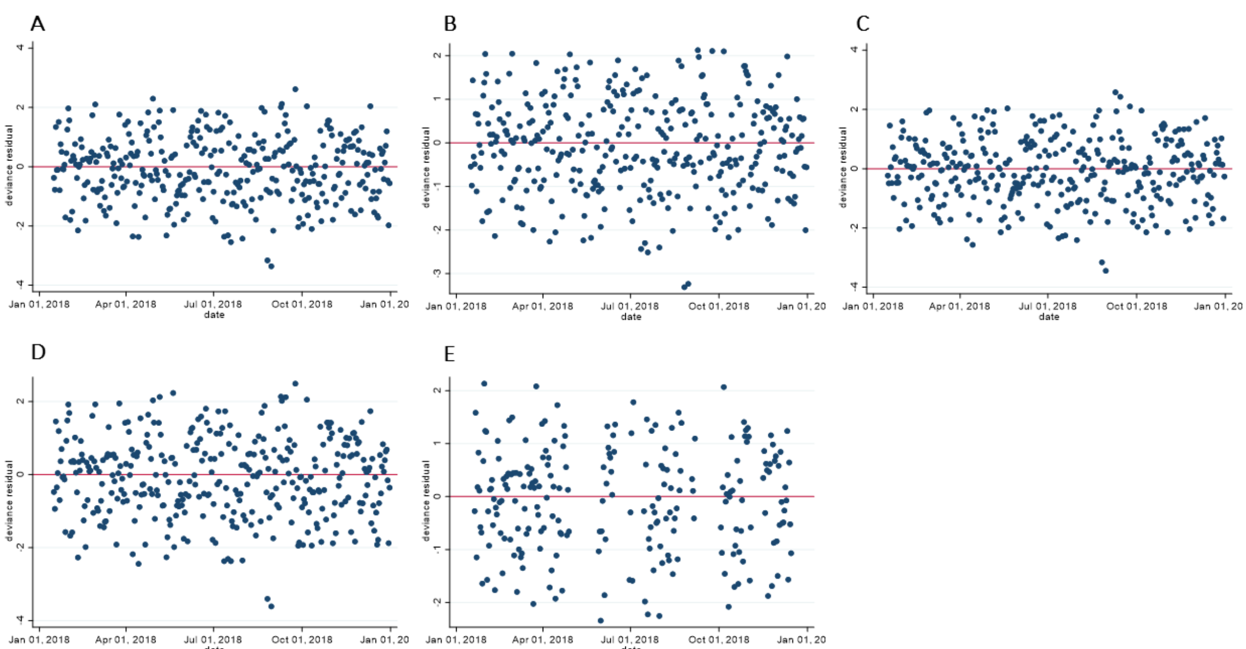


Figure 3.13 Residual plots of yearly models of 2018 for CO (A), NO_2 (B), O_3 (C), $PM_{2.5}$ (D), and SO_2 (E)

3.2.8 Summary of time-series results

Table 3.56 presents a summary of all significant results from time-series analysis. Overall, NO_2 and O_3 showed more significant results than the other three air pollutants. With a greater number of significant results and larger magnitudes of association, male children were observed to be affected more by air pollution than female children, and older children (5-16 ages) more than younger children (0-4 ages). Meanwhile, stronger associations were found during wildfire seasons compared to non-wildfire seasons. Among the three years, the strongest associations were in the year 2016.

Table 3.56 Summary of significant results from time-series analysis

	Pollutant	Lag	IRR	P-value	95% CI
Three-year model	NO_2 (ppm)	4-day lag	1.085	0.032	1.007-1.169
	O_3 (ppm)	4-day lag	0.88	0.02	0.804-0.981
		5-day lag	1.08	0.011	1.018-1.146
		9-day lag	1.08	0.011	1.018-1.146
		11-day lag	1.08	0.011	1.018-1.146
Sex-stratified model (male)	NO_2 (ppm)	4-day lag	1.071	0.025	1.009-1.137
		6-day lag	1.071	0.025	1.009-1.137
		8-day lag	1.071	0.025	1.009-1.137
	O_3 (ppm)	5-day lag	1.109	0.019	1.017-1.21
		11-day lag	1.109	0.019	1.017-1.21
Age-stratified model (0-4 ages)	NO_2 (ppm)	4-day lag	1.068	0.042	1.002-1.139
		8-day lag	1.068	0.042	1.002-1.139
	O_3 (ppm)	4-day lag	0.89	0.044	0.795-0.997
Age-stratified model (5-16 ages)	NO_2 (ppm)	2-day lag	1.074	0.048	1.001-1.152
		4-day lag	1.074	0.048	1.001-1.152
		6-day lag	1.074	0.048	1.001-1.152
		10-day lag	1.074	0.048	1.001-1.152
	O_3 (ppm)	1-day lag	1.152	0.042	1.005-1.32
		5-day lag	1.152	0.042	1.005-1.32
	SO_2 (ppm)	8-day lag	1.043	0.028	1.005-1.082
		9-day lag	1.043	0.028	1.005-1.082
Wildfire model	CO (ppm)	2-day lag	1.196	0.028	1.02-1.403
		6-day lag	1.196	0.028	1.02-1.403
	NO_2 (ppm)	0-day lag	1.08	0.036	1.005-1.16
		5-day lag	1.08	0.036	1.005-1.16
		6-day lag	1.147	0.018	1.024-1.285
		10-day lag	1.08	0.036	1.005-1.16
	O_3 (ppm)	5-day lag	1.12	0.045	0.997-1.256

		11-day lag	1.12	0.045	0.997-1.256
	$PM_{2.5}$ (μg/m^3)	0-day lag	1.056	0.035	1.004-1.112
		2-day lag	1.056	0.035	1.004-1.112
		6-day lag	1.056	0.035	1.004-1.112
Non-wildfire model	NO_2 (ppm)	4-day lag	1.073	0.046	1.001-1.15
		8-day lag	1.073	0.046	1.001-1.15
	O_3 (ppm)	1-day lag	1.101	0.029	1.01-1.2
		5-day lag	1.101	0.029	1.01-1.2
	SO_2 (ppm)	1-day lag	1.033	0.03	1.003-1.064
		4-day lag	1.033	0.03	1.003-1.064
Yearly model (2016)	NO_2 (ppm)	6-day lag	1.09	0.022	1.013-1.174
		7-day lag	0.792	< 0.001	0.697-0.901
		8-day lag	1.09	0.022	1.013-1.174
		13-day lag	1.09	0.022	1.013-1.174
	O_3 (ppm)	5-day lag	1.198	0.029	1.018-1.409
		6-day lag	0.844	0.024	0.727-0.978
Yearly model (2017)	NO_2 (ppm)	2-day lag	1.119	0.029	1.011-1.239
		4-day lag	1.119	0.029	1.011-1.239
	O_3 (ppm)	4-day lag	0.8	0.007	0.681-0.94
Year model (2018)	SO_2 (ppm)	4-day lag	1.051	0.018	1.009-1.096
		9-day lag	1.051	0.018	1.009-1.096

3.3 Results of multivariable logistic regression and multiple linear regression

3.3.1 Results of multivariable logistic regression

Tables 3.57 to 3.60 present the results of the multivariable logistic regression modelling that investigated the association between hospital admission (yes/no) for respiratory diseases among children and air pollutant concentrations. The estimated odds ratios and 95% confidence intervals for inpatient hospital admission are shown for a 1 ppm increase in NO_2, O_3, and SO_2 concentrations, and 1 μg/m^3 increase in $PM_{2.5}$ concentrations. Evidence of significant associations between inpatient hospital admission and air pollutant exposure was not found. Inpatient hospital admission was marginally associated with $PM_{2.5}$ (p-value 0.056).

Table 3.57 Results of multivariable logistic regression of the associations between pediatric hospital admissions for respiratory diseases and exposure to NO_2 in Edmonton between 2016 to 2018

Variable	Odds Ratio	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2	1.025	0.020	1.250	0.212	0.986	1.065	

1.CTAS	129.037	128.690	4.870	0.000	18.273	911.228	***
2.CTAS	20.783	14.900	4.230	0.000	5.099	84.715	***
3.CTAS	4.187	3.030	1.980	0.048	1.014	17.294	***
4b.CTAS	1.000	.	.	.	.	.	
1b.Age	1.000	.	.	.	.	.	
2.Age	0.640	0.109	-2.610	0.009	0.457	0.894	***
3.Age	0.394	0.122	-3.000	0.003	0.214	0.724	***
4.Age	0.406	0.216	-1.690	0.090	0.143	1.153	*
1b.SES	1.000	.	.	.	.	.	
2.SES	1.173	0.229	0.820	0.412	0.801	1.719	
3.SES	1.305	0.255	1.360	0.173	0.890	1.912	
4.SES	1.305	0.293	1.180	0.236	0.840	2.028	
5.SES	1.359	0.298	1.400	0.162	0.885	2.087	
Constant	1.331	0.995	0.380	0.702	0.308	5.759	

Mean dependent var	0.141	SD dependent var	0.348
Pseudo r-squared	0.122	Number of obs	2546
Chi-square	251.343	Prob > chi2	0.000
Akaike crit. (AIC)	1840.387	Bayesian crit. (BIC)	1910.494

Table 3.58 Results of multivariable logistic regression of the associations between pediatric hospital admissions for respiratory diseases and exposure to O_3 in Edmonton between 2016 to 2018

Variable	Odds Ratio	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
1b.O_3	1.000	.	.	.	.	.	
2. O_3	1.021	0.202	0.110	0.915	0.693	1.504	
3. O_3	0.775	0.119	-1.650	0.098	0.573	1.049	*
4. O_3	0.794	0.183	-1.000	0.317	0.506	1.247	
1b.Age	1.000	.	.	.	.	.	
2.Age	0.621	0.106	-2.790	0.005	0.445	0.868	***
3.Age	0.421	0.126	-2.880	0.004	0.233	0.758	***
4.Age	0.399	0.212	-1.730	0.084	0.141	1.132	*
0b.Sex	1.000	.	.	.	.	.	
1.Sex	1.334	0.160	2.400	0.016	1.055	1.688	**
1b.SES	1.000	.	.	.	.	.	
2.SES	1.130	0.215	0.640	0.522	0.778	1.642	
3.SES	1.276	0.251	1.240	0.216	0.867	1.878	
4.SES	1.262	0.293	1.010	0.315	0.801	1.989	
5.SES	1.263	0.287	1.030	0.305	0.809	1.973	
1.CTAS	150.601	150.472	5.020	0.000	21.250	1067.329	***
2.CTAS	21.424	15.358	4.270	0.000	5.257	87.316	***
3.CTAS	4.555	3.293	2.100	0.036	1.105	18.783	***
4b.CTAS	1.000	.	.	.	.	.	
Constant	2.132	1.524	1.060	0.289	0.525	8.653	

Mean dependent var	0.138	SD dependent var	0.345
Pseudo r-squared	0.120	Number of obs	2694
Chi-square	260.030	Prob > chi2	0.000
Akaike crit. (AIC)	1933.097	Bayesian crit. (BIC)	2021.579

*** p<.01, ** p<.05, * p<.1

xi: logistic admit i.o3 i.age i.sex i.ses i.ctas

Table 3.59 Results of multivariable logistic regression of the associations between pediatric hospital admissions for respiratory diseases and exposure to $PM_{2.5}$ in Edmonton between 2016 to 2018

Variable	Odds Ratio	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$	1.045	0.024	1.910	0.056	0.999	1.093	*
1b.Age	1.000	.	.	.	.	.	
2.Age	0.706	0.071	-3.470	0.001	0.580	0.859	***
3.Age	0.523	0.086	-3.930	0.000	0.378	0.722	***
4.Age	0.463	0.145	-2.460	0.014	0.251	0.854	**
0b.Sex	1.000	.	.	.	.	.	
1.Sex	1.285	0.091	3.560	0.000	1.119	1.475	***
1b.SES	1.000	.	.	.	.	.	
2.SES	1.319	0.145	2.530	0.012	1.064	1.635	**
3.SES	1.390	0.155	2.950	0.003	1.117	1.730	***
4.SES	1.223	0.161	1.530	0.127	0.945	1.584	
5.SES	1.486	0.181	3.240	0.001	1.169	1.887	***
1.CTAS	296.737	180.434	9.360	0.000	90.114	977.131	***
2.CTAS	33.919	17.116	6.980	0.000	12.616	91.198	***
3.CTAS	6.713	3.407	3.750	0.000	2.483	18.152	***
4b.CTAS	1.000	.	.	.	.	.	
Constant	1.478	0.581	0.990	0.321	0.684	3.193	
Mean dependent var	0.136		SD dependent var		0.343		
Pseudo r-squared	0.125		Number of obs		7997		
Chi-square	796.985		Prob > chi2		0.000		
Akaike crit. (AIC)	5586.605		Bayesian crit. (BIC)		5677.433		

*** p<.01, ** p<.05, * p<.1

xi: logistic admit pm25 i.age i.sex i.ses i.ctas

Table 3.60 Results of multivariable logistic regression of the associations between pediatric hospital admissions for respiratory diseases and exposure to SO_2 in Edmonton between 2016 to 2018

Variable	Odds Ratio	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2	0.800	0.437	-0.410	0.683	0.275	2.332	
1b.Age	1.000	.	.	.	.	.	
2.Age	0.648	0.111	-2.530	0.011	0.463	0.906	**

3.Age	0.423	0.127	-2.870	0.004	0.234	0.762	***
4.Age	0.386	0.205	-1.790	0.073	0.136	1.094	*
0b.Sex	1.000	.	.	.	.	.	
1.Sex	1.323	0.161	2.300	0.022	1.042	1.680	**
1b.SES	1.000	.	.	.	.	.	
2.SES	1.215	0.240	0.990	0.324	0.825	1.790	
3.SES	1.451	0.280	1.930	0.054	0.994	2.119	*
4.SES	1.398	0.329	1.420	0.155	0.881	2.218	
5.SES	1.495	0.331	1.810	0.070	0.968	2.308	*
1.CTAS	124.850	126.127	4.780	0.000	17.238	904.271	***
2.CTAS	21.155	15.172	4.260	0.000	5.187	86.276	**
3.CTAS	4.335	3.137	2.030	0.043	1.050	17.903	**
4b.CTAS	1.000	.	.	.	.	.	
Constant	1.532	1.143	0.570	0.567	0.355	6.609	

Mean dependent var	0.139	SD dependent var	0.346
Pseudo r-squared	0.119	Number of obs	2579
Chi-square	248.051	Prob > chi2	0.000
Akaike crit. (AIC)	1859.258	Bayesian crit. (BIC)	1935.375

*** p<.01, ** p<.05, * p<.1

xi: logistic admit so2 i.age i.sex i.ses i.ctas

3.3.2 Results of multiple linear regression

Tables 3.61 to 3.64 show the results of the multiple linear regression modelling that explored the association between square root of length of stay (LOS) of patients in the ED and air pollution exposure. O_3 was transformed into the categorical variable due to its nonlinearity. Strong evidence of an association between square root of LOS with NO_2 and $PM_{2.5}$ was found, with coefficients of 0.092 (p-value: 0.002, 95%CI: 0.034, 0.150) and 0.138 (p-value: <0.001, 95%CI: 0.072, 0.203), respectively, indicating that the square root of LOS increased by 0.092 and 0.138 units, respectively, per 1 ppm increase in the concentration of NO_2 and per 1 $\mu g/m^3$ increase in the concentration of $PM_{2.5}$ after adjusting for other variables.

For LOS, LOS increased by (3.698 + 0.017*C) minutes per 1 ppm increase in the concentration of NO_2 after adjusting for other variables. C represents the value of NO_2 concentration. For example, the NO_2 concentration was 0.02 ppm. In this situation, LOS increased by approximately 3.698 minutes with 1 ppm increase of NO_2 concentration after adjusting for other variables. Meanwhile, LOS increased by (4.567 + 0.038*C) minutes per 1 $\mu g/m^3$ increase in the concentration of $PM_{2.5}$

after adjusting for other variables. C represents the value of $PM_{2.5}$ concentration. For example, $PM_{2.5}$ concentration was 10 $\mu g/m^3$. In this situation, LOS increased by approximately 4.947 minutes with 1 $\mu g/m^3$ increase of $PM_{2.5}$ concentration after adjusting for other variables.

There were no significant associations between LOS with O_3 and SO_2.

Table 3.61 Results of multiple linear regression of associations between LOS and exposure to NO_2 among children under 17 ages in Edmonton between 2016 to 2018

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NO_2	**0.092**	**0.030**	**3.110**	**0.002**	**0.034**	**0.150**	***
1.CTAS	8.685	1.459	5.950	0.000	5.823	11.546	
2.CTAS	2.934	0.380	7.730	0.000	2.189	3.678	***
3.CTAS	1.636	0.378	4.330	0.000	0.894	2.377	***
4b.CTAS	0.000	.	.	.	.	.	***
Rate	11.470	5.430	2.110	0.035	0.823	22.117	**
1b.SES	0.000	.	.	.	.	.	
2.SES	0.054	0.271	0.200	0.841	-0.476	0.585	
3.SES	0.251	0.280	0.900	0.370	-0.298	0.800	
4.SES	0.449	0.323	1.390	0.164	-0.184	1.083	
5.SES	0.152	0.318	0.480	0.633	-0.471	0.774	
Constant	20.051	1.489	13.470	0.000	17.131	22.971	***
Mean dependent var			15.302	SD dependent var		4.576	
R-squared			0.051	Number of obs		2546	
F-test			15.044	Prob > F		0.000	
Akaike crit. (AIC)			14856.358	Bayesian crit. (BIC)		14914.781	

*** p<.01, ** p<.05, * p<.1
xi: regress sqrtlos no2 i.ctas rate i.ses

Table 3.62 Results of multiple linear regression of associations between LOS and exposure to O_3 among children under 17 ages in Edmonton between 2016 to 2018

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
1b.O_3	0.000	.	.	.	.	.	
2.O_3	-0.235	0.306	-0.770	0.443	-0.835	0.365	
3.O_3	-0.410	0.230	-1.780	0.075	-0.861	0.042	*
4.O_3	-0.118	0.335	-0.350	0.726	-0.775	0.540	
1b.SES	0.000	.	.	.	.	.	
2.SES	0.250	0.260	0.960	0.336	-0.260	0.761	
3.SES	0.482	0.277	1.740	0.082	-0.062	1.026	*
4.SES	0.635	0.330	1.930	0.054	-0.012	1.282	*
5.SES	0.398	0.326	1.220	0.222	-0.241	1.036	
1.CTAS	8.852	1.457	6.080	0.000	5.995	11.709	

2.CTAS	3.005	0.370	8.130	0.000	2.280	3.730	***
3.CTAS	1.704	0.368	4.630	0.000	0.982	2.426	***
4b.CTAS	0.000	.	.	.	.	.	***
Rate	12.461	5.267	2.370	0.018	2.133	22.788	**
Constant	21.362	1.449	14.740	0.000	18.521	24.203	***

Mean dependent var	15.265	SD dependent var	4.573
R-squared	0.049	Number of obs	2694
F-test	12.697	Prob > F	0.000
Akaike crit. (AIC)	15721.722	Bayesian crit. (BIC)	15792.508

*** p<.01, ** p<.05, * p<.1
xi: regress sqrtlos i.o3 i.ses i.ctas rate

Table 3.63 Results of multiple linear regression of associations between LOS and exposure to $PM_{2.5}$ among children under 17 ages in Edmonton between 2016 to 2018

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
$PM_{2.5}$	**0.138**	**0.033**	**4.140**	**0.000**	**0.072**	**0.203**	***
1b.Age	0.000	.	.	.	.	.	
2.Age	0.409	0.130	3.150	0.002	0.155	0.663	***
3.Age	-0.395	0.176	-2.240	0.025	-0.739	-0.050	**
4.Age	-0.305	0.324	-0.940	0.346	-0.941	0.330	
1b.SES	0.000	.	.	.	.	.	
2.SES	0.186	0.147	1.260	0.207	-0.103	0.475	
3.SES	0.224	0.153	1.460	0.144	-0.076	0.524	
4.SES	0.065	0.181	0.360	0.720	-0.290	0.420	
5.SES	0.225	0.172	1.300	0.192	-0.113	0.563	
1.CTAS	4.848	0.697	6.960	0.000	3.482	6.213	
2.CTAS	2.811	0.215	13.100	0.000	2.391	3.232	***
3.CTAS	1.478	0.211	7.020	0.000	1.066	1.891	***
4b.CTAS	0.000	.	.	.	.	.	***
Rate	9.495	3.117	3.050	0.002	3.385	15.606	***
Constant	16.478	0.735	22.420	0.000	15.038	17.919	***

Mean dependent var	15.232	SD dependent var	4.513
R-squared	0.043	Number of obs	7997
F-test	29.662	Prob > F	0.000
Akaike crit. (AIC)	46472.993	Bayesian crit. (BIC)	46563.821

*** p<.01, ** p<.05, * p<.1
xi: regress sqrtlos pm25 i.age i.ses i.ctas rate

Table 3.64 Results of multiple linear regression of associations between LOS and exposure to SO_2 among children under 17 ages in Edmonton between 2016 to 2018

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SO_2	-0.064	0.781	-0.080	0.934	-1.596	1.468	
0b.Sex	0.000	.	.	.	.	.	

