Does the air pollution model influence the evidence of socio-economic disparities in exposure and susceptibility?

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ABSTRACT

Studies assessing socio-economic disparities in air pollution exposure and susceptibility are usually based on a single air pollution model. A time stratified case-crossover study was designed to assess the impact of the type of model on differential exposure and on the differential susceptibility in the relationship between ozone exposure and daily mortality by socio-economic strata (SES) in Montreal. Non-accidental deaths along with deaths from cardiovascular and respiratory causes on the island of Montreal for the period 1991-2002 were included as cases. Daily ozone concentration estimates at participants' residence were obtained from the five following air pollution models: Average value (AV), Nearest station model (NS), Inverse-distance weighting interpolation (IDW), Land-use regression model with back-extrapolation (LUR-BE) and Bayesian maximum entropy model combined with a land-use regression (BME-LUR). The prevalence of a low household income (< 20,000/year) was used as socio-economic variable, divided into two categories as a proxy for deprivation. Multivariable conditional logistic regressions were used considering 3-day average concentrations. Multiplicative and additive interactions (using Relative Excess Risk due to Interaction) as well as Cochran's tests were calculated and results were compared across the different air pollution models. Heterogeneity of susceptibility and exposure according to socio-economic status (SES) were found. Ratio of exposure across SES groups means ranged from 0.75 [0.74-0.76] to 1.01 [1.00-1.02], respectively for the LUR-BE and the BME-LUR models. Ratio of mortality odds ratios ranged from 1.01 [0.96-1.05] to 1.02 [0.97-1.08], respectively for the IDW and LUR-BE models. Cochran's test of heterogeneity between the air pollution models showed important heterogeneity regarding the differential exposure by SES, but the air pollution model was not found to influence heterogeneity regarding the differential susceptibility. The study showed air pollution models can influence the assessment of disparities in exposure according to SES in Montreal but not that of disparities in susceptibility.

Keywords: *ozone and health ; air pollution and health ; environmental inequality ; effect measure modification ; air pollution modelling*

1. INTRODUCTION

Air pollution plays a significant part in the Global Burden of disease for both children and adults (Brauer et al., 2016). In particular, ambient air pollution was estimated by WHO to contribute to 5.4% of all deaths – 3 million people worldwide - in 2012 ('WHO | Mortality and burden of disease from ambient air pollution', 2017). Ground level ozone (O_3), in particular, was estimated to be responsible each year for more than 2,000 premature deaths, 3 million cases of acute respiratory symptoms and 1 million cases of school-loss days in the USA alone (Berman et al., 2012).

Both short-term and long-term "historical" exposure to ambient O_3 have been associated to health effects. In particular, short term exposure was associated with an increase in hospital admissions related to asthma, acute respiratory infections (Malig et al., 2016) and chronic obstructive pulmonary disease (Bell, Dominici, & Samet, 2005; Medina-Ramón, Zanobetti, & Schwartz, 2006). Levy et al. (Levy, Chemerynski, & Sarnat, 2005) showed similar results for all-cause mortality.

Exposure to O_3 during the previous week was associated with an increase in overall mortality and in cardiovascular and respiratory mortality, independently of particulate matter levels, weather and long-term O_3 trends (Bell, McDermott, Zeger, Samet, & Dominici, 2004). The same authors highlighted the fact shorter lags (i.e. more recent O_3 exposures) brought increased relative rates of mortality. Meta-analyses showed even daily ambient O_3 concentration increases were associated with an increase in daily total, cardiovascular and respiratory mortality (Anderson, Atkinson, Peacock, Marston, & Konstantinou, 2004; Stieb, Judek, & Burnett, 2003; Thurston & Ito, 2001). In Montreal, an association was found between daily ambient O_3 increases and daily non-accidental mortality in some vulnerable populations, in particular amongst patients with congestive heart failure (Buteau et al., 2018). Although the exact mechanisms remain unclear, it was shown short-term exposure to O_3 was associated with an increase in the inflammatory response and a decrement in pulmonary function (Gryparis et al., 2004). Furthermore, daily increases in maximum temperature were also associated with an increase in daily non-accidental mortality in Montreal (Goldberg, Gasparrini, Armstrong, & Valois, 2011).