1.Sex	0.143	0.182	0.780	0.433	-0.214	0.500	
1b.SES	0.000	.	.	.	.	.	
2.SES	0.190	0.270	0.700	0.482	-0.339	0.719	
3.SES	0.545	0.272	2.010	0.045	0.012	1.077	**
4.SES	0.641	0.334	1.920	0.055	-0.014	1.296	*
5.SES	0.532	0.315	1.690	0.091	-0.084	1.149	*
1.CTAS	8.695	1.539	5.650	0.000	5.677	11.714	
2.CTAS	2.947	0.382	7.710	0.000	2.198	3.696	***
3.CTAS	1.673	0.381	4.400	0.000	0.927	2.419	***
4b.CTAS	0.000	.	.	.	.	.	***
Rate	14.102	5.409	2.610	0.009	3.496	24.708	***
Constant	20.896	1.545	13.520	0.000	17.867	23.926	***
Mean dependent var	15.282		SD dependent var		4.578		
R-squared	0.046		Number of obs		2579		
F-test	12.271		Prob > F		0.000		
Akaike crit. (AIC)	15065.615		Bayesian crit. (BIC)		15130.022		

*** p<.01, ** p<.05, * p<.1
xi: regress sqrtlos so2 i.sex i.ses i.ctas rate

3.3.3 Measures of model fit

Plots of jackknife residuals are commonly used for the model fit of linear regression[5]. Figure 3.13 shows the plots of the jackknife residuals of the multiple linear regression models for NO_2, O_3, $PM_{2.5}$, and SO_2. For all the plots, the residuals were not completely randomly distributed. The pattern may be caused by the variable CTAS score because residuals were randomly distributed without CTAS score in the models. However, CTAS score was an essential predictor of LOS, so it was included.

Model fit of logistic regression models was assessed using Hosmer–Lemeshow test goodness-of-fit test. Table 3.65 presents the goodness-of-fit test results for multivariable logistic regression models of NO_2, O_3, $PM_{2.5}$, and SO_2. Large p-values indicate that all four models fit reasonably well to the data. Though more robust goodness-of-fit tests are needed.

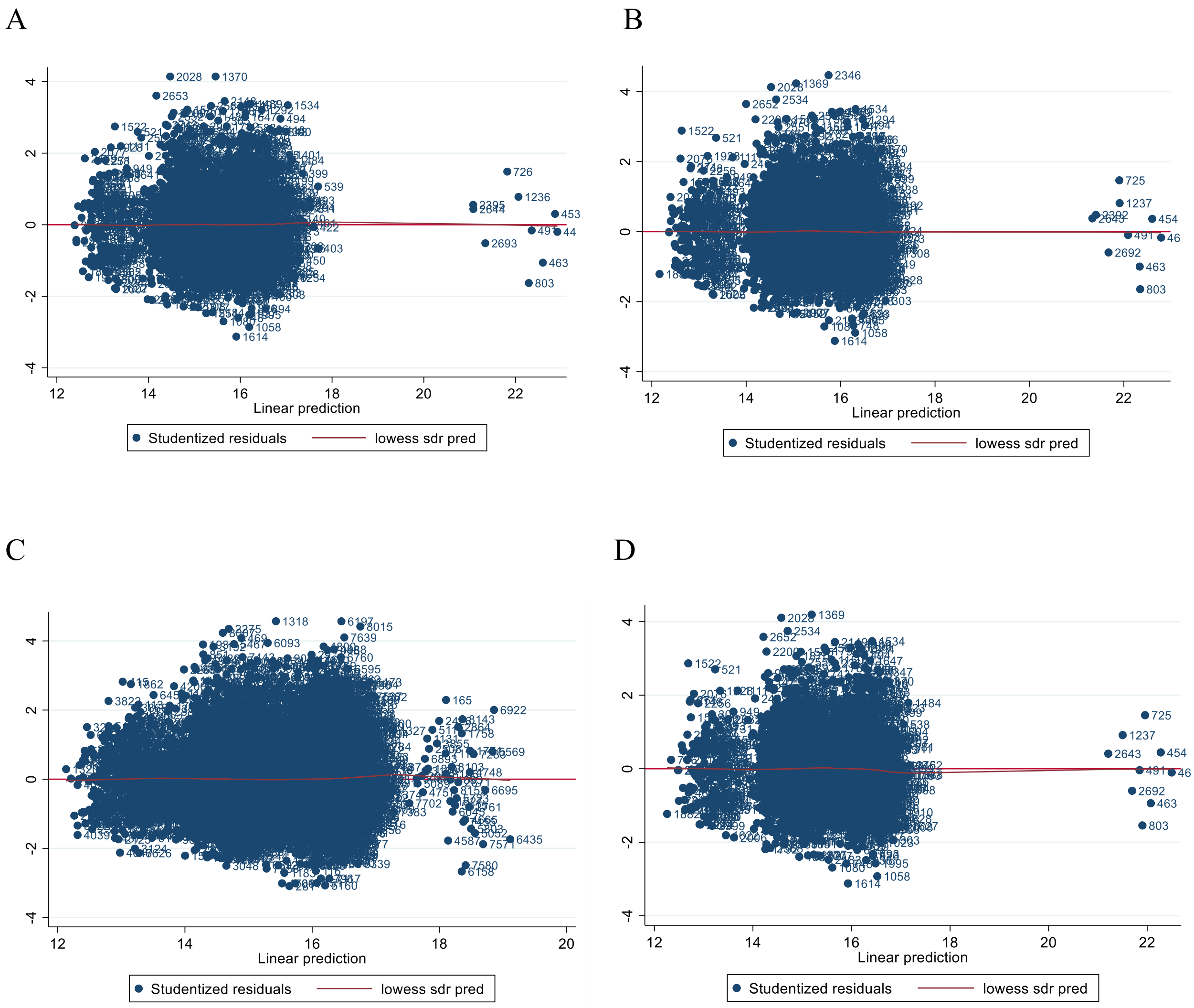


Figure 3.14 Plots of jackknife residuals of multiple linear regression models for (A) NO_2, (B) O_3, (C) $PM_{2.5}$ and (D) SO_2

Table 3.65 Results of Hosmer and Lemeshow's goodness-of-fit test for multivariable logistic regression models

Pollutant	Goodness-of-Fit Test
NO_2	Prob > chi2 = 0.5847
O_3	Prob > chi2 = 0.5922
$PM_{2.5}$	Prob > chi2 = 0.9784
SO_2	Prob > chi2 = 0.5599

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Chapter 4: Discussion

Objectives of this study were to investigate trends in associations between air pollution (CO, NO_2, O_3, $PM_{2.5}$, and SO_2) levels and respiratory (wheeze, asthma, bronchiolitis) ED visits, hospital admissions, and length of stay (LOS) in ED in Edmonton among children under 17 years of age between 2016-2018. The impacts of wildfire-related air pollution on children's respiratory health were also explored.

Strong evidence of positive associations between daily respiratory ED visits among children in Edmonton and exposures to air pollutants including NO_2 and O_3 was found. Clear differences by sex, age, wildfire seasons, and non-wildfire seasons were observed. Male children were found to be more affected by air pollution than female children, and older children (5-16 years old) were more affected than younger children (0-4 years old). Further, the strongest associations between air pollutant exposures and respiratory ED visits were found in the year 2016, out of the three years. Stronger associations were also observed in the wildfire season compared to the non-wildfire season during the study period. Results showed that hospital admissions were not associated with air pollution exposure, and LOS were significantly positively associated with exposure to NO_2 and $PM_{2.5}$.

Inverse relationships between same day lag exposure of O_3 and NO_2 seemed to be common. Four-day lag exposure of O_3 with negative results and NO_2 with positive results appeared concurrently in the time-series three-year models, time-series age-stratified models (0-4 ages), and time-series yearly models (2017). Six-day lag exposure of O_3 with negative results and NO_2 with positive results were observed in time-series yearly model (2016). For NO_2, 4-, 6-, and 8-day lags exposure were most common in time-series models. For O_3, 4-, 5-, and 11-day lags exposure were the most common. Significant results of CO and $PM_{2.5}$ were only found in time-series wildfire season models.

4.1 Associations between daily respiratory ED visits among children and exposure to air pollution (CO, NO_2, O_3, $PM_{2.5}$, and SO_2) among children under 17 years old in Edmonton between 2016 to 2018

In this study, strong evidence of significant positive associations between daily respiratory ED visits among all children and 4-day lag exposure to NO_2 and 5-, 9- and 11-day lags exposure to O_3

was found in three-year models. Also, a significant negative association for 4-day lag exposure to O_3 was found. O_3 is a "secondary pollutant" generated from the key precursor NO_2[1]. The daily mean concentration of NO_2 and O_3 had opposite trends, as shown in figure 2 in the results chapter. Therefore, the possible reason for the negative association of 4-day lag exposure to O_3 may be due to the positive association of 4-day lag exposure to NO_2.

This study also examined the difference between different sex and age groups. Associations between daily respiratory ED visits and ambient air pollutant concentrations were stronger among male children than female children and stronger among older children (5-16 years of age) than younger children (0-4 years of age). This phenomenon may be because male children and older children spend more time outdoors, and have greater exposure to ambient air pollution than female and younger children[2–4].

The findings of this study were in agreement with the results of two previous studies conducted in Edmonton. Both studies observed significant associations between daily respiratory ED visits among children and exposures to NO_2 and O_3[5,6], as found in this study. The first study using time-series regression observed that 2-day lag exposure to NO_2 and 0-day lag exposure to O_3 had positive associations among children younger than 10 years old[5]. Meanwhile, the study found that exposures to air pollution had stronger impacts on male children than female children[5], which also supported findings in our study. The second one was a case-crossover study. The results showed significant associations observed between daily respiratory ED visits among children under 14 and exposure to NO_2 and O_3 using a 5-day average[6]. Exposure to SO_2 did not have a significant association[6], as also found in the current study.

However, there are some differences between findings from our study and these two Edmonton studies. The two Edmonton studies found significant positive associations between ED visits and exposure to CO and $PM_{2.5}$, which our study did not. The significant lags were also inconsistent. Additionally, the case-crossover Edmonton study found stronger associations among younger children (2-4 ages) than older children (5-14 ages), contrary to findings of our study. Possible reasons may be due to the different numbers of lags examined, different study periods, different concentrations of air pollutants, and the busyness of ED. In the time-series Edmonton-based study, the period examined was 1992 to 2002. The data on ambient air pollution were supplied by

Environment Canada, which is also from the NAPS program, as used in our study. The mean of daily mean concentration of CO and NO_2 in this previous Edmonton-based study were 0.7000 and 0.0220 ppm[5], respectively, much higher than results in the current study of 0.2427 and 0.0124 ppm as a result of air quality improvements over time. We only observed significant results for NO_2, unlike results of the prior study, which showed that both CO and NO_2 were significantly associated with daily respiratory ED visits among children in Edmonton. The mean concentration of $PM_{2.5}$ in the previous study was 8.5 $\mu g/m^3$[5], slightly lower than the result in the current study of 8.884 $\mu g/m^3$. Similarly, the mean concentration of SO_2 in previous study was 0.0003 ppm[5], lower than the results in the current study of 0.0006 ppm. $PM_{2.5}$ and SO_2 measured in the earlier study were lower than in this study, but we did not observe significant results, unlike the prior study. For O_3, the previous Edmonton-based study calculated the mean of the daily average concentration (0.0019 ppm)[5]. The current study calculated mean of 8-hour daily maximum concentration (0.0308 ppm).

Besides studies in Edmonton, the observed effects of pollutants (NO_2 and O_3) on children's respiratory ED visits were also consistent with several previous studies conducted in other cities in Canada and other countries. In Windsor, Canada, Lavigne et al. found significant positive associations between daily respiratory ED visits among children (2-14 years of age) and exposures to O_3[7]. Another study conducted in Turin, Italy also found exposure to NO_2 was significantly positively associated with respiratory ED visits among children under 18 ages, and significant negative associations of O_3 were found for the same time lags, as in this study[8]. Two time-series studies in China (Ningbo and Shijiazhuang) reported that exposures to NO_2 were associated with increased daily ED visits for respiratory reasons among children, which were stronger among older children (5-14 years of age) than younger children (0-4 years of age)[2,4], supporting findings from the current study. Moreover, the results of a multi-city study in the United States (Atlanta, Dallas, and St. Louis) showed significant positive associations between daily respiratory ED visits among children and pollutant concentrations with the strongest associations observed for NO_2 and O_3, similar to this study[3]. Associations in this study were also found to be generally stronger among male children than female children. A study conducted in Adelaide, Australia also found significant associations between daily respiratory ED visits among children and exposure to NO_2, as well as stronger associations among male children than female children[9].

4.2 Impacts of wildfires on daily respiratory ED visits among children under 17 years old in Edmonton between 2016 to 2018

To our best knowledge, this is the first study that estimated the impacts of wildfire-related air pollution on daily respiratory ED visits among children in Alberta. Wildfire smoke was the largest contributor to $PM_{2.5}$, according to the 2015 Alberta Air Zones Report[10]. Elevated $PM_{2.5}$, CO, NO_2, and O_3 levels are usually observed when wildfires occur, as they are by-products of combustion[10,11]. Six-day lag exposures to $PM_{2.5}$ were also positively associated with daily respiratory ED visits among children. More significant results were found with different air pollutants during wildfire seasons compared to non-wildfire seasons. Also, the magnitude of the associations was larger in wildfire seasons (IRR of 1.08 and 1.147 for NO_2 and IRR of 1.12 for O_3), compared to the non-wildfire season (IRR of 1.073 for NO_2 and IRR of 1.101 for O_3). Therefore, children's respiratory health appeared to be more affected by air pollution during the wildfire seasons than during the non-wildfire seasons.

To further explore the finding that impacts on children's respiratory health in the wildfire season were caused by wildfires-related air pollution, we examined the associations between daily respiratory ED visits among children and exposure to air pollution levels each year. The strongest associations were in 2016 among the three years. The total number of wildfires in Alberta was the greatest in 2016, out of the three years. In 2016, there were 1376 wildfires, more than 2017 (1244) and 2018 (1288)[12]. Moreover, in 2016, the most devastating wildfire in Alberta history, the Fort McMurray wildfire, occurred[13]. Thus, the greatest number of wildfires and the strongest wildfire-related pollution levels observed in 2016, correlated with the strongest associations (measured in time-series yearly models). Additionally, CO, NO_2, O_3, and $PM_{2.5}$ all had significant results in time-series wildfire season models, but only NO_2 and O_3 had significant results in time-series three-year models. Effects are likely diluted in three-year models. Meanwhile, both CO and $PM_{2.5}$ showed peaks during the 2018 wildfire season, as shown in figure 3.2. These two aspects can also be evidence of health impacts of wildfire-related air pollution. However, the air pollutants concentrations of each year were not consistent with the association levels from time-series yearly models. The explanation could be the effect of mixtures or interactions not tested in this study. The Air Quality Health Index (AQHI) in Edmonton was also examined in this study. However, the number of days with higher AQHI ($\geqslant$7) in 2016, 2017, and 2018 were 8, 12, and 15[14], which was not consistent with evidence from this study. A possible reason could be that the AQHI is based on mortality data in the general population.

In conclusion, stronger associations were observed in the wildfire seasons compared to the non-wildfire seasons during the study period. Also, there was consistency between the strongest associations, the greatest number of wildfire activities, and the strongest wildfire-related pollution levels in 2016. These two aspects together could indicate that wildfires, in addition to baseline air pollution, indeed had impacts on children's respiratory health. Wildfire smoke can be inhaled into bronchioles and alveoli, where it causes local irritation, inflammation and damage, resulting in respiratory problems in humans[15]. Children's respiratory and lung functions are not fully developed, so they are more susceptible to the effects of wildfires pollution and suffer from respiratory diseases[16].

This study finding agrees with previous studies. A study conducted in Vancouver, Canada, found a significant increase in respiratory emergency department visits and asthma hospitalizations within the first 3 days of exposure to wildfire smoke, particularly in children younger than 5 years old[17]. Three other studies conducted in the United States (San Diego, Washington, and Albuquerque) demonstrated an increase in pediatric respiratory visits during wildfires[18]. In Valencia, Spain, Vicedo-Cabrera et al. also found that exposure to wildfire smoke was associated with increased respiratory symptoms in children, particularly those susceptible individuals with asthma or rhinitis[19]. Another study conducted in Sydney, Australia, concluded that wildfire events were associated with an immediate increase in presentations for respiratory conditions, especially children under 15 years of age[20]. Compared with studies listed above, one strength of this study was its comparison with non-wildfire periods in the same population.

4.3 Associations between air pollution exposure and hospital admissions and LOS due to respiratory diseases for in Edmonton among children under 17 years old between 2016 to 2018

The findings in this study suggested that air pollution exposures were not significantly associated with hospital admissions for respiratory reasons among children were consistent with previous studies both in Canada and other countries. A study conducted in Windsor and Hamilton, Canada, found that hospital admissions due to respiratory symptoms among children were not significantly associated with exposure to O_3[21]. Another study in Ottawa, Canada, found that hospitalizations due to respiratory diseases among children were not significantly associated with exposure to $PM_{2.5}$ over the whole year period[22]. Tramuto et al. found that in another Italian city, Palermo, there was no significant association between pediatric hospital admissions for respiratory reasons and exposure to NO_2 and SO_2 using the same statistical methods as in this study[23]. A study conducted in Sao Paulo, Brazil, also indicates that respiratory hospital admissions among children were not associated with SO_2 concentrations[24]. However, there are other studies that found significant associations between hospital admissions for respiratory reasons among children and exposure to NO_2, O_3, $PM_{2.5}$, and SO_2[9,25–28]. Two possible reasons could explain the different results. First, study designs being used were different. Ecological study design was used in this study, different from crossover study design in other studies. Second, the covariates and confounders in this study were limited by the availability of data.

LOS in this study was found to be positively associated with NO_2 and $PM_{2.5}$ concentrations among children. However, few previous studies have examined the associations between air pollution and LOS. LOS could be affected by many other factors and its utility in indicating the severity of conditions is likely limited. For example, very sickest patients are often transferred to the ICU immediately, so their LOS are short, contrary to longer LOS, which may represent other varying degrees of severity. Meanwhile, the results of this multiple linear regression were less robust due to the patterns in residual plots.

4.4 Limitations

There are some limitations to this study. First, ICD-10 diagnosis codes were used to represent diagnoses in this study, so respiratory disease misclassification could occur due to code errors (Existing studies report that, across most states, the prevalence of misclassification ranges from 11% to 30% depending on the method used[29]). Second, seasonality and long-term trends were not completely controlled for using periodic functions (Fourier terms) in sex-stratified female models, wildfire season models, non-wildfire seasons models, and yearly models, which may have led to confounded results. Third, the choice of model constraints may be imprecise as they were determined by scatter plots. Also, land-use regression data for CO was not available, preventing the examination of the association of hospital admissions and LOS with exposure to CO. Meanwhile, land-use regression data was only available until 2015 for NO_2, so only 2016 ED visit data were used in analysis, possibly leading to less accurate results. What is more, the residuals of multiple linear regression still have some patterns, so the results were not completely robust. Additionally, unknown comorbidities could be a missing confounder in multivariate logistic regression. Also, indoor air pollution is an essential consideration for children's respiratory health, but data for this exposure was not available. Furthermore, hospital visits used in this study could also represent the same child on multiple occasions. Besides, many other air pollutants which may also impact children's respiratory health were not measured in this study. Finally, measures of exposure in this study were based on the average in the population, so it should be interpreted carefully as a grouped result, rather than individual-level results.

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Conclusions

This study suggests that exposures to air pollutants, most notably NO_2 and O_3, may contribute to the increase of daily respiratory ED visits among children under 17 years old in Edmonton from 2016 to 2018. Also, the results indicate that male children were more affected by air pollution than female children, and older children (5-16 years old) were more affected by air pollution than younger children (0-4 years old). Moreover, evidence of the impacts of wildfires on children's respiratory health in Edmonton was found. Significant positive associations between LOS and exposure to NO_2 and $PM_{2.5}$ were observed, but there was no significant association between exposure to air pollution and hospital admissions for respiratory conditions among children. Results of time-series three-year models, sex-stratified male models, and age-stratified models (both 0-4 ages and 5-16 ages) are robust because residuals of these models appear completely randomly distributed. Results of multivariable logistic regression also appear robust due the insignificant p-value associated with the goodness-of-fit test.

Further studies are needed to investigate the associations in various areas and populations, taking into consideration the spatial and temporal variability of air pollution. To protect children's health in Edmonton and in Canada, it is recommended that further health risk assessments be conducted to reduce children's exposure to air pollution. Meanwhile, further studies are needed to address knowledge gaps regarding the health impacts of wildfires. More accurate and direct methods to measure wildfire-related air pollution exposure should be explored. The causes of increasing wildfires, such as climate change, should also be further studied. In summary, preventive measures should be explored to reduce wildfire hazards and maintain population health, especially susceptible groups like children.

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Appendices

Appendix 1: Results of lag selection of time-series regression

Table A1. Results of lag selection of the time-series three-year model for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-183.986				.082445	.34225	.343996	.346862
1	96.2419	560.46	1	0.000	.049182	-.174361	-.170868	-.165137
2	98.1801	3.8764	1	0.049	.049096	-.176096	-.170858	-.16226
3	115.348	34.336	1	0.000	.047649	-.20601	-.199025	-.187561
4	121.578	12.459	1	0.000	.047191	-.215685	-.206954	-.192625
5	127.173	11.189	1	0.001	.046791	-.224186	-.213708	-.196514
6	135.693	17.041	1	0.000	.046145	-.2381	-.225876	-.205815
7	144.753	18.121	1	0.000	.045462	-.253013	-.239042	-.216116*
8	**147.137**	**4.7664***	**1**	**0.029**	**.045345***	**-.255572***	**-.239855***	**-.214063**
9	147.879	1.4854	1	0.223	.045367	-.255096	-.237633	-.208975
10	147.893	.02832	1	0.866	.04545	-.253272	-.234063	-.202539
11	147.906	.02623	1	0.871	.045533	-.251446	-.230491	-.196101
12	148.72	1.6275	1	0.202	.045549	-.251101	-.2284	-.191144
13	149.201	.9623	1	0.327	.045592	-.250141	-.225694	-.185572
14	149.241	.07953	1	0.778	.045673	-.248365	-.222171	-.179184
15	149.609	.73526	1	0.391	.045727	-.247195	-.219255	-.173402

Table A2. Results of lag selection of the time-series three-year model for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-928.224				.326709	1.71919	1.72094	1.7238
1	-566.321	723.81	1	0.000	.167562	1.05147	1.05497	1.0607
2	-564.809	3.0242	1	0.082	.167403	1.05053	1.05576	1.06436
3	-540.493	48.633	1	0.000	.160335	1.00739	1.01437	1.02584
4	-529.715	21.556	1	0.000	.15746	.989296	.998027	1.01236
5	-514.727	29.975	1	0.000	.153438	.963417	.973894	.991089

6	-479.205	71.043	1	0.000	.143944	.899547	.911771	.931832
7	-465.859	26.693	1	0.000	.140693	.876705	.890675	.913601
8	-460.777	10.163	1	0.001	.139635	.869153	.88487	.910662*
9	-460.697	.16151	1	0.688	.139873	.870854	.888317	.916975
10	-460.663	.06619	1	0.797	.140123	.872643	.891852	.923376
11	-460.147	1.0329	1	0.309	.140249	.873537	.894493	.928882
12	-458.116	4.0613	1	0.044	.139981	.871631	.894332	.931587
13	-450.487	15.259	1	0.000	.138275	.859365	.883813	.923934
14	**-447.712**	**5.5506***	**1**	**0.018**	**.137822***	**.856081***	**.882275***	**.925262**
15	-447.704	.01514	1	0.902	.138075	.857917	.885857	.93171

Table A3. Results of lag selection of the time-series three-year model for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-658.829				.198473	1.22077	1.22252	1.22539
1	-245.96	825.74	1	0.000	.092632	.45876	.462253	.467985
2	-238.378	15.164	1	0.000	.091511	.446583	.451822	.460419
3	-224.422	27.912	1	0.000	.089344	.422612	.429597	.44106
4	-220.698	7.4474	1	0.006	.088895	.417573	.426304	.440633
5	-215.656	10.085	1	0.001	.088232	.410094	.420571	.437766
6	-204.027	23.257	1	0.000	.086514	.390429	.402653	.422714
7	-198.829	10.396	1	0.001	.085845	.382663	.396633	.419559
8	-194.12	9.4189	1	0.002	.085258	.3758	.391516	.417308*
9	-191.991	4.2569	1	0.039	.08508	.373712	.391175	.419833
10	-189.564	4.8548	1	0.028	.084856	.371071	.39028	.421804
11	**-185.577**	**7.9747***	**1**	**0.005**	**.084388***	**.365544***	**.386499***	**.420889**
12	-184.743	1.668	1	0.197	.084414	.365851	.388553	.425808
13	-184.278	.92982	1	0.335	.084497	.366841	.391289	.43141
14	-183.358	1.8402	1	0.175	.08451	.366989	.393183	.43617
15	-183.191	.33246	1	0.564	.08464	.368532	.396472	.442325

Table A4. Results of lag selection of the time-series three-year model for $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1053.3				.411778	1.95061	1.95235	1.95522
1	-791.452	523.7	1	0.000	.254137	1.468	1.47149	1.47722
2	-791.406	.0912	1	0.763	.254586	1.46976	1.475	1.4836
3	-781.664	19.484	1	0.000	.250502	1.45359	1.46057	1.47204
4	-780.348	2.6312	1	0.105	.250355	1.453	1.46173	1.47606
5	-777.667	5.3634	1	0.021	.249578	1.44989	1.46037	1.47756
6	-770.127	15.079	1	0.000	.246576	1.43779	1.45002	1.47008
7	**-765.083**	**10.089***	**1**	**0.001**	**.244738***	**1.43031***	**1.44428***	**1.46721***
8	-764.506	1.1535	1	0.283	.24493	1.43109	1.44681	1.4726
9	-764.496	.01992	1	0.888	.245379	1.43292	1.45039	1.47905
10	-764.437	.11686	1	0.732	.245807	1.43467	1.45388	1.4854
11	-764.302	.27101	1	0.603	.2462	1.43627	1.45722	1.49161
12	-764.262	.07917	1	0.778	.246638	1.43804	1.46074	1.498
13	-764.154	.21613	1	0.642	.247046	1.43969	1.46414	1.50426
14	-764.003	.30254	1	0.582	.247434	1.44126	1.46746	1.51044
15	-763.936	.13436	1	0.714	.247861	1.44299	1.47093	1.51678

Table A5. Results of lag selection of the time-series three-year model for SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-778.324				1.17295	2.9974	3.0006	3.00558
1	-770.407	15.833	1	0.000	1.14216	2.9708	2.97721*	2.98716*
2	-770.247	.3195	1	0.572	1.14586	2.97403	2.98364	2.99857
3	-769.336	1.8229	1	0.177	1.14625	2.97437	2.98719	3.00709
4	-769.312	.0478	1	0.827	1.15056	2.97812	2.99415	3.01903
5	-766.103	6.4186	1	0.011	1.14082	2.96963	2.98885	3.01871
6	-766.103	.00053	1	0.982	1.14522	2.97347	2.9959	3.03073
7	-765.613	.97838	1	0.323	1.14747	2.97544	3.00107	3.04088
8	-764.371	2.484	1	0.115	1.14641	2.97451	3.00335	3.04813
9	**-758.152**	**12.439***	**1**	**0.000**	**1.12362***	**2.95443***	**2.98648**	**3.03623**
10	-758.107	.08972	1	0.765	1.12776	2.9581	2.99335	3.04809

11	-757.891	.43135	1	0.511	1.13117	2.96112	2.99958	3.05929
12	-757.809	.16489	1	0.685	1.13517	2.96465	3.00631	3.071
13	-757.468	.68235	1	0.409	1.13805	2.96718	3.01205	3.08171
14	-757.098	.73884	1	0.390	1.14082	2.96961	3.01768	3.09232
15	-756.779	.63837	1	0.424	1.14382	2.97223	3.0235	3.10311

Table A6. Results of lag selection of the time-series three-year model for temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-4157.93				128.601	7.69459	7.69634	7.69921
1	-2857.29	2601.3	1	0.000	11.6139	5.29008	5.29357	5.2993
2	-2848.51	17.555	1	0.000	11.4479	5.27569	5.28093	5.28952
3	-2817.34	62.336	1	0.000	10.8265	5.21987	5.22686	5.23832*
4	-2817.33	.02019	1	0.887	10.8463	5.2217	5.23043	5.24476
5	-2815.48	3.7046	1	0.054	10.8292	5.22013	5.2306	5.2478
6	-2814.99	.96814	1	0.325	10.8396	5.22108	5.2333	5.25337
7	-2814.66	.66723	1	0.414	10.8529	5.22231	5.23628	5.25921
8	-2806	17.322	1	0.000	10.7002	5.20814	5.22386	5.24965
9	-2804.94	2.1102	1	0.146	10.6991	5.20804	5.2255	5.25416
10	**-2802.07**	**5.7522**	**1**	**0.016**	**10.662***	**5.20457***	**5.22378***	**5.2553**
11	-2801.95	.24342	1	0.622	10.6794	5.20619	5.22715	5.26154
12	-2801.91	.07952	1	0.778	10.6984	5.20797	5.23067	5.26793
13	-2801.37	1.0815	1	0.298	10.7075	5.20882	5.23327	5.27339
14	-2799.28	4.1772*	1	0.041	10.6859	5.2068	5.233	5.27599
15	-2797.47	3.611	1	0.057	10.67	5.20531	5.23325	5.27911

Table A7. Results of lag selection of the time-series three-year model for humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-4390.63				197.798	8.12512	8.12687	8.12973
1	-3943.45	894.35	1	0.000	86.6398	7.29964	7.30313	7.30886*
2	-3943.32	.25698	1	0.612	86.7796	7.30125	7.30649	7.31508

3	-3939.1	8.4406	1	0.004	86.2641	7.29529	7.30228*	7.31374
4	-3938.38	1.4466	1	0.229	86.3083	7.2958	7.30453	7.31886
5	-3937.75	1.2708	1	0.260	86.3665	7.29648	7.30695	7.32415
6	-3936.74	2.0047	1	0.157	86.3661	7.29647	7.3087	7.32876
7	-3936.52	.456	1	0.499	86.4896	7.2979	7.31187	7.3348
8	-3935.31	2.4029	1	0.121	86.4574	7.29753	7.31324	7.33904
9	-3933.55	3.5342	1	0.060	86.3348	7.29611	7.31357	7.34223
10	-3932.81	1.4644	1	0.226	86.3776	7.2966	7.31581	7.34734
11	-3932.8	.02419	1	0.876	86.5356	7.29843	7.31939	7.35378
12	-3932.24	1.1242	1	0.289	86.6058	7.29924	7.32194	7.3592
13	**-3929.1**	**6.2777***	**1**	**0.012**	**86.2638***	**7.29529***	**7.31973**	**7.35985**
14	-3928.97	.25352	1	0.615	86.4033	7.2969	7.32309	7.36608
15	-3928.97	.00096	1	0.975	86.5632	7.29875	7.32669	7.37254

Table A8. Results of lag selection of the time-series three-year model for flu

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-65.668				.441476	2.02024	2.03335	2.05342
1	**-62.6257**	**6.0846**	**1**	**0.014**	**.414989***	**1.95836***	**1.98458***	**2.02471***
2	-62.4125	.42652	1	0.514	.425021	1.9822	2.02153	2.08173
3	-61.4773	1.8703	1	0.171	.425893	1.98416	2.0366	2.11687
4	-61.2623	.43004	1	0.512	.436207	2.00795	2.0735	2.17383
5	-60.472	1.5806	1	0.209	.439082	2.0143	2.09296	2.21336
6	-60.4344	.07528	1	0.784	.452209	2.04347	2.13523	2.2757
7	-60.4343	.00016	1	0.990	.466306	2.07377	2.17864	2.33918
8	-60.4236	.02148	1	0.883	.480743	2.10374	2.22173	2.40233
9	-59.594	1.6592	1	0.198	.483542	2.10891	2.24	2.44067
10	-59.3314	.52509	1	0.469	.494859	2.13125	2.27546	2.4962
11	-59.0613	.54024	1	0.462	.506406	2.15337	2.31069	2.55149
12	-58.6546	.81336	1	0.367	.516175	2.17135	2.34178	2.60265
13	-56.9897	3.3298	1	0.068	.506549	2.1512	2.33474	2.61568
14	-56.9886	.00212	1	0.963	.522921	2.18147	2.37812	2.67912

15	-54.5133	4.9508*	1	0.026	.500943	2.13677	2.34652	2.66759

Table A9. Results of lag selection of time-series wildfire model for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-97.3045		.086485	.390097	.393384	.398475		
1	77.0131	348.64	1	0.000	.043476	-.297671	-.291098	-.280915
2	79.6936	5.3609	1	0.021	.043187	-.30434	-.29448	-.279205
3	86.6412	13.895	1	0.000	.04218	-.327941	-.314795	-.294429
4	89.155	5.0277	1	0.025	.041927	-.333949	-.317516	-.292058
5	95.7562	13.202	1	0.000	.041005	-.356175	-.336457	-.305907
6	102.626	13.739	1	0.000	.040061	-.379467	-.356462	-.32082
7	106.471	7.6916	1	0.006	.039612	-.39076	-.364468*	-.323735*
8	106.776	.60962	1	0.435	.039721	-.388001	-.358423	-.312598
9	**109.898**	**6.2432***	**1**	**0.012**	**.039388***	**-.39642***	**-.363556**	**-.312639**
10	110.053	.30987	1	0.578	.03952	-.393067	-.356916	-.300907
11	110.102	.09913	1	0.753	.03967	-.389295	-.349858	-.288757
12	110.104	.00268	1	0.959	.039827	-.385332	-.342608	-.276416
13	110.11	.01355	1	0.907	.039985	-.381391	-.33538	-.264097
14	110.307	.39407	1	0.530	.040113	-.378204	-.328908	-.252532
15	110.395	.17541	1	0.675	.040258	-.374584	-.322001	-.240534

Table A10. Results of lag selection of time-series wildfire model for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-250.644		.15893	.998588	1.00187	1.00697		
1	-191.465	118.36	1	0.000	.126166	.767719	.774292	.784476
2	-188.895	5.1404	1	0.023	.125382	.761489	.771348	.786623
3	-188.806	.17921	1	0.672	.125836	.765101	.778247	.798614
4	-188.8	.01162	1	0.914	.126334	.769046	.785479	.810937
5	-187.585	2.4294	1	0.119	.126226	.768194	.787913	.818463
6	-176.493	22.183	1	0.000	.121271	.728149	.751154	.786795
7	-170.899	11.19	1	0.001	.11908	.709915	.736206*	.77694*