Air pollutant concentrations are not distributed homogeneously in space (Briggs et al., 2000; Michael Jerrett et al., 2001, 2005; Wilson, Kingham, Pearce, & Sturman, 2005; Zhu, Hinds, Kim, Shen, & Sioutas, 2002). Within-city concentrations of some pollutants may exhibit greater differences than between-city concentrations (Michael Jerrett et al., 2005). Notably, road traffic was found to be intimately linked to the within-city spatial variability in some air pollutant concentrations, including NOx, CO or SOx (Crouse, Goldberg, & Ross, 2009; M. Jerrett et al., 2007). The spatial distribution of other pollutants may be more complex to predict, including O_3 (Adam-Poupart, Brand, Fournier, Jerrett, & Smargiassi, 2014), which is a secondary pollutant formed by photochemical reactions of nitrogen oxides and volatile organic compounds (VOCs) (Chameides W. L. et al., 2012).

It has been shown variability in O_3 concentration depends on the spatial scale considered, the relative concentration of its precursors, and the intensity of sunlight according to a non-linear relationship making O_3 concentration modelling particularly challenging (Simon, Wells, Baker, & Hubbell, 2016).

Many air pollution models have been developed in the last few decades, their progress being due to improvements in Geographic Information Systems (GIS), increased computer power and a growing interest in assessing exposure on an intra-urban scale. Such models, in particular a land-use regression model and a combination of a land-use and Bayesian maximum entropy model, have been developed for O_3 for the Island of Montreal (Adam-Poupart et al., 2014; Deville Cavellin et al., 2016). In this city, O_3 concentrations showed substantial spatial variability and seemed linked with road traffic and NO_2 concentrations (Buteau et al., 2017). However, when comparing different models, differential estimates of intra-urban air pollution exposure were obtained, and to date there is no gold standard regarding air pollution modelling (Buteau et al., 2017). In the absence of an air pollution model, a common approach is to use the average daily measures of fixed-station monitors to characterize a mean concentration of pollutant for the entire area (i.e. city) of interest. This method has been widely used to assess the short or long-term impact of O_3 concentrations on mortality (Michael Jerrett et al., 2009; Smith, Xu, & Switzer, 2009).

The choice of model can be critical when the objective is to show heterogeneity of exposure or related health effects across population subgroups within the city. Within the scope of this work, the use of the Average value (AV) and the four following models were considered: the Nearest station model (NS), the Inverse-distance interpolation model (IDW), the Land-use regression model (LUR) and the Bayesian maximum entropy model (BME).

Over the last 15 years, several studies have reported socio-economic strata (SES) may be associated with urban exposure to air pollution (O'Neill et al., 2003; Pope et al., 2002). More specifically, communities belonging to lower socio-economic strata were reported to be exposed to higher concentrations of air pollutants than communities in higher SES (Crouse, Ross, & Goldberg, 2009; Hajat, Hsia, & O'Neill, 2015; Havard, Deguen, Zmirou-Navier, Schillinger, & Bard, 2009; Premji, Bertrand, Smargiassi, & Daniel, 2007). However, whilst these results were shown to be true in most parts of North America, findings were mixed in Europe (Hajat et al., 2015).

Lower SES is also suggested to be associated with a higher susceptibility in regard to air pollution health effects (Laurent, Bard, Filleul, & Segala, 2007; Medina-Ramón & Schwartz, 2008; Pope et al., 2002). The term "susceptibility" in this study refers to the modification by SES on the association between air pollution exposure and mortality (Bell & Dominici, 2008). Hence, a strong disparity in susceptibility in favour of higher SES means people in higher SES have a lower risk of health effects (e.g. mortality) for a set increase in O_3 exposure than people in less privileged SES.

Assessment of environmental disparity was shown to be sensitive to several factors, likely explaining the sometimes contradictory conclusions. Indeed, whilst race-based disparities seemed consistent in the United States in a 2005 meta-analysis, income-based disparities were influenced by the considered risk, levels of aggregation, and regression model used (Ringquist, 2005).