8	-170.594	.60864	1	0.435	.119409	.712676	.742254	.788079
9	-168.717	3.7542	1	0.053	.118995	.709195	.74206	.792976
10	-168.027	1.3797	1	0.240	.119141	.710426	.746577	.802585
11	-167.443	1.1688	1	0.280	.119338	.712075	.751512	.812612
12	-167.281	.32281	1	0.570	.119736	.715403	.758126	.824318
13	**-162.976**	**8.6109***	**1**	**0.003**	**.118176***	**.702286***	**.748296**	**.81958**
14	-162.289	1.3741	1	0.241	.118324	.703528	.752824	.8292
15	-162.101	.37666	1	0.539	.118706	.706749	.759332	.840799

Table A11. Results of lag selection of time-series wildfire model for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-185.324		.122641	.739381	.742668	.747759		
1	-33.9612	302.73	1	0.000	.067531	.142703	.149276	.159459*
2	-33.8853	.15176	1	0.697	.067779	.14637	.15623	.171505
3	-27.9456	11.88	1	0.001	.066463	.126768	.139914	.160281
4	-27.2746	1.342	1	0.247	.06655	.128074	.144506	.169964
5	-26.6665	1.2162	1	0.270	.066654	.129629	.149347	.179898
6	-24.1436	5.0458	1	0.025	.066252	.123586	.146591	.182232
7	-22.0462	4.1947	1	0.041	.065964	.119231	.145523	.186256
8	-21.9595	.1734	1	0.677	.066204	.122855	.152433	.198258
9	-20.5626	2.7938	1	0.095	.0661	.12128	.154145	.205062
10	-18.6076	3.91	1	0.048	.06585	.117491	.153642	.20965
11	**-7.00722**	**23.201***	**1**	**0.000**	**.063137***	**.075425***	**.114863***	**.175963**
12	-6.98258	.04929	1	0.824	.063382	.079296	.12202	.188212
13	-6.65363	.6579	1	0.417	.063552	.081959	.127969	.199253
14	-6.62761	.05203	1	0.820	.063798	.085824	.135121	.211496
15	-6.62472	.00578	1	0.939	.064051	.089781	.142364	.223831

Table A12. Results of lag selection of time-series wildfire model for $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC

0	-533.199		.487708	2.11984	2.12313	2.12822		
1	-379.787	306.82	1	0.000	.266375	1.51503	1.5216	1.53178
2	-379.252	1.0691	1	0.301	.266868	1.51687	1.52673	1.54201
3	-375.819	6.8678	1	0.009	.264303	1.50722	1.52036	1.54073
4	-375.287	1.0627	1	0.303	.264795	1.50908	1.52551	1.55097
5	-371.245	8.0841	1	0.004	.261618	1.497	1.51672	1.54727
6	-364.505	13.481	1	0.000	.255726	1.47423	1.49723	1.53287
7	**-359.968**	**9.0746**	**1**	**0.003**	**.252162***	**1.46019***	**1.48648***	**1.52721***
8	-359.936	.06296	1	0.802	.253133	1.46403	1.49361	1.53944
9	-359.887	.09835	1	0.754	.25409	1.46781	1.50067	1.55159
10	-359.335	1.1048	1	0.293	.254542	1.46958	1.50573	1.56174
11	-359.222	.22451	1	0.636	.255441	1.4731	1.51254	1.57364
12	-357.138	4.1677*	1	0.041	.254345	1.4688	1.51153	1.57772
13	-356.894	.48874	1	0.484	.25511	1.4718	1.51781	1.5891
14	-356.795	.1982	1	0.656	.256024	1.47538	1.52467	1.60105
15	-356.691	.20768	1	0.649	.256937	1.47893	1.53152	1.61298

Table A13. Results of lag selection of time-series wildfire model for SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	**-303.036**		**1.36718***	**3.15063***	**3.15747***	**3.16753***		
1	-302.082	1.9064	1	0.167	1.36785	3.15111	3.16481	3.18492
2	-302.076	.01321	1	0.908	1.382	3.16141	3.18195	3.21212
3	-301.005	2.1422	1	0.143	1.38099	3.16067	3.18805	3.22829
4	-300.204	1.6018	1	0.206	1.38385	3.16273	3.19696	3.24726
5	-299.071	2.2652	1	0.132	1.38196	3.16136	3.20244	3.26279
6	-297.715	2.7115	1	0.100	1.37689	3.15767	3.2056	3.27601
7	-297.614	.20235	1	0.653	1.3898	3.16699	3.22176	3.30223
8	-297.585	.05871	1	0.809	1.40388	3.17705	3.23866	3.32919
9	-296.839	1.4916	1	0.222	1.40761	3.17968	3.24814	3.34873
10	-296.245	1.1891	1	0.276	1.41358	3.18388	3.25919	3.36984
11	-296.245	4.4e-06	1	0.998	1.42836	3.19424	3.2764	3.39711

12	-296.065	.35861	1	0.549	1.44062	3.20275	3.29175	3.42252
13	-295.959	.21316	1	0.644	1.4541	3.21201	3.30785	3.44868
14	-295.944	.02857	1	0.866	1.46911	3.22222	3.32491	3.4758
15	-295.941	.00634	1	0.937	1.48447	3.23255	3.34209	3.50303

Table A14. Results of lag selection of time-series wildfire model for temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1542.85		26.8034	6.1264	6.12969	6.13478		
1	-1188.92	707.86	1	0.000	6.60624	4.72589	4.73246	4.74265
2	-1175.82	26.215	1	0.000	6.29635	4.67785	4.68771	4.70298
3	-1160.23	31.167	1	0.000	5.94231	4.61998	4.63312*	4.65349*
4	-1159.76	.94069	1	0.332	5.95482	4.62208	4.63851	4.66397
5	-1158.33	2.8765	1	0.090	5.94447	4.62034	4.64006	4.67061
6	**-1156.01**	**4.6375***	**1**	**0.031**	**5.91345***	**4.6151***	**4.63811**	**4.67375**
7	-1155.36	1.2916	1	0.256	5.92177	4.61651	4.6428	4.68354
8	-1155.26	.20891	1	0.648	5.94286	4.62006	4.64964	4.69547
9	-1153.36	3.7874	1	0.052	5.92183	4.61652	4.64938	4.7003
10	-1152.85	1.0171	1	0.313	5.9334	4.61847	4.65462	4.71063
11	-1152.8	.11433	1	0.735	5.95565	4.62221	4.66165	4.72275
12	-1152.71	.17051	1	0.680	5.97733	4.62584	4.66856	4.73475
13	-1152.34	.74644	1	0.388	5.99223	4.62833	4.67434	4.74562
14	-1151.77	1.1323	1	0.287	6.00257	4.63005	4.67934	4.75572
15	-1151.74	.07007	1	0.791	6.02563	4.63388	4.68646	4.76793

Table A15. Results of lag selection of time-series wildfire model for humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-2081.97		227.669	8.26577	8.26906	8.27415		
1	**-1881.73**	**400.48**	**1**	**0.000**	**103.261***	**7.47514***	**7.48171***	**7.49189***
2	-1881.72	.02417	1	0.876	103.666	7.47906	7.48891	7.50419
3	-1880.36	2.7323	1	0.098	103.516	7.4776	7.49075	7.51111
4	-1880.3	.10252	1	0.749	103.906	7.48137	7.4978	7.52326

5	-1879.53	1.552	1	0.213	103.999	7.48226	7.50197	7.53252
6	-1879.51	.04019	1	0.841	104.404	7.48614	7.50915	7.54479
7	-1878.99	1.0442	1	0.307	104.602	7.48804	7.51433	7.55507
8	-1878.32	1.3313	1	0.249	104.741	7.48937	7.51895	7.56477
9	-1875.94	4.7673*	1	0.029	104.168	7.48388	7.51674	7.56766
10	-1875.73	.40837	1	0.523	104.498	7.48704	7.52319	7.57919
11	-1874.84	1.7818	1	0.182	104.543	7.48747	7.52691	7.58801
12	-1874.26	1.1606	1	0.281	104.718	7.48913	7.53186	7.59805
13	-1872.93	2.6684	1	0.102	104.579	7.48781	7.53382	7.6051
14	-1872.37	1.1127	1	0.291	104.764	7.48957	7.53886	7.61524
15	-1872.1	.53493	1	0.465	105.069	7.49247	7.54506	7.62652

Table A16. Results of lag selection of time-series non-wildfire model for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-13.4943		.062141	.059525	.062903	.068125		
1	37.073	101.13	1	0.000	.050696	-.144037	-.13728*	-.126837*
2	37.4438	.74158	1	0.389	.050827	-.141453	-.131318	-.115653
3	**39.6166**	**4.3455***	**1**	**0.037**	**.050583***	**-.146269***	**-.132755**	**-.111869**
4	40.1318	1.0305	1	0.310	.050683	-.144279	-.127386	-.101278
5	40.161	.05823	1	0.809	.050886	-.140291	-.120021	-.088691
6	40.3748	.42765	1	0.513	.051051	-.137063	-.113414	-.076862
7	41.7413	2.7331	1	0.098	.050974	-.138568	-.11154	-.069767
8	42.6726	1.8626	1	0.172	.050988	-.138286	-.10788	-.060885
9	43.0765	.80771	1	0.369	.051113	-.135838	-.102053	-.049836
10	43.3093	.46553	1	0.495	.051275	-.132687	-.095524	-.038085
11	43.5133	.40802	1	0.523	.051443	-.129418	-.088876	-.026216
12	43.6821	.33763	1	0.561	.051619	-.126004	-.082084	-.014203
13	43.6833	.00249	1	0.960	.051831	-.121903	-.074604	-.001501
14	43.835	.3034	1	0.582	.052012	-.118419	-.067742	.010583
15	44.081	.49192	1	0.483	.052174	-.115322	-.061267	.02228

Table A17. Results of lag selection of time-series non-wildfire model for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-286.585		.190743	1.18105	1.18443	1.18965		
1	-228.129	116.91	1	0.000	.150651	.945087	.951844	.962287*
2	-226.787	2.6827	1	0.101	.15044	.943685	.95382	.969485
3	-223.229	7.1176	1	0.008	.148867	.933177	.94669	.967577
4	-222.649	1.16	1	0.281	.149124	.934902	.951794	.977902
5	-221.162	2.9723	1	0.085	.148827	.932905	.953176	.984506
6	-217.308	7.709	1	0.005	.147093	.921182	.944832*	.981383
7	-215.824	2.9672	1	0.085	.146801	.919196	.946224	.987997
8	-214.25	3.1484	1	0.076	.146455	.916838	.947244	.994239
9	-213.794	.91143	1	0.340	.146783	.919073	.952858	1.00507
10	**-210.774**	**6.0409***	**1**	**0.014**	**.145571***	**.910776***	**.947939**	**1.00538**
11	-210.774	.00074	1	0.978	.14617	.914881	.955423	1.01808
12	-210.57	.40616	1	0.524	.146649	.918154	.962074	1.02996
13	-209.651	1.8393	1	0.175	.146698	.918484	.965782	1.03889
14	-209.13	1.0415	1	0.307	.146988	.920452	.971129	1.04945
15	-209.005	.24947	1	0.617	.147518	.924047	.978102	1.06165

Table A18. Results of lag selection of time-series non-wildfire model for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-304.197		.20505	1.25337	1.25675	1.26197		
1	-177.53	253.33	1	0.000	.122385	.73729	.744047	.75449*
2	-174.774	5.5122	1	0.019	.121505	.730078	.740213	.755878
3	-171.734	6.0802	1	0.014	.120491	.7217	.735214	.7561
4	-171.076	1.3152	1	0.251	.120661	.723106	.739998	.766107
5	-168.842	4.4677	1	0.035	.120051	.718039	.73831	.76964
6	-163.281	11.124	1	0.001	.117823	.699304	.722953	.759505
7	-161.881	2.7983	1	0.094	.11763	.697665	.724693	.766466
8	**-158.721**	**6.3211***	**1**	**0.012**	**.116591***	**.688792***	**.719198***	**.766193**
9	-158.372	.6982	1	0.403	.116904	.691465	.72525	.777467

10	-157.881	.98072	1	0.322	.117149	.693558	.730721	.78816
11	-157.879	.00493	1	0.944	.11763	.697655	.738196	.800856
12	-157.447	.86293	1	0.353	.117905	.69999	.74391	.811791
13	-157.035	.82421	1	0.364	.118191	.702404	.749702	.822806
14	-156.449	1.1736	1	0.279	.118392	.704101	.754778	.833103
15	-156.139	.61908	1	0.431	.118728	.706937	.760992	.844539

Table A19. Results of lag selection of time-series non-wildfire model for $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-428.686		.341895	1.76463	1.768	1.77323		
1	-344.016	169.34	1	0.000	.242472	1.42101	1.42777*	1.43821*
2	-343.986	.05973	1	0.807	.24344	1.42499	1.43513	1.45079
3	**-340.556**	**6.8594***	**1**	**0.009**	**.241023***	**1.41501***	**1.42853**	**1.44942**
4	-340.08	.95265	1	0.329	.241542	1.41717	1.43406	1.46017
5	-340.063	.03312	1	0.856	.24252	1.4212	1.44148	1.47281
6	-339.7	.72705	1	0.394	.243155	1.42382	1.44747	1.48402
7	-339.55	.29898	1	0.585	.244006	1.42731	1.45434	1.49611
8	-338.192	2.7162	1	0.099	.243648	1.42584	1.45625	1.50324
9	-337.793	.7983	1	0.372	.24425	1.42831	1.46209	1.51431
10	-337.505	.57617	1	0.448	.244966	1.43123	1.46839	1.52583
11	-336.293	2.4237	1	0.120	.244753	1.43036	1.4709	1.53356
12	-336.168	.24981	1	0.617	.245635	1.43396	1.47788	1.54576
13	-335.908	.51947	1	0.471	.246384	1.437	1.48429	1.5574
14	-335.879	.0585	1	0.809	.247369	1.44098	1.49166	1.56998
15	-335.589	.58093	1	0.446	.248092	1.4439	1.49795	1.5815

Table A20. Results of lag selection of time-series non-wildfire model for SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-416.922		1.05582	2.89219	2.89728	2.90488		
1	-409.978	13.888	1	0.000	1.01327	2.85106	2.86123	2.87643*
2	-409.919	.11834	1	0.731	1.01989	2.85757	2.87282	2.89563

3	-404.997	9.8445	1	0.002	.992578	2.83043	2.85076*	2.88117
4	-404.111	1.7713	1	0.183	.993365	2.83122	2.85663	2.89465
5	-402.939	2.3429	1	0.126	.99219	2.83003	2.86053	2.90615
6	-402.476	.92737	1	0.336	.995883	2.83374	2.86933	2.92255
7	-402.355	.24167	1	0.623	1.00197	2.83983	2.88049	2.94132
8	-401.772	1.166	1	0.280	1.00487	2.84271	2.88846	2.95689
9	-397.975	7.5928*	1	0.006	.985614	2.82336	2.87419	2.95023
10	**-396.726**	**2.4992**	**1**	**0.114**	**.983923***	**2.82163***	**2.87755**	**2.96118**
11	-396.425	.60227	1	0.438	.988704	2.82647	2.88747	2.97871
12	-395.998	.85405	1	0.355	.992645	2.83043	2.89652	2.99536
13	-395.877	.24088	1	0.624	.99872	2.83652	2.90769	3.01413
14	-395.693	.36841	1	0.544	1.00439	2.84217	2.91842	3.03247
15	-394.901	1.5851	1	0.208	1.00586	2.8436	2.92494	3.04659

Table A21. Results of lag selection of time-series non-wildfire model for temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1715.78		67.5281	7.05042	7.0538	7.05902		
1	-1367.66	696.23	1	0.000	16.2327	5.6249	5.63166	5.64211
2	-1361.93	11.468	1	0.001	15.9202	5.60546	5.6156	5.63126
3	-1356.52	10.819	1	0.001	15.6345	5.58736	5.60087*	5.62176*
4	-1355.26	2.5152	1	0.113	15.6179	5.5863	5.60319	5.6293
5	-1355.25	.01853	1	0.892	15.6816	5.59037	5.61064	5.64197
6	-1354.92	.66489	1	0.415	15.7247	5.59311	5.61676	5.65331
7	-1354.88	.08343	1	0.773	15.7867	5.59704	5.62407	5.66584
8	**-1350.06**	**9.6318***	**1**	**0.002**	**15.5413***	**5.58137***	**5.61178**	**5.65877**
9	-1350.06	.00148	1	0.969	15.6052	5.58548	5.61926	5.67148
10	-1349.57	.98383	1	0.321	15.6378	5.58756	5.62473	5.68216
11	-1349.57	.00315	1	0.955	15.7021	5.59166	5.6322	5.69486
12	-1349.37	.39619	1	0.529	15.754	5.59496	5.63888	5.70676
13	-1349.37	.00349	1	0.953	15.8187	5.59906	5.64635	5.71946
14	-1348.86	1.0278	1	0.311	15.8504	5.60105	5.65173	5.73005

15	-1347.6	2.5179	1	0.113	15.8336	5.59999	5.65404	5.73759

Table A22. Results of lag selection of time-series non-wildfire model for humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1879.91		132.503	7.72449	7.72786	7.73309		
1	-1714.88	330.06*	1	0.000	67.5573	7.05085	7.05761*	7.06805*
2	-1713.4	2.9756	1	0.085	67.4221	7.04885	7.05899	7.07465
3	**-1712.01**	**2.7698**	**1**	**0.096**	**67.3157***	**7.04727***	**7.06078**	**7.08167**
4	-1711.95	.12607	1	0.723	67.5752	7.05112	7.06801	7.09412
5	-1711.88	.13467	1	0.714	67.8346	7.05495	7.07522	7.10655
6	-1711.01	1.7477	1	0.186	67.8698	7.05547	7.07912	7.11567
7	-1710.69	.62786	1	0.428	68.0613	7.05828	7.08531	7.12708
8	-1710.57	.24451	1	0.621	68.3072	7.06189	7.09229	7.13929
9	-1710.34	.46233	1	0.497	68.5233	7.06505	7.09883	7.15105
10	-1710.33	.01449	1	0.904	68.8034	7.06912	7.10629	7.16372
11	-1708.8	3.0555	1	0.080	68.6546	7.06696	7.1075	7.17016
12	-1708.49	.62179	1	0.430	68.8494	7.06979	7.11371	7.18159
13	-1708.19	.60125	1	0.438	69.0476	7.07266	7.11996	7.19306
14	-1707.81	.77224	1	0.380	69.2222	7.07518	7.12586	7.20418
15	-1707.1	1.4118	1	0.235	69.3061	7.07639	7.13044	7.21399