Surprisingly, no study has, to the best of our knowledge, assessed whether the evidence of disparity in exposure to air pollution and disparity in susceptibility with regard to mortality were influenced by the model used to assign daily exposures. Yet, numerous studies showed the type of intra-urban air pollution model used influenced both air pollution exposure assessment and that of its health effect (Adam-Poupart et al., 2014; Baxter et al., 2013; Bell, 2006; Sarnat et al., 2013; Wong, Yuan, & Perlin, 2004). The exposure and ozone-related mortality could thus be influenced differentially between SES by the air pollution model used. To address this question, a time-stratified case-crossover design was used to estimate whether, and to what extent the evidence of both disparity in exposure and in susceptibility for daily mortality in Montreal, 1991-2002, was influenced by five different models used to predict daily exposure to ambient O_3 at participants' residence.

2. METHODS

2.1 Study settings and mortality data

The study population included all men and women who were residents of Montreal, 18 years and older and died of a non-accidental cause during the study period ranging from January 01, 1991 to December 31, 2002 as used in recent studies (Benmarhnia et al., 2016). The cases were sorted in subcategories according to the following causes of death: 1) all cardiovascular causes; 2) all respiratory causes. Listed in *Supplement 1* are the complete list of causes and their respective ICD-10 codes for each category. Subject-specific information was included: sex, age, cause of death as well as residential location of individual at time of death. For privacy reasons the full six characters of the Canadian postal code, which represent a block face or a large apartment complex, were not available. The information about the residence was limited to the Forward Sortation Area (FSA), a spatial unit defined by the first three characters of the six-character postal code (Government of Canada, n.d.), which was shown to be a good proxy for natural neighbourhoods when assessing the effect of social context on health (Ross, Tremblay, & Graham, 2004). **Fig. 1a-1c** show maps of Montreal with the boundaries of FSAs. There were 98 three-digit FSAs in 2001 in Montreal with areas varying between 0.3 and 28 km^2 (mean area of approximately 6 km^2) depending on the population density.

2.2 Air pollution data

Previously developed spatially-resolved estimates of daily exposures to ambient O_3 were used (Buteau et al., 2017). Briefly, they gathered air pollution data from the Canadian National Air Pollution Surveillance network as well as from other special monitoring campaigns. Daily mean 8-hour concentrations of O_3 were then computed for each area defined by the first three characters of the postal code in Montreal, 1991-2002, specifically for the warm seasons (May-September, inclusively). They assigned, for each day of the study period, a daily concentration of O_3 to each three-character postal code area using the following five different methods:

1) Assigning concentration measured at the nearest fixed-site monitoring station (NS);
2) Inverse-distance weighting interpolation model from fixed-site monitors and using a first order decay (IDW);
3) Land-use regression surface developed from a dense monitoring survey (Deville Cavellin et al., 2016) that was back-extrapolated using spatial interpolation of the daily ratios of measurements at fixed-site monitors (LUR-BE);

4) Bayesian maximum entropy model combined with a LUR using measurements at fixed-site monitors (BME-LUR) (Adam-Poupart et al., 2014);
5) Use of the average concentration across all monitoring stations (AV)

2.3 Weather data

Weather data for the study period 1st January 1991 to 31st December 2002 were extracted from the Environment Canada meteorological observation station at the Montreal Pierre Elliott Trudeau International Airport (Canada, 2011). As suggested by other authors, daily maximum temperature and daily average relative humidity was used (Buteau et al., 2018; Carracedo-Martínez, Taracido, Tobías, Sáez, & Figueiras, 2010).

2.4 Socio-economic level indicator

The socio-economic data were extracted from a 1996 Census of Population by Statistics Canada ('1996 Census of Population', n.d.), which listed various census indicators sorted by FSA. This census was chosen as it is central in the study period (1991-2002). In a previous study conducted in Montreal, unemployment rate, low income, low level of education, counts of people belonging to visible minorities, proportion of individuals living alone and proportion of buildings built before 1961 have been shown to be associated with air pollution (Crouse, Ross, et al., 2009). The prevalence of households with an income below $20,000 per year (referred to as "Low Income") was used as indicator of socio-economic status. Two strata were created using the median value of "Low income" as the threshold for determining in which category of deprivation each case was assigned (thus distinguishing the more deprived from the less deprived). A sensitivity analysis with three quantiles was performed, of which the main results were reported in the figures with additional details available in *Supplement 4*. A sensitivity analysis was also performed using a "contingent component" of deprivation, as described by Briggs et al., here the prevalence of buildings built before 1961 ("Old Buildings"), using two and three quantiles, respectively available in *Supplement 5 and 6*.

2.5 Statistical analysis

A case-crossover analysis was used, which contrasts a person's exposure on the day the event (i.e., death) occurred (or within the previous days) to the exposures that same person experienced at different times. A time-stratified approach was used to select control days, which considered all the same days of the week as the day the case occurred, as controls, in the same month and year. The regression model was a conditional logistic regression with each person as a cluster. Odds Ratios (OR) can be interpreted as Risk Ratios in this context.

To each case and control days were assigned spatially resolved daily exposures to predicted O_3 from the five different spatiotemporal models based on the FSA of residence of the case at time of death. Each metric of exposure was modelled separately. O_3 concentration was considered both as a single-day exposure with a lag 0 (current day concentration) and as an average cumulative exposure for lag 0 to 2 (cumulative exposure over the three previous days). The following three statistical models were considered: 1) a non-adjusted model with O_3 lag 0 and no confounders (NC); 2) a model including O_3 lag 0 adjusted on the maximum temperature lag 0 and relative humidity lag 0 (Adjusted model lag 0); 3) a model including O_3 with a cumulative lag 0-2 adjusted on the maximum temperature with a cumulative lag 0-2 and relative humidity with a cumulative lag 0-2 (Adjusted model lag 0-2).

A ratio of exposure means (ROM) was computed for all cases in the study, comparing the O_3 exposure mean for the more deprived cases (lower SES) over that for the less deprived cases (higher SES). A ROM lower than 1.0 means a disparity in exposure favouring the less deprived. A Cochran's Q test (Kaufman & MacLehose, 2013), for which the formula is provided in *Supplement 8,* was then performed on the ratios of means to compare them pairwise, in order to assess their heterogeneity.

Regarding potential heterogeneity in the risk of non-accidental mortality, conditional logistic regression analyses by "Low Income" category were first conducted, for a 10-ppb increase in predicted O_3 concentration. This was done for each of the three statistical models, each of the five air pollution models and each of the three populations. In order to assess disparity in susceptibility to O_3 amongst more and less deprived categories depending on the air pollution model used - i.e. modification in effect measure of the relationship between O_3 exposure and mortality - a Cochran's Q test statistic was performed (Kaufman & MacLehose, 2013), for which the formula is provided in *Supplement 8***,** in the statistical model adjusted for lag 0-2. Both joint tests, simultaneously testing for heterogeneity amongst all models, and separate tests, testing each model against the use of the average value, were performed.

In addition, statistical interaction on both multiplicative and additive scales were assessed. Multiplicative interaction was assessed through testing for heterogeneity (Kaufman & MacLehose, 2013) of point estimates in the strata of our SES variable for a 10-ppb increase in

O_3 concentration, with a Wald test on the interaction term in our adjusted logistic – thus multiplicative model. Interaction on an additive scale was tested through the calculation of the RERI (Relative Excess Risk due to Interaction) for a continuous exposure for an increase from 0 to 10 ppb in O_3 concentration (VanderWeele & Knol, 2014) and for the statistical model adjusted on temperature lag 0-2 and relative humidity lag 0-2. If the RERI is different than 0, there is an additive interaction. A positive RERI means a positive additive interaction, which would mean more deprived categories are more vulnerable to air pollution than less deprived ones, and vice versa for a negative RERI (meaning a negative additive interaction). It is recommended to assessing heterogeneity on both scales (Vandenbroucke et al., 2007). The formula for the RERI is detailed in *Supplement 8*.

The analysis and data management were performed using STATA software version 14.2 (*Stata Statistical Software*, 2015). Stata syntax is available upon request.