Table A23. Results of lag selection of time-series non-wildfire model for flu

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-67.3631		.464745	2.07161	2.08472	2.10479		
1	**-64.8667**	**4.9928**	**1**	**0.025**	**.444149***	**2.02626***	**2.05248***	**2.09262***
2	-64.7586	.21618	1	0.642	.456338	2.05329	2.09262	2.15282
3	-64.5588	.39963	1	0.527	.467578	2.07754	2.12998	2.21025
4	-64.1126	.89251	1	0.345	.475558	2.09432	2.15987	2.2602
5	-64.0034	.21839	1	0.640	.488674	2.12131	2.19997	2.32037
6	-64.0033	.00023	1	0.988	.503857	2.15161	2.24338	2.38385
7	-64.0019	.00274	1	0.958	.519544	2.18188	2.28675	2.44729
8	-63.952	.09976	1	0.752	.534993	2.21067	2.32865	2.50926

9	-62.6779	2.5483	1	0.110	.530908	2.20236	2.33346	2.53413
10	-62.3769	.60199	1	0.438	.542701	2.22354	2.36775	2.58848
11	-62.0117	.73036	1	0.393	.553768	2.24278	2.40009	2.6409
12	-61.474	1.0753	1	0.300	.562215	2.25679	2.42721	2.68808
13	-59.3129	4.3223*	1	0.038	.543495	2.2216	2.40514	2.68607
14	-59.2814	.06302	1	0.802	.560544	2.25095	2.4476	2.7486
15	-57.8436	2.8756	1	0.090	.554136	2.23768	2.44744	2.76851

Table A24. Results of lag selection of time-series yearly model of 2016 for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-22.814		.067085	.13608	.140468	.147103		
1	27.0833	99.795	1	0.000	.050731	-.143333	-.134558	-.121288
2	27.1062	.04585	1	0.830	.051015	-.13775	-.124587	-.104682
3	31.191	8.1696	1	0.004	.050124	-.155377	-.137828	-.111287
4	36.1027	9.8233	1	0.002	.049016	-.17773	-.155793	-.122616*
5	36.1096	.01393	1	0.906	.049295	-.172055	-.145731	-.105919
6	39.9746	7.7299	1	0.005	.048495	-.188426	-.157714	-.111267
7	**42.439**	**4.9288***	**1**	**0.026**	**.048091***	**-.196794***	**-.161695***	**-.108613**
8	42.4903	.10264	1	0.749	.048352	-.191373	-.151887	-.092169
9	42.5501	.11948	1	0.730	.048613	-.186	-.142126	-.075774
10	43.0626	1.0251	1	0.311	.048749	-.183215	-.134953	-.061966
11	43.8761	1.6271	1	0.202	.048801	-.182149	-.1295	-.049877
12	43.9322	.11214	1	0.738	.049066	-.176755	-.119719	-.033461
13	43.9334	.00234	1	0.961	.049347	-.171048	-.109624	-.016731
14	44.5626	1.2585	1	0.262	.049452	-.168929	-.103118	-.003589
15	44.5851	.045	1	0.832	.04973	-.163344	-.093145	.013019

Table A25. Results of lag selection of time-series yearly model of 2016 for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-275.08		.283575	1.5776	1.58199	1.58862		
1	-181.36	187.44	1	0.000	.166942	1.04777	1.05654	1.06982

2	-180.955	.80967	1	0.368	.167511	1.05117	1.06433	1.08424
3	-173.931	14.049	1	0.000	.161843	1.01675	1.0343	1.06084
4	-169.177	9.5081	1	0.002	.158408	.995294	1.01723	1.05041
5	-164.031	10.292	1	0.001	.1547	.971604	.997928	1.03774
6	-151.118	25.824	1	0.000	.14452	.903534	.934246	.980693
7	**-145.734**	**10.769**	**1**	**0.001**	**.140944***	**.878479***	**.913579***	**.966661***
8	-144.763	1.9427	1	0.163	.140968	.878643	.91813	.977847
9	-144.751	.02267	1	0.880	.141767	.884293	.928167	.994519
10	-144.618	.26728	1	0.605	.142472	.889243	.937505	1.01049
11	-143.923	1.389	1	0.239	.142721	.890989	.943638	1.02326
12	-143.913	.02039	1	0.886	.143532	.896645	.953681	1.03994
13	-141.772	4.2816*	1	0.039	.1426	.890126	.95155	1.04444
14	-141.172	1.1997	1	0.273	.142928	.892413	.958224	1.05775
15	-141.049	.24654	1	0.620	.143648	.897422	.967621	1.07379

Table A26. Results of lag selection of time-series yearly model of 2016 for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-135.047		.127395	.777413	.7818	.788435		
1	-58.8058	152.48	1	0.000	.082876	.347462	.356236	.369507
2	-56.8653	3.8809	1	0.049	.082431	.342087	.35525	.375155
3	-52.2412	9.2483	1	0.002	.080742	.321378	.338928	.365469*
4	-51.3438	1.7947	1	0.180	.080789	.321965	.343902	.377078
5	-49.8635	2.9605	1	0.085	.080568	.31922	.345545	.385356
6	-44.7775	10.172	1	0.001	.078709	.295872	.326583*	.37303
7	-44.0357	1.4836	1	0.223	.078825	.297347	.332446	.385528
8	-44.0307	.01006	1	0.920	.079275	.303033	.342519	.402237
9	-43.7616	.53815	1	0.463	.079607	.307209	.351083	.417436
10	-43.5169	.48941	1	0.484	.079952	.311525	.359787	.432775
11	-41.1855	4.6628	1	0.031	.079346	.303917	.356566	.436189
12	-38.4398	5.4914	1	0.019	.078559	.293942	.350978	.437237
13	-38.4239	.03179	1	0.858	.079003	.299565	.360989	.453883

14	-35.6706	5.5067*	1	0.019	.078216	.289546	.355357	.454886
15	**-34.3788**	**2.5836**	**1**	**0.108**	**.078087***	**.287879***	**.358077**	**.464241**

Table A27. Results of lag selection of time-series yearly model of 2016 $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-339.034		.408679	1.94305	1.94744	1.95407		
1	-274.186	129.7	1	0.000	.283747	1.5782	1.58698	1.60025*
2	-273.249	1.8736	1	0.171	.28385	1.57857	1.59173	1.61163
3	-270.283	5.9316	1	0.015	.280679	1.56733	1.58488*	1.61142
4	-268.933	2.7002	1	0.100	.280118	1.56533	1.58727	1.62045
5	-268.93	.00592	1	0.939	.281719	1.57103	1.59735	1.63717
6	-267.118	3.6251	1	0.057	.280415	1.56639	1.5971	1.64355
7	**-264.852**	**4.5304***	**1**	**0.033**	**.278396***	**1.55916***	**1.59426**	**1.64734**
8	-264.851	.00272	1	0.958	.27999	1.56486	1.60435	1.66407
9	-264.74	.22191	1	0.638	.281417	1.56994	1.61382	1.68017
10	-264.462	.55695	1	0.455	.282581	1.57407	1.62233	1.69532
11	-263.778	1.3669	1	0.242	.283094	1.57588	1.62852	1.70815
12	-263.546	.46396	1	0.496	.284342	1.58026	1.6373	1.72356
13	-262.947	1.1976	1	0.274	.284997	1.58256	1.64398	1.73687
14	-262.944	.00651	1	0.936	.286627	1.58825	1.65406	1.75359
15	-262.901	.08703	1	0.768	.288201	1.59372	1.66392	1.77008

Table A28. Results of lag selection of time-series yearly model of 2016 SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	**-258.472**		**1.41316***	**3.1837***	**3.19141***	**3.20268***		
1	-258.402	.13945	1	0.709	1.42938	3.19512	3.21053	3.23308
2	-258.321	.1622	1	0.687	1.44559	3.20639	3.22951	3.26333
3	-257.684	1.2743	1	0.259	1.45205	3.21084	3.24167	3.28676
4	-257.683	.00093	1	0.976	1.46998	3.22311	3.26164	3.31801
5	-256.952	1.4628	1	0.226	1.47486	3.2264	3.27264	3.34029
6	-256.637	.62936	1	0.428	1.48734	3.23481	3.28875	3.36767

7	-256.618	.03829	1	0.845	1.50539	3.24685	3.30849	3.39869
8	-254.935	3.3671	1	0.067	1.49286	3.23846	3.30781	3.40928
9	-253.047	3.776	1	0.052	1.47675	3.22757	3.30462	3.41737
10	-252.912	.26889	1	0.604	1.49259	3.23819	3.32295	3.44697
11	-252.766	.29277	1	0.588	1.5084	3.24866	3.34113	3.47642
12	-252.562	.4073	1	0.523	1.52332	3.25843	3.35861	3.50517
13	-252.53	.06332	1	0.801	1.54166	3.27031	3.37819	3.53603
14	-252.526	.0097	1	0.922	1.56075	3.28252	3.39811	3.56722
15	-252.518	.01476	1	0.903	1.58005	3.2947	3.41799	3.59838

Table A29. Results of lag selection of time-series yearly model of 2016 temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1347.75		130.226	7.70715	7.71154	7.71817		
1	-903.244	889.01	1	0.000	10.3289	5.17282	5.1816	5.19487
2	-898.124	10.241	1	0.001	10.0885	5.14928	5.16244	5.18235
3	**-889.282**	**17.683**	**1**	**0.000**	**9.64648***	**5.10447***	**5.12202***	**5.14856***
4	-889.264	.03649	1	0.849	9.70076	5.11008	5.13202	5.16519
5	-888.567	1.3932	1	0.238	9.71761	5.11181	5.13814	5.17795
6	-888.483	.169	1	0.681	9.7686	5.11704	5.14776	5.1942
7	-888.437	.09083	1	0.763	9.82205	5.1225	5.1576	5.21068
8	-887.768	1.3398	1	0.247	9.84063	5.12439	5.16387	5.22359
9	-887.332	.87022	1	0.351	9.87249	5.12761	5.17149	5.23784
10	-884.317	6.0302*	1	0.014	9.75951	5.1161	5.16436	5.23735
11	-883.701	1.2331	1	0.267	9.78098	5.11829	5.17094	5.25056
12	-883.65	.10123	1	0.750	9.83426	5.12371	5.18075	5.26701
13	-883.114	1.0718	1	0.301	9.86046	5.12637	5.18779	5.28068
14	-881.873	2.482	1	0.115	9.84698	5.12499	5.1908	5.29033
15	-880.837	2.0724	1	0.150	9.84506	5.12478	5.19498	5.30115

Table A30. Results of lag selection of time-series yearly model of 2016 humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC

0	-1381.94		158.327	7.90254	7.90693	7.91356		
1	**-1276.61**	**210.67***	**1**	**0.000**	**87.2212***	**7.30632***	**7.3151***	**7.32837***
2	-1276.6	.02167	1	0.883	87.7156	7.31198	7.32514	7.34504
3	-1276.01	1.1783	1	0.278	87.9218	7.31432	7.33187	7.35841
4	-1275.81	.39341	1	0.531	88.3264	7.31891	7.34085	7.37403
5	-1275.79	.03195	1	0.858	88.8246	7.32454	7.35086	7.39067
6	-1275.64	.31145	1	0.577	89.2544	7.32936	7.36007	7.40652
7	-1275.49	.29589	1	0.586	89.6902	7.33423	7.36933	7.42241
8	-1275.13	.71234	1	0.399	90.0211	7.33791	7.3774	7.43711
9	-1273.56	3.1415	1	0.076	89.7284	7.33465	7.37852	7.44487
10	-1273.16	.80224	1	0.370	90.0364	7.33807	7.38633	7.45932
11	-1272.04	2.2383	1	0.135	89.9757	7.33739	7.39004	7.46966
12	-1270.56	2.9669	1	0.085	89.7281	7.33463	7.39166	7.47792
13	-1270.38	.36451	1	0.546	90.1492	7.3393	7.40072	7.49362
14	-1270.37	.00602	1	0.938	90.6651	7.345	7.41081	7.51034
15	-1270.2	.35401	1	0.552	91.0935	7.3497	7.4199	7.52606

Table A31. Results of lag selection of time-series yearly model of 2016 for flu

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-10.6976		.411524	1.9496	1.93464	1.99001		
1	**-10.5728**	**.24966**	**1**	**0.617**	**.47746***	**2.09546***	**2.06554**	**2.17628**
2	-10.1323	.88088	1	0.348	.528175	2.18872	2.14384	2.30995
3	-9.97592	.31286	1	0.576	.617499	2.32932	2.26948	2.49096
4	-9.72042	.51099	1	0.475	.718562	2.4534	2.3786	2.65545
5	-9.11424	1.2124	1	0.271	.802339	2.51904	2.42928	2.76149
6	-8.96651	.29546	1	0.587	.991578	2.66109	2.55636	2.94395
7	-8.91097	.11107	1	0.739	1.29269	2.8185	2.69881	3.14177
8	-8.69822	.4255	1	0.514	1.74672	2.9497	2.81506	3.31338
9	-5.34867	6.6991	1	0.010	1.57061	2.55811	2.4085	2.9622
10	-5.32033	.05668	1	0.812	3.26853	2.72006	2.55549	3.16455
11	400.587	811.81*	1	0.000	.	-64.7645	-64.9441	-64.2796

12	400.587	0	1	.	.	-64.7645	-64.9441	-64.2796
13	400.587	0	1	.	.	-64.7645	-64.9441	-64.2796
14	400.587	0	1	.	.	-64.7645	-64.9441	-64.2796
15	400.587	0	1	.	.	-64.7645	-64.9441*	-64.2796*

Table A32. Results of lag selection of time-series yearly model of 2017 for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-79.5497		.092774	.460284	.464672	.471307		
1	21.8834	202.87	1	0.000	.052261	-.113619	-.104844	-.091574
2	23.431	3.0953	1	0.079	.052098	-.116749	-.103586	-.083681
3	28.5069	10.152	1	0.001	.050899	-.140039	-.12249	-.095949
4	28.9706	.92737	1	0.336	.051055	-.136975	-.115038	-.081861
5	36.3375	14.734	1	0.000	.049231	-.173357	-.147033	-.107221
6	38.1719	3.6687	1	0.055	.048997	-.178125	-.147413	-.100966
7	42.8148	9.286	1	0.002	.047988	-.198942	-.163843	-.110761
8	**46.0805**	**6.5314***	**1**	**0.011**	**.047371***	**-.211889***	**-.172402***	**-.112685***
9	46.6914	1.2217	1	0.269	.047476	-.209665	-.165791	-.099438
10	46.6953	.00792	1	0.929	.047747	-.203973	-.155712	-.082724
11	46.7507	.11078	1	0.739	.048006	-.198576	-.145927	-.066304
12	46.9716	.44179	1	0.506	.048221	-.194124	-.137087	-.050829
13	48.1416	2.34	1	0.126	.048174	-.195095	-.133671	-.040777
14	48.1964	.10952	1	0.741	.048436	-.189693	-.123882	-.024353
15	48.3386	.28459	1	0.594	.048674	-.184792	-.114594	-.00843

Table A33. Results of lag selection of time-series yearly model of 2017 for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-303.567		.333705	1.74038	1.74477	1.7514		
1	-182.68	241.77	1	0.000	.168207	1.05531	1.06409	1.07736
2	-180.836	3.6889	1	0.055	.167397	1.05049	1.06365	1.08356
3	-174.826	12.02	1	0.001	.162673	1.02186	1.03941	1.06595
4	-169.964	9.7238	1	0.002	.159122	.999793	1.02173	1.05491

5	-165.89	8.1473	1	0.004	.156352	.98223	1.00855	1.04837
6	-158.341	15.098	1	0.000	.150609	.944806	.975517	1.02196
7	-155.936	4.8097	1	0.028	.149405	.936778	.971877	1.02496
8	-151.4	9.0729	1	0.003	.146417	.91657	.956056*	1.01577*
9	-151.206	.38768	1	0.534	.147094	.921176	.96505	1.0314
10	-151.155	.10103	1	0.751	.147895	.926602	.974863	1.04785
11	-151.154	.00318	1	0.955	.148742	.932307	.984956	1.06458
12	-149.978	2.3516	1	0.125	.148594	.931302	.988339	1.0746
13	-146.011	7.9329*	1	0.005	.146097	.914351	.975775	1.06867
14	**-144.904**	**2.2153**	**1**	**0.137**	**.146009***	**.913736***	**.979547**	**1.07908**
15	-144.762	.28355	1	0.594	.146728	.91864	.988839	1.095

Table A34. Results of lag selection of time-series yearly model of 2017 for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-243.8		.23716	1.39886	1.40324	1.40988		
1	-84.0685	319.46	1	0.000	.095746	.49182	.500595	.513866
2	-81.3753	5.3865	1	0.020	.094824	.482145	.495307	.515213
3	-79.1593	4.4319	1	0.035	.094168	.475196	.492746	.519287
4	-73.5114	11.296	1	0.001	.091699	.448636	.470573	.50375
5	-72.8184	1.3858	1	0.239	.091861	.450391	.476716	.516527
6	-70.5866	4.4637	1	0.035	.091216	.443352	.474064	.520511
7	-63.9221	13.329	1	0.000	.088311	.410983	.446083	.499165*
8	-61.6476	4.549*	1	0.033	.087671	.4037	.443187*	.502904
9	-60.2198	2.8556	1	0.091	.087457	.401256	.44513	.511483
10	-58.4344	3.5707	1	0.059	.087066	.396768	.44503	.518018
11	**-56.7319**	**3.4051**	**1**	**0.065**	**.086718***	**.392754***	**.445403**	**.525026**
12	-56.7145	.03489	1	0.852	.087207	.398368	.455405	.541663
13	-55.6669	2.0951	1	0.148	.087184	.398096	.45952	.552414
14	-55.2955	.74267	1	0.389	.087498	.401689	.4675	.567029
15	-54.6004	1.3902	1	0.238	.087652	.403431	.47363	.579794

Table A35. Results of lag selection of time-series yearly model of 2017 for $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-373.797		.498485	2.1417	2.14608	2.15272		
1	-270.905	205.78	1	0.000	.278477	1.55946	1.56823	1.5815
2	-268.011	5.7893	1	0.016	.275479	1.54863	1.56179	1.5817
3	-265.021	5.9786	1	0.014	.272365	1.53727	1.55481	1.58136*
4	-264.519	1.0039	1	0.316	.273142	1.54011	1.56205	1.59522
5	-261.313	6.413	1	0.011	.26972	1.5275	1.55383	1.59364
6	-258.385	5.8561*	1	0.016	.266765	1.51649	1.5472*	1.59364
7	-257.59	1.5889	1	0.207	.267079	1.51766	1.55276	1.60584
8	-256.406	2.3682	1	0.124	.266799	1.51661	1.55609	1.61581
9	**-254.566**	**3.6809**	**1**	**0.055**	**.265522***	**1.51181***	**1.55568**	**1.62203**
10	-254.176	.77999	1	0.377	.266451	1.51529	1.56355	1.63654
11	-253.574	1.2031	1	0.273	.26706	1.51757	1.57022	1.64984
12	-252.999	1.1511	1	0.283	.26771	1.51999	1.57703	1.66329
13	-252.41	1.1782	1	0.278	.268342	1.52234	1.58377	1.67666
14	-252.109	.60092	1	0.438	.269419	1.52634	1.59215	1.69168
15	-252.1	.01809	1	0.893	.270952	1.532	1.6022	1.70836