3. RESULTS

The mortality data included 199,146 Montreal residents aged 18 and older who died from non-accidental causes. Out of these 171,428 had to be excluded for missing O_3 concentration data, as predictions were restricted to the warm seasons (May-September). Therefore, analyses included a total of 27,718 case-days matched with 95,602 control-days. The spatial distribution of these cases for the different causes of mortality (i.e., all non-accidental, cardiovascular diseases, and respiratory diseases), referred to as "populations", are shown in **Fig. 1a-1c**. All non-accidental cases and cardiovascular diseases related deaths followed a similar spatial distribution whereas respiratory diseases related deaths seemed to have a lower incidence in the Western part of Montreal. The study population is described in **Table 1**. The mean age was high in the three populations, ranging from 74 to 79, (see *Supplement 3* for a description of the populations according to their "Low Income" category). Ninety-seven FSAs were home to at least one case after the exclusion process, holding between 195 and 48,507 inhabitants with an average of 25,125 people. Only 3 FSAs had population less than 500 inhabitants, corresponding to 14 cases. The spatial distribution of the socio-economic indicators is available in *Supplement 2* (*Fig. 2a and 2b*).

3.1 Differential Exposure to ozone

In terms of daily exposure to O_3, estimates and their 95% confidence intervals (CI) according to the deprivation categories (more deprived and less deprived) defined by "Low Income" are displayed in **Table 2**. The calculations for exposure to O_3 only involved cases, excluding all controls. The biggest difference across models was found between BME-LUR, which systematically showed the highest estimations in all populations and socio-economic categories and either LUR-BE in the more deprived category or AV in the less deprived category. LUR-BE seemed to estimate lower O_3 concentrations for the more deprived category no matter the number of categories used.

LUR-BE consistently had the smallest ROM across all populations. In the all non-accidental causes population, its ROM, according to the "Low Income" variable was 0.75 (95% CI 0.74-0.76), showing a different magnitude and direction of the disparity in exposure compared to the ROM for BME-LUR, which was the only one to be higher than 1.0 although not by a large margin (1.01; 95% CI 1.00-1.02). The ROM for AV, IDW and BME-LUR were very close to

1.0, suggesting no influence of the socio-economic category on exposure according to these models. Similar results were observed when stratifying "Low Income" in 3 categories, comparing the highest to the lowest category (see **Table 3**).

Regarding the Cochran's Q tests, some heterogeneity was found between LUR-BE and all other models and between BME-LUR and all other models but AV (see **Table 6**). This heterogeneity was greater when considering "Low Income" as a three-category variable than as a two-category one (see *Supplement 4.1*). This heterogeneity suggests a difference in magnitude when assessing disparity in exposure to O_3, depending on the air pollution model used.

3.2 Differential Susceptibility to ozone

Results of the conditional logistic regressions are shown in **Table 4**, which presents the estimated OR of mortality for the more deprived and less deprived categories, along with a ratio of these two ORs (ROR, ratio of the OR of mortality for more deprived over that for less deprived) and their respective 95% confidence intervals. No heterogeneity between socio-economic categories was found for any population defined according to "Low Income" in the statistical model adjusted for lag 0-2, although some was found for every model but BME-LUR in the unadjusted statistical model.

The Cochran's Q tests are displayed in **Table 6** for the separate tests, and **Table 7** for the joint tests. No heterogeneity between the assessments of disparity in mortality was found between the air pollution models. Sensitivity analyses with three categories yielded similar results (see *Supplement 4.3*).

Regarding multiplicative interaction, results can be seen in **Table 8** for the three populations. Multiplicative interaction was only found in the respiratory causes populations for AV, NS and IDW.

Regarding additive interaction, the RERI obtained are shown in **Table 9**. Additive interaction was only detected in the respiratory causes population for AV, NS and IDW, and was positive. No additive interaction was found for the three-category socio-economic variable in sensitivity analyses (see *Supplement 4.5*).

4. DISCUSSION

This study is the first to involve multiple spatiotemporal air pollution modelling techniques to investigate environmental inequalities in daily exposure and acute susceptibility to air pollution. Different air pollution modelling approaches were found to yield different estimates of air pollution exposure when considering the population as a whole, consistently with previous studies (Adam-Poupart et al., 2014; Bell, 2006; Buteau et al., 2017; Sarnat et al., 2013; Wong et al., 2004). The exposure data came from Buteau et al (Buteau et al., 2017), whose study focused on the comparison of daily predictions across the different methods. Their analysis of absolute agreement showed that there could be substantial difference (as high as 131 ppb) in the daily concentrations of O_3 assigned to a postal code area depending on the exposure assessment method. The present article suggests this discrepancy affects ozone exposure differentially across different SES. Indeed, these differences in O_3 concentrations between models were stronger when considering only the more deprived category of people. The major strength of the LUR-BE model is it was developed from dense monitoring surveys (measurements at 76 sampling sites), thus likely to better capture the influence of local sources and small-scale variability in air pollutant concentrations. In contrast, other models relied solely on measurements routinely collected by the air pollution monitoring network, which is constrained by the smaller number of fixed-site monitors. The siting of these fixed-site monitors is also critical as substantial exposure misclassification may results from an over-representation of areas exhibiting either high or low concentrations.

The magnitude of exposure heterogeneity between socio-economic categories for the five models was shown to be affected by the choice of air pollution model, even when choosing amongst two complex models such as LUR-BE and BME-LUR that are expected to enhance the spatial resolution of ambient air pollution data. These findings were consistent across the two socio-economic variables and across the number of categories (two or three) in sensitivity analyses (see *Supplement 4-6* for further details), which is interesting given that the spatial distributions for the two variables did not entirely overlap. In the assessment of exposure heterogeneity, some models showed less deprived populations were more exposed than more deprived populations. These mixed findings are consistent with those from the literature (Carrier, Apparicio, Séguin, & Crouse, 2014; Crouse, Ross, et al., 2009). In particular, the LUR-BE model brought systematically lower ROM when assessing differential exposure by socioeconomic category, mostly through lower mean estimations of O_3 exposure amongst the more deprived categories. It might be possible other models overestimate O_3 exposure for the more deprived populations. Studies reporting heterogeneity of exposure between socio-economic categories obtained using a single air pollution model could instead be referring, at least partially, to a non-reliable effect related to the use of that particular air pollution model. The authors thus recommend for studies assessing disparity in exposure to O_3 to use multiple models in order to verify whether the detected disparity is consistent across them. Should this prove impossible, the use of models that make use of higher spatially resolved data, from dense exposure surveys or from high spatial resolution satellite data would be recommended, which might make it less likely any detected disparity would be an artefact. A recent literature review (Hajat et al., 2015) showed most studies regarding disparity in exposure used complex models, such as LUR. However, it should be reminded the absence of a gold standard still makes it impossible to state unequivocally which model is more valid, thus more likely to minimize the risk of a non consistent result.

This could be particularly important when defining concentration thresholds for air pollution standards as these are defined for a non-susceptible population but include a safety margin aiming at protecting more susceptible individuals (Bell, Zanobetti, & Dominici, 2014). The order of magnitude of O_3 concentrations difference between more or less deprived categories of cases lies between 1 and 2 ppb for most models and between 6 to 8 ppb for LUR-BE in the all cases population. This difference can already be substantial in a single city with regard to the recommended thresholds (all inferior or equal to 70 ppb) (US EPA, 2015). Moreover, this study was conducted in Montreal, where, as mentioned above, findings were mixed regarding which socio-economic category was more exposed to air pollution, contrary to most other cities in North America but similarly to European cities (Hajat et al., 2015). It might thus be interesting to investigate whether the influence of a given model on disparity in exposure is consistent across Montreal and European cities.