Table A36. Results of lag selection of time-series yearly model of 2017 for SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-279.653		1.1411	2.96987	2.97682	2.98702		
1	-271.293	16.718	1	0.000	1.05561	2.89199	2.90589*	2.9263*
2	-271.282	.02356	1	0.878	1.06671	2.90245	2.9233	2.95391
3	-269.766	3.0312	1	0.082	1.06091	2.897	2.92479	2.9656
4	-269.128	1.2759	1	0.259	1.06499	2.90083	2.93557	2.98659
5	-267.041	4.1741	1	0.041	1.05282	2.88932	2.93102	2.99224
6	-266.433	1.2168	1	0.270	1.0572	2.89347	2.94211	3.01353
7	-266.173	.51929	1	0.471	1.06553	2.9013	2.95689	3.03852
8	-261.869	8.6086	1	0.003	1.02894	2.86634	2.92888	3.02071

9	**-260.837**	**2.0633**	**1**	**0.151**	**1.02863***	**2.866***	**2.93549**	**3.03752**
10	-260.411	.85224	1	0.356	1.03493	2.87207	2.94851	3.06075
11	-260.278	.26571	1	0.606	1.04451	2.88125	2.96464	3.08708
12	-260.198	.16057	1	0.689	1.05477	2.89098	2.98132	3.11396
13	-259.629	1.1382	1	0.286	1.05965	2.89554	2.99283	3.13567
14	-257.56	4.1373*	1	0.042	1.0478	2.88423	2.98847	3.14152
15	-257.18	.76056	1	0.383	1.05477	2.89079	3.00197	3.16523

Table A37. Results of lag selection of time-series yearly model of 2017 temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1348.58		130.843	7.71188	7.71626	7.7229		
1	-923.573	850.01	1	0.000	11.6012	5.28899	5.29776	5.31103
2	-923.358	.42909	1	0.512	11.6534	5.29347	5.30664	5.32654
3	-908.107	30.503	1	0.000	10.742	5.21204	5.22959	5.25613*
4	-907.257	1.6993	1	0.192	10.7512	5.2129	5.23483	5.26801
5	-903.355	7.8029	1	0.005	10.5745	5.19632	5.22264*	5.26245
6	-903.329	.05203	1	0.820	10.6335	5.20188	5.23259	5.27904
7	-903.231	.19631	1	0.658	10.6885	5.20704	5.24214	5.29522
8	-899.737	6.9877	1	0.008	10.5373	5.19279	5.23227	5.29199
9	-899.553	.36924	1	0.543	10.5865	5.19744	5.24132	5.30767
10	**-897.441**	**4.2233**	**1**	**0.040**	**10.5196***	**5.19109***	**5.23935**	**5.31234**
11	-897.404	.07498	1	0.784	10.5776	5.19659	5.24924	5.32886
12	-896.781	1.2452	1	0.264	10.6006	5.19875	5.25579	5.34204
13	-896.781	1.7e-06	1	0.999	10.6614	5.20446	5.26589	5.35878
14	-893.985	5.593*	1	0.018	10.5526	5.1942	5.26001	5.35954
15	-893.595	.77809	1	0.378	10.5896	5.19769	5.26789	5.37405

Table A38. Results of lag selection of time-series yearly model of 2017 for humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1432.82		211.741	8.19324	8.19763	8.20426		
1	-1288.91	287.82	1	0.000	93.5722	7.37661	7.38539*	7.39866*

2	-1288.91	.00273	1	0.958	94.1077	7.38232	7.39548	7.41538
3	-1285.77	6.2728*	1	0.012	92.9659	7.37011	7.38766	7.4142
4	-1283.89	3.7604	1	0.052	92.4996	7.36508	7.38702	7.42019
5	**-1282.88**	**2.0188**	**1**	**0.155**	**92.4947***	**7.36503***	**7.39135**	**7.43116**
6	-1282.81	.13254	1	0.716	92.9898	7.37036	7.40107	7.44752
7	-1282.2	1.2218	1	0.269	93.197	7.37258	7.40768	7.46077
8	-1282.02	.35652	1	0.550	93.636	7.37728	7.41677	7.47648
9	-1281.88	.29366	1	0.588	94.094	7.38216	7.42603	7.49238
10	-1281.18	1.3882	1	0.239	94.2591	7.3839	7.43217	7.50515
11	-1281.18	.00193	1	0.965	94.7993	7.38961	7.44226	7.52188
12	-1281.18	5.3e-06	1	0.998	95.3433	7.39533	7.45236	7.53862
13	-1280.06	2.2377	1	0.135	95.2793	7.39465	7.45607	7.54896
14	-1279.96	.21009	1	0.647	95.7688	7.39976	7.46557	7.5651
15	-1279.9	.11077	1	0.739	96.2882	7.40516	7.47536	7.58152

Table A39. Results of lag selection of time-series yearly model of 2017 for flu

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-13.8243		.48681	2.11775	2.11353	2.1634		
1	**-12.131**	**3.3864**	**1**	**0.066**	**.441671***	**2.01872***	**2.01027**	**2.11001**
2	-10.8903	2.4814	1	0.115	.428786	1.98433	1.97166	2.12127
3	-10.3668	1.0471	1	0.306	.463421	2.0524	2.0355	2.23499
4	-10.0833	.56701	1	0.451	.521945	2.15476	2.13363	2.38299
5	-9.91754	.33149	1	0.565	.60363	2.27393	2.24858	2.54782
6	-9.43058	.97392	1	0.324	.675678	2.34723	2.31765	2.66676
7	-8.69587	1.4694	1	0.225	.743544	2.38512	2.35132	2.7503
8	-8.69513	.00148	1	0.969	.932711	2.52788	2.48985	2.9387
9	-6.82364	3.743	1	0.053	.931172	2.40338	2.36112	2.85985
10	-5.99775	1.6518	1	0.199	1.14936	2.42825	2.38177	2.93037
11	1.69162	15.379	1	0.000	.597747	1.47263	1.42192	2.02039
12	23.2009	43.019	1	0.000	.057472	-1.45728	-1.51221	-.863868
13	435.173	823.94	1	0.000	.	-60.1675	-60.2267	-59.5285

14	444.677	19.009*	1	0.000	.	-61.5253	-61.5845	-60.8863
15	444.677	0	1	.	.	-61.5253	-61.5845*	-60.8863*

Table A40. Results of lag selection of time-series yearly model of 2018 for CO

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-65.7702		.085656	.380457	.384835	.391456		
1	60.4936	252.53	1	0.000	.041954	-.333297	-.324541	-.311298
2	60.9821	.97701	1	0.323	.042077	-.330382	-.317249	-.297384
3	67.4404	12.917	1	0.000	.040788	-.361484	-.343973	-.317486*
4	68.7191	2.5574	1	0.110	.040724	-.363072	-.341184	-.308075
5	72.3902	7.3422	1	0.007	.040109	-.378292	-.352026*	-.312296
6	73.9887	3.197	1	0.074	.039972	-.381702	-.351058	-.304707
7	75.875	3.7726	1	0.052	.039771	-.386752	-.351731	-.298757
8	76.0655	.381	1	0.537	.039955	-.38214	-.342741	-.283145
9	76.918	1.705	1	0.192	.039989	-.381299	-.337522	-.271305
10	77.4159	.99585	1	0.318	.040103	-.378438	-.330284	-.257445
11	77.808	.78404	1	0.376	.040243	-.374974	-.322442	-.242981
12	80.67	5.7241	1	0.017	.039818	-.385584	-.328674	-.242592
13	**83.1697**	**4.9994***	**1**	**0.025**	**.03948***	**-.394129***	**-.332842**	**-.240138**
14	83.1828	.02608	1	0.872	.039703	-.388506	-.32284	-.223515
15	83.715	1.0644	1	0.302	.039809	-.38584	-.315797	-.20985

Table A41. Results of lag selection of time-series yearly model of 2018 for NO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-307.5		.339582	1.75784	1.76221	1.76884		
1	-181.88	251.24	1	0.000	.166939	1.04775	1.0565	1.06975
2	-181.874	.01164	1	0.914	.167887	1.05341	1.06655	1.08641
3	-172.685	18.378	1	0.000	.160233	1.00675	1.02426	1.05075
4	-171.258	2.8532	1	0.091	.159844	1.00432	1.02621	1.05932
5	-165.33	11.856	1	0.001	.155418	.976239	1.00251	1.04224
6	-151.591	27.477	1	0.000	.144537	.903654	.934298	.98065
7	-146.159	10.865	1	0.001	.140933	.878399	.91342*	.966394*

8	-145.663	.99113	1	0.319	.141339	.881273	.920672	.980267
9	-145.652	.0228	1	0.880	.142138	.886906	.930683	.9969
10	-145.24	.82468	1	0.364	.142616	.890254	.938409	1.01125
11	-144.422	1.6356	1	0.201	.142765	.891293	.943825	1.02329
12	-142.04	4.7641*	1	0.029	.141646	.883418	.940328	1.02641
13	-140.249	3.5811	1	0.058	.14101	.878913	.940201	1.0329
14	**-139.042**	**2.4146**	**1**	**0.120**	**.140845***	**.877732***	**.943397**	**1.04272**
15	-138.914	.25661	1	0.612	.141548	.882699	.952742	1.05869

Table A42. Results of lag selection of time-series yearly model of 2018 for O_3

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-240.549		.231881	1.37635	1.38072	1.38734		
1	-85.8931	309.31	1	0.000	.096611	.500816	.509571	.522814
2	-83.6573	4.4717	1	0.034	.095933	.493774	.506907	.526772
3	-78.7712	9.7723	1	0.002	.093832	.471631	.489141	.515628*
4	-78.7254	.09159	1	0.762	.094344	.477068	.498956	.532065
5	-74.8608	7.7292	1	0.005	.092817	.460745	.487011	.526741
6	-70.6922	8.3371	1	0.004	.091156	.442691	.473334	.519686
7	-70.6117	.16094	1	0.688	.091635	.44793	.482952	.535925
8	-67.3348	6.5539	1	0.010	.090454	.434956	.474355	.533951
9	**-65.3441**	**3.9814***	**1**	**0.046**	**.089946***	**.429311***	**.473088***	**.539305**
10	-64.4324	1.8233	1	0.177	.089991	.429814	.477969	.550808
11	-64.1019	.66115	1	0.416	.090336	.433629	.486161	.565621
12	-64.0984	.00681	1	0.934	.090851	.439307	.496217	.582299
13	-64.0955	.00597	1	0.938	.091369	.444988	.506276	.59898
14	-63.5595	1.0718	1	0.301	.091612	.447633	.513298	.612624
15	-63.5496	.01995	1	0.888	.092131	.453274	.523317	.629264

Table A43. Results of lag selection of time-series yearly model of 2018 $PM_{2.5}$

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-293.761		.31401	1.67955	1.68393	1.69055		

1	-211.926	163.67	1	0.000	.198111	1.21895	1.2277*	1.24095*
2	-211.278	1.2961	1	0.255	.198509	1.22095	1.23409	1.25395
3	-209.731	3.0926	1	0.079	.197892	1.21784	1.23535	1.26184
4	-209.446	.5709	1	0.450	.1987	1.22191	1.2438	1.27691
5	-208.825	1.2417	1	0.265	.19913	1.22407	1.25034	1.29007
6	**-205.021**	**7.6075***	**1**	**0.006**	**.195974***	**1.2081***	**1.23874**	**1.28509**
7	-204.719	.60498	1	0.437	.196755	1.21207	1.24709	1.30007
8	-204.695	.04666	1	0.829	.197854	1.21764	1.25704	1.31663
9	-203.915	1.5614	1	0.211	.198102	1.21889	1.26266	1.32888
10	-203.771	.28702	1	0.592	.199072	1.22377	1.27192	1.34476
11	-203.522	.49914	1	0.480	.199926	1.22804	1.28058	1.36004
12	-202.99	1.0635	1	0.302	.200462	1.23071	1.28762	1.3737
13	-202.924	.13253	1	0.716	.201533	1.23603	1.29732	1.39002
14	-202.878	.09157	1	0.762	.202634	1.24147	1.30713	1.40646
15	-202.578	.59882	1	0.439	.203446	1.24546	1.3155	1.42145

Table A44. Results of lag selection of time-series yearly model of 2018 SO_2

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-214.081		1.03032	2.86775	2.8759	2.88782		
1	-211.185	5.7918	1	0.016	1.0046	2.84247	2.85878*	2.88261*
2	-211.178	.01529	1	0.902	1.01799	2.8557	2.88016	2.91591
3	-210.821	.71286	1	0.398	1.02677	2.86428	2.8969	2.94457
4	-210.685	.27139	1	0.602	1.03868	2.87581	2.91658	2.97616
5	-209.797	1.7777	1	0.182	1.04024	2.87729	2.92621	2.99771
6	-207.832	3.9299	1	0.047	1.02697	2.86442	2.9215	3.00492
7	-207.805	.0533	1	0.817	1.04042	2.8774	2.94263	3.03797
8	-203.872	7.8666	1	0.005	1.00056	2.83829	2.91168	3.01893
9	**-201.844**	**4.0549***	**1**	**0.044**	**.986996***	**2.82459***	**2.90613**	**3.0253**
10	-201.217	1.2544	1	0.263	.99198	2.82956	2.91926	3.05034
11	-201.145	.14493	1	0.703	1.0044	2.84193	2.93978	3.08278
12	-201.087	.11419	1	0.735	1.0172	2.8545	2.9605	3.11542

13	-201.017	.14134	1	0.707	1.03	2.86689	2.98105	3.14788
14	-200.615	.80437	1	0.370	1.03837	2.87486	2.99717	3.17593
15	-200.489	.25111	1	0.616	1.0507	2.88652	3.01699	3.20766

Table A45. Results of lag selection of time-series yearly model of 2018 for temperature

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1312.46		104.194	7.48413	7.48851	7.49513		
1	-899.761	825.41	1	0.000	9.97778	5.13824	5.14699	5.16024
2	-895.172	9.1777	1	0.002	9.77581	5.11779	5.13092	5.15079
3	-878.402	33.539	1	0.000	8.93572	5.02793	5.04544*	5.07193*
4	-878.376	.05238	1	0.819	8.98545	5.03348	5.05537	5.08848
5	-875.764	5.2242	1	0.022	8.9033	5.0243	5.05056	5.09029
6	-875.289	.95026	1	0.330	8.92998	5.02729	5.05793	5.10428
7	-873.678	3.222	1	0.073	8.89897	5.0238	5.05883	5.1118
8	**-870.429**	**6.4967***	**1**	**0.011**	**8.78572***	**5.01099***	**5.05039**	**5.10999**
9	-870.284	.29139	1	0.589	8.82863	5.01586	5.05964	5.12586
10	-869.752	1.0631	1	0.303	8.85227	5.01853	5.06669	5.13952
11	-869.14	1.2239	1	0.269	8.87192	5.02074	5.07327	5.15273
12	-868.026	2.2279	1	0.136	8.86623	5.02009	5.077	5.16308
13	-866.281	3.4903	1	0.062	8.82874	5.01585	5.07713	5.16984
14	-864.628	3.3068	1	0.069	8.79601	5.01212	5.07779	5.17711
15	-864.179	.89677	1	0.344	8.8238	5.01527	5.08531	5.19126

Table A46. Results of lag selection of time-series yearly model of 2018 for humidity

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1455.92		235.961	8.30154	8.30592	8.31254		
1	**-1274.97**	**361.9**	**1**	**0.000**	**84.6318***	**7.27619***	**7.28494***	**7.29819***
2	-1274.3	1.34	1	0.247	84.7911	7.27807	7.2912	7.31107
3	-1273.7	1.2073	1	0.272	84.9828	7.28033	7.29784	7.32432
4	-1273.57	.26153	1	0.609	85.4049	7.28528	7.30717	7.34028
5	-1273.36	.42095	1	0.516	85.7901	7.28978	7.31604	7.35577

6	-1270.18	6.3552	1	0.012	84.7323	7.27737	7.30801	7.35436
7	-1270.09	.17254	1	0.678	85.1749	7.28258	7.3176	7.37057
8	-1269.78	.61577	1	0.433	85.5117	7.28652	7.32592	7.38551
9	-1269.72	.13725	1	0.711	85.9671	7.29183	7.3356	7.40182
10	-1268.24	2.9596	1	0.085	85.7328	7.28909	7.33725	7.41009
11	-1267.28	1.9015	1	0.168	85.7574	7.28937	7.34191	7.42137
12	-1267.28	.00375	1	0.951	86.2471	7.29506	7.35197	7.43805
13	-1264.95	4.6707*	1	0.031	85.5941	7.28745	7.34874	7.44144
14	-1263.85	2.1965	1	0.138	85.547	7.28689	7.35256	7.45188
15	-1263.82	.06544	1	0.798	86.0208	7.2924	7.36245	7.46839

Table A47. Results of lag selection of time-series yearly model of 2018 for flu

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	**-35.2966**		**.416493***	**1.96198***	**1.97733***	**2.00552***		
1	-34.8273	.93868	1	0.333	.428652	1.99066	2.02136	2.07774
2	-34.2573	1.1398	1	0.286	.438845	2.01391	2.05996	2.14453
3	-33.7492	1.0162	1	0.313	.450891	2.0405	2.1019	2.21465
4	-33.3242	.85011	1	0.357	.465503	2.07158	2.14832	2.28927
5	-32.7673	1.1137	1	0.291	.477373	2.09553	2.18763	2.35676
6	-32.7641	.00637	1	0.936	.50467	2.14941	2.25686	2.45418
7	-32.0586	1.4112	1	0.235	.513957	2.16533	2.28812	2.51363
8	-31.9641	.18899	1	0.664	.541369	2.21427	2.35242	2.60612
9	-31.8913	.14551	1	0.703	.571373	2.26439	2.41789	2.69978
10	-29.948	3.8867*	1	0.049	.545549	2.2134	2.38225	2.69233
11	-29.907	.08199	1	0.775	.577909	2.26524	2.44943	2.7877
12	-29.9068	.00026	1	0.987	.614269	2.31929	2.51883	2.88529
13	-29.7237	.36629	1	0.545	.647356	2.36344	2.57833	2.97298
14	-28.4318	2.5837	1	0.108	.643509	2.34767	2.57791	3.00074
15	-28.394	.07578	1	0.783	.685711	2.39967	2.64526	3.09629

Appendix 2: Results of time-series models without air pollutants

Table A2.1 Results of time-series three-year model without air pollutants among children under 17 ages in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.005	0.004	1.140	0.256	0.996	1.014	
Temperature_lag1	0.995	0.006	-0.780	0.438	0.983	1.007	
Temperature_lag2	1.008	0.006	1.180	0.238	0.995	1.020	
Temperature_lag3	0.994	0.006	-0.920	0.357	0.982	1.007	
Temperature_lag4	1.006	0.006	0.910	0.363	0.993	1.019	
Temperature_lag5	0.996	0.006	-0.580	0.560	0.984	1.009	
Temperature_lag6	0.999	0.006	-0.140	0.885	0.987	1.012	
Temperature_lag7	1.001	0.006	0.140	0.887	0.988	1.014	
Temperature_lag8	1.002	0.006	0.390	0.696	0.990	1.015	
Temperature_lag9	1.007	0.006	1.060	0.287	0.994	1.019	
Temperature_lag10	0.995	0.004	-1.090	0.277	0.987	1.004	
Humidity_lag0	1.000	0.002	-0.070	0.945	0.997	1.003	
Humidity_lag1	0.999	0.002	-0.430	0.669	0.995	1.003	
Humidity_lag2	1.000	0.002	0.160	0.872	0.997	1.004	
Humidity_lag3	1.000	0.002	-0.200	0.844	0.996	1.003	
Humidity_lag4	1.001	0.002	0.490	0.625	0.997	1.005	
Humidity_lag5	0.999	0.002	-0.290	0.771	0.996	1.003	
Humidity_lag6	1.000	0.002	-0.110	0.910	0.996	1.004	
Humidity_lag7	0.999	0.002	-0.630	0.531	0.995	1.003	
Humidity_lag8	1.002	0.002	1.110	0.269	0.998	1.006	
Humidity_lag9	1.000	0.002	0.220	0.822	0.997	1.004	
Humidity_lag10	1.001	0.002	0.570	0.571	0.997	1.005	
Humidity_lag11	1.000	0.002	-0.250	0.806	0.996	1.003	
Humidity_lag12	1.000	0.002	0.100	0.919	0.997	1.004	
Humidity_lag13	1.000	0.001	0.280	0.782	0.998	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.082	0.031	2.770	0.006	1.023	1.144	***
Flu_lag0	0.984	0.029	-0.560	0.579	0.928	1.043	
Flu_lag1	0.992	0.030	-0.250	0.799	0.936	1.052	
Flu_lag2	0.938	0.028	-2.150	0.031	0.885	0.994	**
Flu_lag3	1.024	0.031	0.800	0.425	0.966	1.086	
Flu_lag4	1.018	0.030	0.590	0.556	0.960	1.079	
Flu_lag5	0.961	0.029	-1.310	0.192	0.906	1.020	
Flu_lag6	1.058	0.032	1.870	0.061	0.997	1.123	*
Flu_lag7	1.043	0.032	1.390	0.166	0.983	1.107	
Flu_lag8	1.028	0.031	0.930	0.354	0.969	1.091	
Flu_lag9	1.015	0.031	0.490	0.625	0.957	1.077	

Flu_lag10	1.003	0.030	0.100	0.923	0.945	1.064	
Flu_lag11	0.958	0.029	-1.420	0.156	0.904	1.016	
Flu_lag12	0.987	0.029	-0.450	0.653	0.931	1.046	
cos_1	1.585	0.098	7.430	0.000	1.403	1.789	***
cos_2	0.884	0.018	-5.950	0.000	0.849	0.921	***
cos_3	1.188	0.023	8.740	0.000	1.143	1.235	***
cos_4	1.101	0.021	4.950	0.000	1.060	1.143	***
sin_1	1.072	0.033	2.300	0.021	1.010	1.138	**
sin_2	0.937	0.019	-3.170	0.002	0.900	0.975	***
sin_3	1.229	0.025	10.200	0.000	1.181	1.278	***
sin_4	0.841	0.016	-9.130	0.000	0.810	0.873	***
Constant	5.963	0.965	11.030	0.000	4.342	8.189	***
lnalpha	-3.014	0.158	.b	.b	-3.325	-2.704	

Mean dependent var	7.538	SD dependent var	4.081
Pseudo r-squared	0.087	Number of obs	1083
Chi-square	518.972	Prob > chi2	0.000
Akaike crit. (AIC)	5556.978	Bayesian crit. (BIC)	5801.365

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg dailycounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.2 Results of time-series sex-stratified model among female children under 17 ages in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.002	0.007	0.260	0.791	0.989	1.015	
Temperature_lag1	1.001	0.009	0.140	0.889	0.983	1.020	
Temperature_lag2	1.014	0.010	1.460	0.144	0.995	1.033	
Temperature_lag3	0.980	0.010	-2.060	0.039	0.961	0.999	**
Temperature_lag4	1.018	0.010	1.820	0.069	0.999	1.037	*
Temperature_lag5	0.982	0.009	-1.840	0.066	0.964	1.001	*
Temperature_lag6	1.002	0.010	0.180	0.859	0.983	1.021	
Temperature_lag7	1.011	0.010	1.130	0.258	0.992	1.030	
Temperature_lag8	1.003	0.010	0.300	0.764	0.984	1.022	
Temperature_lag9	0.997	0.009	-0.370	0.709	0.978	1.015	
Temperature_lag10	1.002	0.007	0.300	0.762	0.989	1.015	
Humidity_lag0	0.999	0.002	-0.290	0.775	0.994	1.004	
Humidity_lag1	1.003	0.003	1.080	0.280	0.997	1.009	
Humidity_lag2	1.000	0.003	-0.020	0.987	0.994	1.006	
Humidity_lag3	1.000	0.003	-0.110	0.916	0.994	1.006	
Humidity_lag4	1.000	0.003	0.030	0.973	0.994	1.006	
Humidity_lag5	0.996	0.003	-1.280	0.201	0.990	1.002	
Humidity_lag6	1.002	0.003	0.600	0.547	0.996	1.008	

Humidity_lag7	0.999	0.003	-0.250	0.804	0.993	1.005	
Humidity_lag8	1.003	0.003	0.840	0.403	0.997	1.008	
Humidity_lag9	1.001	0.003	0.440	0.663	0.995	1.007	
Humidity_lag10	0.999	0.003	-0.190	0.853	0.994	1.005	
Humidity_lag11	1.001	0.003	0.380	0.707	0.995	1.007	
Humidity_lag12	0.999	0.003	-0.280	0.783	0.994	1.005	
Humidity_lag13	1.001	0.002	0.430	0.665	0.997	1.005	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.063	0.047	1.390	0.165	0.975	1.159	
Flu_lag0	0.939	0.042	-1.400	0.162	0.860	1.026	
Flu_lag1	1.020	0.046	0.440	0.663	0.933	1.115	
Flu_lag2	0.936	0.042	-1.470	0.142	0.856	1.023	
Flu_lag3	1.012	0.046	0.270	0.786	0.926	1.106	
Flu_lag4	1.030	0.047	0.660	0.511	0.943	1.126	
Flu_lag5	1.007	0.046	0.150	0.883	0.920	1.101	
Flu_lag6	1.067	0.049	1.420	0.157	0.975	1.168	
Flu_lag7	1.092	0.050	1.900	0.057	0.997	1.195	*
Flu_lag8	1.021	0.047	0.460	0.649	0.933	1.118	
Flu_lag9	0.976	0.045	-0.530	0.597	0.892	1.068	
Flu_lag10	0.991	0.045	-0.210	0.837	0.906	1.083	
Flu_lag11	0.982	0.044	-0.400	0.689	0.899	1.073	
Flu_lag12	0.935	0.042	-1.500	0.133	0.856	1.021	
cos_1	1.766	0.165	6.080	0.000	1.471	2.122	***
cos_2	0.906	0.029	-3.040	0.002	0.850	0.966	***
cos_3	1.278	0.040	7.880	0.000	1.202	1.358	***
cos_4	1.045	0.031	1.480	0.139	0.986	1.109	
sin_1	1.137	0.053	2.770	0.006	1.038	1.245	***
sin_2	0.937	0.030	-2.050	0.040	0.881	0.997	**
sin_3	1.194	0.037	5.650	0.000	1.123	1.270	***
sin_4	0.838	0.025	-6.010	0.000	0.791	0.887	***
Constant	1.855	0.460	2.490	0.013	1.141	3.017	**
lnalpha	-2.567	0.248	.b	.b	-3.053	-2.082	

Mean dependent var	2.820	SD dependent var	2.144
Pseudo r-squared	0.070	Number of obs	1083
Chi-square	314.213	Prob > chi2	0.000
Akaike crit. (AIC)	4266.596	Bayesian crit. (BIC)	4510.983

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg femalecounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.3 Results of time-series sex-stratified model among male children under 17 ages in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.007	0.005	1.440	0.149	0.997	1.018	
Temperature_lag1	0.991	0.007	-1.270	0.204	0.977	1.005	
Temperature_lag2	1.004	0.007	0.540	0.590	0.990	1.019	
Temperature_lag3	1.003	0.007	0.350	0.726	0.988	1.017	
Temperature_lag4	0.999	0.007	-0.140	0.891	0.985	1.014	
Temperature_lag5	1.005	0.007	0.730	0.463	0.991	1.020	
Temperature_lag6	0.997	0.007	-0.360	0.718	0.983	1.012	
Temperature_lag7	0.994	0.007	-0.820	0.412	0.980	1.008	
Temperature_lag8	1.003	0.007	0.350	0.729	0.988	1.017	
Temperature_lag9	1.013	0.007	1.790	0.073	0.999	1.027	*
Temperature_lag10	0.991	0.005	-1.720	0.085	0.981	1.001	*
Humidity_lag0	1.000	0.002	0.170	0.867	0.997	1.004	
Humidity_lag1	0.997	0.002	-1.430	0.153	0.992	1.001	
Humidity_lag2	1.000	0.002	0.150	0.883	0.996	1.005	
Humidity_lag3	1.000	0.002	-0.120	0.906	0.995	1.004	
Humidity_lag4	1.002	0.002	0.680	0.497	0.997	1.006	
Humidity_lag5	1.001	0.002	0.660	0.508	0.997	1.006	
Humidity_lag6	0.999	0.002	-0.630	0.529	0.994	1.003	
Humidity_lag7	0.998	0.002	-0.700	0.481	0.994	1.003	
Humidity_lag8	1.002	0.002	0.820	0.410	0.997	1.006	
Humidity_lag9	1.000	0.002	-0.040	0.964	0.996	1.004	
Humidity_lag10	1.002	0.002	0.990	0.320	0.998	1.006	
Humidity_lag11	0.999	0.002	-0.700	0.487	0.994	1.003	
Humidity_lag12	1.001	0.002	0.380	0.702	0.997	1.005	
Humidity_lag13	1.000	0.002	0.010	0.994	0.997	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.095	0.036	2.750	0.006	1.026	1.168	***
Flu_lag0	1.014	0.035	0.390	0.694	0.947	1.085	
Flu_lag1	0.977	0.034	-0.680	0.495	0.912	1.045	
Flu_lag2	0.938	0.032	-1.850	0.064	0.876	1.004	*
Flu_lag3	1.033	0.036	0.950	0.344	0.966	1.106	
Flu_lag4	1.008	0.035	0.230	0.817	0.942	1.079	
Flu_lag5	0.932	0.033	-2.000	0.045	0.871	0.999	**
Flu_lag6	1.051	0.037	1.430	0.152	0.982	1.126	
Flu_lag7	1.015	0.036	0.430	0.667	0.948	1.088	
Flu_lag8	1.031	0.036	0.890	0.371	0.964	1.104	
Flu_lag9	1.042	0.036	1.170	0.241	0.973	1.116	
Flu_lag10	1.008	0.035	0.230	0.822	0.941	1.079	
Flu_lag11	0.942	0.033	-1.720	0.086	0.880	1.009	*
Flu_lag12	1.019	0.035	0.550	0.583	0.953	1.090	
cos_1	1.493	0.108	5.550	0.000	1.296	1.720	***

cos_2	0.867	0.021	-5.990	0.000	0.827	0.908	***
cos_3	1.146	0.026	5.970	0.000	1.096	1.198	***
cos_4	1.129	0.025	5.420	0.000	1.080	1.179	***
sin_1	1.038	0.036	1.070	0.284	0.969	1.112	
sin_2	0.940	0.023	-2.560	0.010	0.897	0.986	**
sin_3	1.248	0.029	9.490	0.000	1.192	1.306	***
sin_4	0.842	0.018	-7.860	0.000	0.806	0.879	***
Constant	4.120	0.772	7.560	0.000	2.854	5.948	***
lnalpha	-3.431	0.321	.b	.b	-4.061	-2.801	
Mean dependent var	4.718		SD dependent var		2.782		
Pseudo r-squared	0.074		Number of obs		1083		
Chi-square	382.689		Prob > chi2		0.000		
Akaike crit. (AIC)	4867.752		Bayesian crit. (BIC)		5112.139		

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg malecounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.4 Results of time-series age-stratified model among younger children (0-4 ages) in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.004	0.005	0.840	0.401	0.995	1.013	
Temperature_lag1	0.993	0.007	-1.020	0.310	0.980	1.006	
Temperature_lag2	1.006	0.007	0.950	0.344	0.993	1.020	
Temperature_lag3	0.991	0.007	-1.280	0.202	0.978	1.005	
Temperature_lag4	1.006	0.007	0.810	0.418	0.992	1.019	
Temperature_lag5	1.000	0.007	-0.070	0.946	0.986	1.013	
Temperature_lag6	0.996	0.007	-0.540	0.590	0.983	1.010	
Temperature_lag7	1.002	0.007	0.360	0.722	0.989	1.016	
Temperature_lag8	0.997	0.007	-0.500	0.619	0.983	1.010	
Temperature_lag9	1.010	0.007	1.520	0.129	0.997	1.023	
Temperature_lag10	0.994	0.005	-1.260	0.208	0.985	1.003	
Humidity_lag0	1.001	0.002	0.420	0.675	0.997	1.004	
Humidity_lag1	0.998	0.002	-0.930	0.353	0.994	1.002	
Humidity_lag2	1.002	0.002	1.000	0.319	0.998	1.007	
Humidity_lag3	0.999	0.002	-0.630	0.529	0.994	1.003	
Humidity_lag4	1.001	0.002	0.230	0.820	0.996	1.005	
Humidity_lag5	1.001	0.002	0.320	0.750	0.996	1.005	
Humidity_lag6	0.997	0.002	-1.380	0.167	0.993	1.001	
Humidity_lag7	1.000	0.002	0.210	0.832	0.996	1.005	
Humidity_lag8	1.002	0.002	1.020	0.307	0.998	1.007	
Humidity_lag9	0.999	0.002	-0.430	0.664	0.995	1.003	
Humidity_lag10	1.001	0.002	0.540	0.591	0.997	1.005	

Humidity_lag11	0.998	0.002	-0.750	0.455	0.994	1.003	
Humidity_lag12	1.001	0.002	0.280	0.778	0.996	1.005	
Humidity_lag13	1.001	0.002	0.570	0.570	0.998	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.046	0.034	1.380	0.167	0.982	1.114	
Flu_lag0	0.994	0.032	-0.190	0.846	0.932	1.059	
Flu_lag1	0.961	0.031	-1.210	0.227	0.901	1.025	
Flu_lag2	0.917	0.030	-2.660	0.008	0.860	0.978	***
Flu_lag3	1.022	0.033	0.660	0.510	0.958	1.089	
Flu_lag4	1.019	0.033	0.580	0.565	0.956	1.087	
Flu_lag5	0.968	0.032	-0.980	0.330	0.908	1.033	
Flu_lag6	1.063	0.035	1.840	0.066	0.996	1.134	*
Flu_lag7	1.022	0.034	0.640	0.524	0.957	1.091	
Flu_lag8	1.026	0.034	0.780	0.434	0.962	1.094	
Flu_lag9	1.026	0.034	0.780	0.434	0.962	1.095	
Flu_lag10	1.030	0.034	0.900	0.368	0.966	1.098	
Flu_lag11	0.977	0.032	-0.700	0.484	0.917	1.042	
Flu_lag12	1.001	0.032	0.040	0.972	0.940	1.067	
cos_1	1.725	0.116	8.100	0.000	1.512	1.968	***
cos_2	0.925	0.022	-3.270	0.001	0.883	0.969	***
cos_3	1.174	0.027	6.980	0.000	1.122	1.228	***
cos_4	1.091	0.024	3.960	0.000	1.045	1.139	***
sin_1	1.107	0.037	3.030	0.002	1.037	1.183	***
sin_2	0.943	0.022	-2.480	0.013	0.900	0.988	**
sin_3	1.175	0.028	6.890	0.000	1.122	1.231	***
sin_4	0.853	0.019	-7.290	0.000	0.818	0.891	***
Constant	4.528	0.823	8.310	0.000	3.170	6.466	***
lnalpha	-3.252	0.247	.b	.b	-3.737	-2.767	

Mean dependent var	5.242	SD dependent var	3.374
Pseudo r-squared	0.115	Number of obs	1083
Chi-square	630.675	Prob > chi2	0.000
Akaike crit. (AIC)	4968.159	Bayesian crit. (BIC)	5212.546

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg youngercounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.5 Results of time-series age-stratified model among older children (5-16 ages) in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.009	0.009	1.020	0.306	0.992	1.026	
Temperature_lag1	1.001	0.012	0.070	0.947	0.978	1.024	
Temperature_lag2	1.013	0.012	1.040	0.298	0.989	1.037	

Temperature_lag3	1.003	0.012	0.220	0.822	0.979	1.027	
Temperature_lag4	1.007	0.012	0.550	0.581	0.983	1.031	
Temperature_lag5	0.987	0.012	-1.120	0.261	0.963	1.010	
Temperature_lag6	1.008	0.012	0.680	0.499	0.985	1.032	
Temperature_lag7	0.995	0.012	-0.450	0.649	0.971	1.018	
Temperature_lag8	1.023	0.012	1.890	0.059	0.999	1.047	*
Temperature_lag9	0.994	0.012	-0.520	0.603	0.971	1.017	
Temperature_lag10	1.000	0.008	-0.050	0.957	0.983	1.016	
Humidity_lag0	0.998	0.003	-0.660	0.511	0.993	1.004	
Humidity_lag1	1.002	0.003	0.590	0.558	0.996	1.008	
Humidity_lag2	0.997	0.003	-0.860	0.390	0.991	1.004	
Humidity_lag3	1.003	0.003	0.800	0.427	0.996	1.009	
Humidity_lag4	1.002	0.003	0.720	0.469	0.996	1.009	
Humidity_lag5	0.997	0.003	-1.020	0.309	0.990	1.003	
Humidity_lag6	1.005	0.003	1.580	0.114	0.999	1.011	
Humidity_lag7	0.996	0.003	-1.390	0.166	0.989	1.002	
Humidity_lag8	1.003	0.003	0.970	0.330	0.997	1.010	
Humidity_lag9	1.002	0.003	0.740	0.459	0.996	1.009	
Humidity_lag10	1.001	0.003	0.320	0.750	0.995	1.007	
Humidity_lag11	1.002	0.003	0.730	0.466	0.996	1.008	
Humidity_lag12	1.000	0.003	-0.080	0.936	0.994	1.006	
Humidity_lag13	0.999	0.002	-0.450	0.651	0.994	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.176	0.056	3.390	0.001	1.071	1.291	***
Flu_lag0	0.965	0.052	-0.660	0.511	0.869	1.073	
Flu_lag1	1.099	0.059	1.750	0.081	0.989	1.222	*
Flu_lag2	1.016	0.055	0.300	0.768	0.914	1.129	
Flu_lag3	1.038	0.056	0.690	0.489	0.934	1.153	
Flu_lag4	0.995	0.054	-0.080	0.932	0.896	1.106	
Flu_lag5	0.940	0.051	-1.130	0.258	0.845	1.046	
Flu_lag6	1.047	0.057	0.860	0.391	0.942	1.164	
Flu_lag7	1.113	0.060	1.980	0.048	1.001	1.237	**
Flu_lag8	1.031	0.056	0.570	0.570	0.928	1.146	
Flu_lag9	0.979	0.053	-0.400	0.692	0.879	1.089	
Flu_lag10	0.923	0.051	-1.460	0.144	0.829	1.028	
Flu_lag11	0.897	0.049	-1.980	0.047	0.807	0.999	**
Flu_lag12	0.934	0.050	-1.270	0.206	0.841	1.038	
cos_1	1.390	0.161	2.850	0.004	1.108	1.744	***
cos_2	0.745	0.027	-8.090	0.000	0.694	0.800	***
cos_3	1.167	0.039	4.570	0.000	1.092	1.246	***
cos_4	1.096	0.036	2.750	0.006	1.027	1.169	***
sin_1	1.057	0.057	1.030	0.302	0.951	1.176	

sin_2	0.900	0.031	-3.020	0.003	0.841	0.964	***
sin_3	1.329	0.045	8.380	0.000	1.244	1.421	***
sin_4	0.830	0.027	-5.840	0.000	0.779	0.883	***
Constant	1.076	0.300	0.260	0.794	0.622	1.860	
lnalpha	-2.570	0.282	.b	.b	-3.122	-2.018	

Mean dependent var	2.296	SD dependent var	2.016
Pseudo r-squared	0.076	Number of obs	1083
Chi-square	319.696	Prob > chi2	0.000
Akaike crit. (AIC)	3960.462	Bayesian crit. (BIC)	4204.849

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg oldercounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.6 Results of time-series wildfire season model among children under 17 ages in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.019	0.011	1.810	0.070	0.998	1.040	*
Temperature_lag1	0.991	0.014	-0.680	0.498	0.964	1.018	
Temperature_lag2	1.009	0.012	0.770	0.443	0.986	1.034	
Temperature_lag3	0.991	0.012	-0.750	0.452	0.968	1.015	
Temperature_lag4	1.010	0.012	0.810	0.417	0.986	1.034	
Temperature_lag5	0.983	0.011	-1.500	0.135	0.961	1.005	
Temperature_lag6	1.008	0.008	1.010	0.311	0.993	1.024	
Humidity_lag0	1.001	0.003	0.550	0.581	0.996	1.006	
Humidity_lag1	0.999	0.003	-0.250	0.805	0.994	1.004	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.154	0.048	3.420	0.001	1.063	1.253	***
Flu_lag0	0.924	0.054	-1.350	0.178	0.823	1.037	
Flu_lag1	0.996	0.058	-0.070	0.943	0.889	1.116	
Flu_lag2	0.973	0.057	-0.470	0.640	0.868	1.091	
Flu_lag3	0.910	0.054	-1.600	0.110	0.811	1.022	
Flu_lag4	1.020	0.060	0.340	0.734	0.909	1.146	
Flu_lag5	0.894	0.054	-1.870	0.062	0.795	1.006	*
Flu_lag6	0.942	0.055	-1.010	0.312	0.840	1.057	
Flu_lag7	1.047	0.060	0.800	0.422	0.936	1.171	
Flu_lag8	0.983	0.057	-0.300	0.763	0.877	1.101	
Flu_lag9	0.929	0.055	-1.240	0.214	0.827	1.043	
Flu_lag10	0.969	0.057	-0.540	0.588	0.863	1.087	
Flu_lag11	1.002	0.058	0.040	0.969	0.896	1.122	
Flu_lag12	1.029	0.058	0.510	0.611	0.921	1.150	
Flu_lag13	1.018	0.058	0.320	0.753	0.910	1.139	
Flu_lag14	1.089	0.062	1.490	0.136	0.974	1.217	

Flu_lag15	1.141	0.066	2.270	0.023	1.018	1.278	**
Flu_lag16	0.953	0.056	-0.810	0.418	0.849	1.071	
Flu_lag17	1.006	0.059	0.110	0.915	0.897	1.129	
cos_1	1.065	8.243	0.010	0.994	0.000	4.133E+06	
cos_2	1.080	5.280	0.020	0.988	0.000	1.571E+04	
cos_3	2.079	4.387	0.350	0.729	0.033	130.109	
cos_4	1.778	0.889	1.150	0.249	0.668	4.735	
sin_1	5.831	3.573	2.880	0.004	1.755	19.378	***
sin_2	8.930	7.074	2.760	0.006	1.890	42.186	***
sin_3	6.492	3.516	3.450	0.001	2.246	18.767	***
sin_4	1.644	0.320	2.550	0.011	1.122	2.408	**
Constant	4.282	19.137	0.330	0.745	0.001	2.728E+04	
lnalpha	-3.480	0.355	.b	.b	-4.176	-2.785	

Mean dependent var	6.501	SD dependent var	4.208
Pseudo r-squared	0.130	Number of obs	549
Chi-square	388.950	Prob > chi2	0.000
Akaike crit. (AIC)	2677.026	Bayesian crit. (BIC)	2840.734

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg wildfirecounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.7 Results of time-series non-wildfire season model among children under 17 ages in Edmonton between 2016 to 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.001	0.004	0.150	0.879	0.992	1.009	
Temperature_lag1	0.997	0.006	-0.560	0.575	0.984	1.009	
Temperature_lag2	1.005	0.006	0.820	0.410	0.993	1.018	
Temperature_lag3	0.995	0.006	-0.810	0.418	0.983	1.007	
Temperature_lag4	1.006	0.006	0.890	0.374	0.993	1.018	
Temperature_lag5	1.000	0.006	-0.010	0.988	0.988	1.012	
Temperature_lag6	0.998	0.006	-0.260	0.797	0.987	1.010	
Temperature_lag7	0.997	0.006	-0.520	0.602	0.985	1.009	
Temperature_lag8	1.008	0.004	1.850	0.064	1.000	1.016	*
Humidity_lag0	0.999	0.002	-0.300	0.766	0.995	1.004	
Humidity_lag1	0.998	0.003	-0.820	0.409	0.993	1.003	
Humidity_lag2	1.001	0.003	0.240	0.810	0.996	1.006	
Humidity_lag3	0.999	0.002	-0.520	0.600	0.995	1.003	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.052	0.037	1.450	0.147	0.982	1.128	
Flu_lag0	0.995	0.032	-0.160	0.870	0.934	1.059	
Flu_lag1	0.979	0.032	-0.660	0.510	0.919	1.043	
Flu_lag2	0.917	0.029	-2.720	0.007	0.861	0.976	***

Flu_lag3	1.061	0.034	1.840	0.066	0.996	1.131	*
Flu_lag4	0.995	0.032	-0.170	0.867	0.934	1.060	
Flu_lag5	0.968	0.031	-0.990	0.321	0.909	1.032	
Flu_lag6	1.088	0.036	2.550	0.011	1.020	1.160	**
Flu_lag7	1.028	0.034	0.820	0.415	0.963	1.097	
Flu_lag8	1.030	0.034	0.910	0.363	0.966	1.099	
Flu_lag9	1.038	0.034	1.140	0.255	0.973	1.107	
Flu_lag10	1.005	0.033	0.160	0.875	0.943	1.071	
Flu_lag11	0.946	0.031	-1.700	0.090	0.888	1.009	*
Flu_lag12	0.964	0.031	-1.140	0.254	0.905	1.027	
cos_1	0.000	0.000	-2.370	0.018	0.000	0.059	**
cos_2	3.566E+04	1.544E+05	2.420	0.015	7.352	1.730E+08	**
cos_3	0.013	0.024	-2.350	0.019	0.000	0.488	**
cos_4	2.833	1.228	2.400	0.016	1.211	6.625	**
sin_1	0.619	0.375	-0.790	0.428	0.188	2.031	
sin_2	2.095	1.643	0.940	0.346	0.450	9.748	
sin_3	0.615	0.329	-0.910	0.363	0.216	1.754	
sin_4	1.152	0.215	0.760	0.447	0.800	1.660	
Constant	1.398E+05	5.540E+05	2.990	0.003	59.223	3.301E+08	***
lnalpha	-3.754	0.364	.b	.b	-4.467	-3.041	

Mean dependent var	8.602	SD dependent var	3.653
Pseudo r-squared	0.045	Number of obs	535
Chi-square	128.672	Prob > chi2	0.000
Akaike crit. (AIC)	2807.172	Bayesian crit. (BIC)	2965.616

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg non-wildfirecounts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.8 Results of time-series yearly model among children under 17 ages in Edmonton in 2016

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.017	0.008	2.150	0.031	1.001	1.032	**
Temperature_lag1	0.991	0.010	-0.900	0.367	0.971	1.011	
Temperature_lag2	1.021	0.010	2.060	0.039	1.001	1.041	**
Temperature_lag3	0.986	0.010	-1.410	0.158	0.967	1.005	
Temperature_lag4	1.011	0.010	1.030	0.301	0.991	1.031	
Temperature_lag5	1.007	0.010	0.650	0.516	0.987	1.027	
Temperature_lag6	1.005	0.010	0.450	0.655	0.985	1.025	
Temperature_lag7	1.008	0.010	0.790	0.431	0.989	1.027	
Temperature_lag8	0.991	0.007	-1.300	0.195	0.977	1.005	
Humidity_lag0	1.000	0.003	-0.090	0.930	0.994	1.005	
Humidity_lag1	0.997	0.003	-1.080	0.280	0.992	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.028	0.046	0.610	0.540	0.941	1.123	

Flu_lag0	0.923	0.049	-1.510	0.130	0.832	1.024	
Flu_lag1	0.973	0.049	-0.550	0.584	0.881	1.074	
Flu_lag2	1.029	0.053	0.560	0.573	0.931	1.138	
Flu_lag3	1.069	0.053	1.330	0.182	0.969	1.178	
Flu_lag4	1.050	0.052	0.980	0.327	0.952	1.158	
Flu_lag5	1.009	0.051	0.170	0.862	0.914	1.113	
Flu_lag6	1.076	0.054	1.460	0.145	0.975	1.186	
Flu_lag7	0.974	0.050	-0.510	0.608	0.881	1.077	
cos_1	2.330	0.299	6.580	0.000	1.811	2.998	***
cos_2	0.905	0.034	-2.640	0.008	0.840	0.975	***
cos_3	1.225	0.043	5.730	0.000	1.143	1.313	***
cos_4	1.134	0.038	3.790	0.000	1.063	1.210	***
sin_1	0.987	0.053	-0.240	0.814	0.889	1.096	
sin_2	0.967	0.038	-0.860	0.389	0.895	1.044	
sin_3	1.168	0.039	4.680	0.000	1.095	1.247	***
sin_4	0.725	0.023	-10.290	0.000	0.682	0.771	***
Constant	7.008	1.284	10.630	0.000	4.894	10.036	***
lnalpha	-4.073	0.646	.b	.b	-5.340	-2.806	

Mean dependent var	7.525	SD dependent var	4.284
Pseudo r-squared	0.131	Number of obs	358
Chi-square	261.473	Prob > chi2	0.000
Akaike crit. (AIC)	1798.450	Bayesian crit. (BIC)	1914.866

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg 2016counts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.9 Results of time-series yearly model among children under 17 ages in Edmonton in 2017

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.000	0.009	0.000	0.999	0.983	1.017	
Temperature_lag1	1.010	0.012	0.800	0.423	0.986	1.034	
Temperature_lag2	0.988	0.010	-1.160	0.245	0.968	1.008	
Temperature_lag3	1.005	0.007	0.670	0.503	0.991	1.019	
Humidity_lag0	1.002	0.003	0.760	0.449	0.996	1.008	
Humidity_lag1	1.000	0.003	0.090	0.926	0.995	1.006	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.102	0.053	2.040	0.041	1.004	1.210	**
Flu_lag0	0.980	0.055	-0.360	0.720	0.878	1.094	
Flu_lag1	0.978	0.054	-0.400	0.686	0.878	1.089	
Flu_lag2	1.021	0.055	0.380	0.702	0.918	1.135	
Flu_lag3	1.002	0.054	0.030	0.976	0.901	1.113	
Flu_lag4	1.017	0.055	0.310	0.755	0.915	1.130	
Flu_lag5	0.863	0.048	-2.660	0.008	0.774	0.962	***
Flu_lag6	1.011	0.055	0.190	0.848	0.908	1.125	

Flu_lag7	1.047	0.058	0.830	0.405	0.940	1.167	
Flu_lag8	1.000	0.056	-0.010	0.994	0.896	1.116	
Flu_lag9	1.016	0.056	0.290	0.774	0.911	1.133	
Flu_lag10	1.082	0.060	1.410	0.158	0.970	1.207	
Flu_lag11	1.005	0.056	0.080	0.935	0.901	1.120	
Flu_lag12	1.056	0.059	0.980	0.325	0.947	1.177	
cos_1	1.366	0.117	3.640	0.000	1.155	1.616	***
cos_2	0.944	0.046	-1.180	0.236	0.858	1.039	
cos_3	1.137	0.057	2.570	0.010	1.031	1.254	**
cos_4	1.142	0.040	3.840	0.000	1.067	1.223	***
sin_1	0.959	0.036	-1.100	0.271	0.891	1.033	
sin_2	0.943	0.031	-1.770	0.077	0.884	1.006	*
sin_3	1.272	0.042	7.230	0.000	1.192	1.357	***
sin_4	0.876	0.028	-4.130	0.000	0.822	0.933	***
Constant	5.623	1.284	7.560	0.000	3.594	8.796	***
lnalpha	-3.432	0.382	.b	.b	-4.181	-2.682	

Mean dependent var	7.397	SD dependent var	3.897
Pseudo r-squared	0.086	Number of obs	353
Chi-square	163.845	Prob > chi2	0.000
Akaike crit. (AIC)	1801.230	Bayesian crit. (BIC)	1917.224

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg 2017counts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr

Table A2.10 Results of time-series yearly model among children under 17 ages in Edmonton in 2018

Variable	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Temperature_lag0	1.012	0.008	1.450	0.148	0.996	1.027	
Temperature_lag1	0.982	0.010	-1.770	0.076	0.963	1.002	*
Temperature_lag2	1.010	0.010	0.990	0.321	0.990	1.031	
Temperature_lag3	0.993	0.011	-0.670	0.505	0.972	1.014	
Temperature_lag4	1.009	0.011	0.880	0.377	0.989	1.030	
Temperature_lag5	0.990	0.010	-0.920	0.357	0.970	1.011	
Temperature_lag6	1.007	0.010	0.650	0.514	0.987	1.027	
Temperature_lag7	0.995	0.010	-0.540	0.592	0.975	1.014	
Temperature_lag8	1.011	0.010	1.100	0.272	0.992	1.030	
Temperature_lag9	1.003	0.009	0.350	0.724	0.985	1.021	
Temperature_lag10	1.002	0.007	0.280	0.778	0.989	1.015	
Humidity_lag0	1.001	0.003	0.560	0.576	0.996	1.007	
Humidity_lag1	1.002	0.003	0.670	0.504	0.996	1.008	
Humidity_lag2	1.001	0.003	0.240	0.813	0.995	1.007	
Humidity_lag3	1.000	0.003	-0.140	0.885	0.994	1.005	
Humidity_lag4	1.003	0.003	1.050	0.293	0.997	1.009	

Humidity_lag5	0.997	0.003	-1.040	0.297	0.992	1.002	
0b.H&W	1.000	.	.	.	.	.	
1.H&W	1.147	0.055	2.840	0.004	1.043	1.260	***
Flu_lag0	1.042	0.054	0.800	0.423	0.942	1.153	
Flu_lag1	1.024	0.053	0.450	0.652	0.925	1.133	
Flu_lag2	0.864	0.044	-2.860	0.004	0.782	0.955	***
Flu_lag3	1.047	0.054	0.890	0.372	0.947	1.158	
Flu_lag4	1.001	0.052	0.010	0.991	0.903	1.108	
Flu_lag5	1.020	0.052	0.390	0.693	0.923	1.128	
Flu_lag6	1.114	0.059	2.040	0.041	1.004	1.236	**
Flu_lag7	1.094	0.057	1.720	0.085	0.988	1.212	*
Flu_lag8	1.015	0.054	0.290	0.775	0.914	1.128	
Flu_lag9	1.018	0.056	0.340	0.737	0.915	1.134	
Flu_lag10	0.974	0.053	-0.480	0.633	0.876	1.084	
Flu_lag11	0.979	0.053	-0.400	0.692	0.880	1.089	
Flu_lag12	1.006	0.054	0.110	0.910	0.906	1.117	
Flu_lag13	1.011	0.054	0.210	0.833	0.911	1.123	
Flu_lag14	0.962	0.051	-0.740	0.460	0.867	1.067	
Flu_lag15	0.972	0.052	-0.530	0.593	0.875	1.079	
cos_1	1.472	0.338	1.680	0.093	0.938	2.308	*
cos_2	0.783	0.062	-3.100	0.002	0.670	0.914	***
cos_3	1.175	0.043	4.400	0.000	1.094	1.263	***
cos_4	1.036	0.044	0.820	0.414	0.952	1.127	
sin_1	1.269	0.086	3.500	0.000	1.111	1.450	***
sin_2	0.888	0.044	-2.380	0.017	0.805	0.979	**
sin_3	1.256	0.073	3.940	0.000	1.121	1.407	***
sin_4	0.916	0.043	-1.880	0.060	0.835	1.004	*
Constant	4.431	1.227	5.380	0.000	2.575	7.625	***
lnalpha	-3.942	0.607	.b	.b	-5.131	-2.753	

Mean dependent var	7.314	SD dependent var	3.736
Pseudo r-squared	0.103	Number of obs	350
Chi-square	196.348	Prob > chi2	0.000
Akaike crit. (AIC)	1792.998	Bayesian crit. (BIC)	1962.747

*** p<.01, ** p<.05, * p<.1
H&W: holiday and weekend
xi: nbreg 2018counts temperaturelag* humiditylag* i.holidayweekend flulag* cos* sin*, irr