Regarding modification by socio-economic category of the O_3 exposure – mortality relationship, no impact of the choice of air pollution model was found. This result would suggest that air pollution models do not seem to influence the evidence of disparity in susceptibility to O_3 exposure in Montreal regarding non-accidental mortality. A review of the literature had been conducted regarding case-crossover studies investigating disparity in susceptibility (*Supplement 12*) showing the majority used a single air pollution model. Whilst disparity of susceptibility might not be an issue, Baxter et al. (Baxter et al., 2013) still concluded the way air pollution was modelled influenced the assessment of its health effects, especially when comparing the use of an average value (or that of a single monitored value) with the use of a more complex air pollution model. It should be noted though that such a difference was not observed in the study population when stratifying on deprivation category, as mortality ORs were close to each other within each population and deprivation strata. Regarding confounding, the potential role of weather covariates, such as temperature, is likely complex. Indeed, O_3 was reported to be a causal intermediate in the indirect effect of temperature on mortality, especially during high O_3 concentration episodes, even though direct pathways from high temperature to mortality exist, making temperature both an antecedent and a confounder of the relationship between O_3 and mortality ('Environmental Health Perspectives – The Role of Ambient Ozone in Epidemiologic Studies of Heat-Related Mortality', n.d.). The consequence for this study is that adjusting on weather covariates probably decreased the apparent effect of O_3 concentrations on mortality. Therefore, the actual effect of O_3 concentration on mortality probably lies between the unadjusted and the adjusted effect estimates.

The analysis was limited in its spatial resolution as, due to privacy concerns, access was restricted to three-digit residential postal code for cases instead of the full six-digit ones, meaning more aggregated data. Consequently, the bigger districts might show smaller variances and there was a higher risk of observing a regression towards the mean phenomenon (Baden, Noonan, & Turaga, 2007). On the other hand, bigger areas might lead to lower exposure misclassification due to small-scale changes in land use than if smaller 6-digit areas had been used. Only contextual socio-economic factors that were aggregated on FSA level were considered, using census data, whilst the literature has shown the interest of comparing both individual and community levels for these factors (Hajat et al., 2015). The inclusion of individual socio-economic factors (such as individual level of education) would involve the acquisition of administrative information from medical files to which the authors did not have access. Another limitation was that daily exposure was assigned according to the place of residence and mobility could not be accounted for. Nonetheless, the population had a mean age of 77 years at time of death and possibly had reduced mobility compared to younger adults.

As multiplicative model was used, the RERI was computed to investigate additive interaction. Additive interaction, which was detected and positive in this study, is easier to interpret when translating epidemiological results into public health actions (VanderWeele & Knol, 2014). The combined vulnerability resulting from a contextual environmental vulnerability (increased air pollutant exposure) and a socio-economic vulnerability (through belonging in a lower socio-economic category) being more than the sum of its parts – in other words, additive interaction – has been described by Bowleg (Bowleg, 2012) as intersectionality. The author advocates for people at the intersection between two vulnerabilities to be considered as having a distinct vulnerability rather than the mere sum of their individual ones. This concept is well implemented in fields such as gender studies, but remains rarely discussed in public health (Bowleg, 2012). It would be interesting that future environmental epidemiology studies use systematically both multiplicative and additive interactions (Panagiotou & Wacholder, 2014; Richardson & Kaufman, 2009) to observe and discuss potential discrepancies.

5. CONCLUSION

This study assessed the impact of five different air pollution models on the evidence of socio-economic disparity in exposure and susceptibility to air pollution regarding the risk of non-accidental mortality. The models assessed were use of the Average value, the Nearest station model, the Inverse-distance interpolation model, the Land-use regression model and the Bayesian maximum entropy model. The socio-economic variable used was income. Some heterogeneity of exposure was found between socio-economic categories in the study population, with the BME-LUR yielding the highest estimations in all populations and socio-economic categories. Results show heterogeneity of air pollution models in assessing exposure disparities according to socioeconomic status, in particular for the LUR-BE model compared to the BME-LUR model. These models showed a difference in magnitude and a potential difference in direction when assessing exposure heterogeneity. However, no impact of the air pollution model was found on the modification by socio-economic category of the exposure – health effect relationship, i.e. assessment of heterogeneity of susceptibility. These results were not sensitive to the socio-economic variable used or the number of socio-economic categories considered. Given the importance of epidemiology in the field of environmental disparity as potential groundwork for health policies, the authors thus recommend further studies focusing on disparity of exposure investigate whether this effect is consistent across multiple air pollution models. Should it prove impossible, the use of higher spatially resolved data is recommended, with the risk of the observed disparity being a non consistent result.

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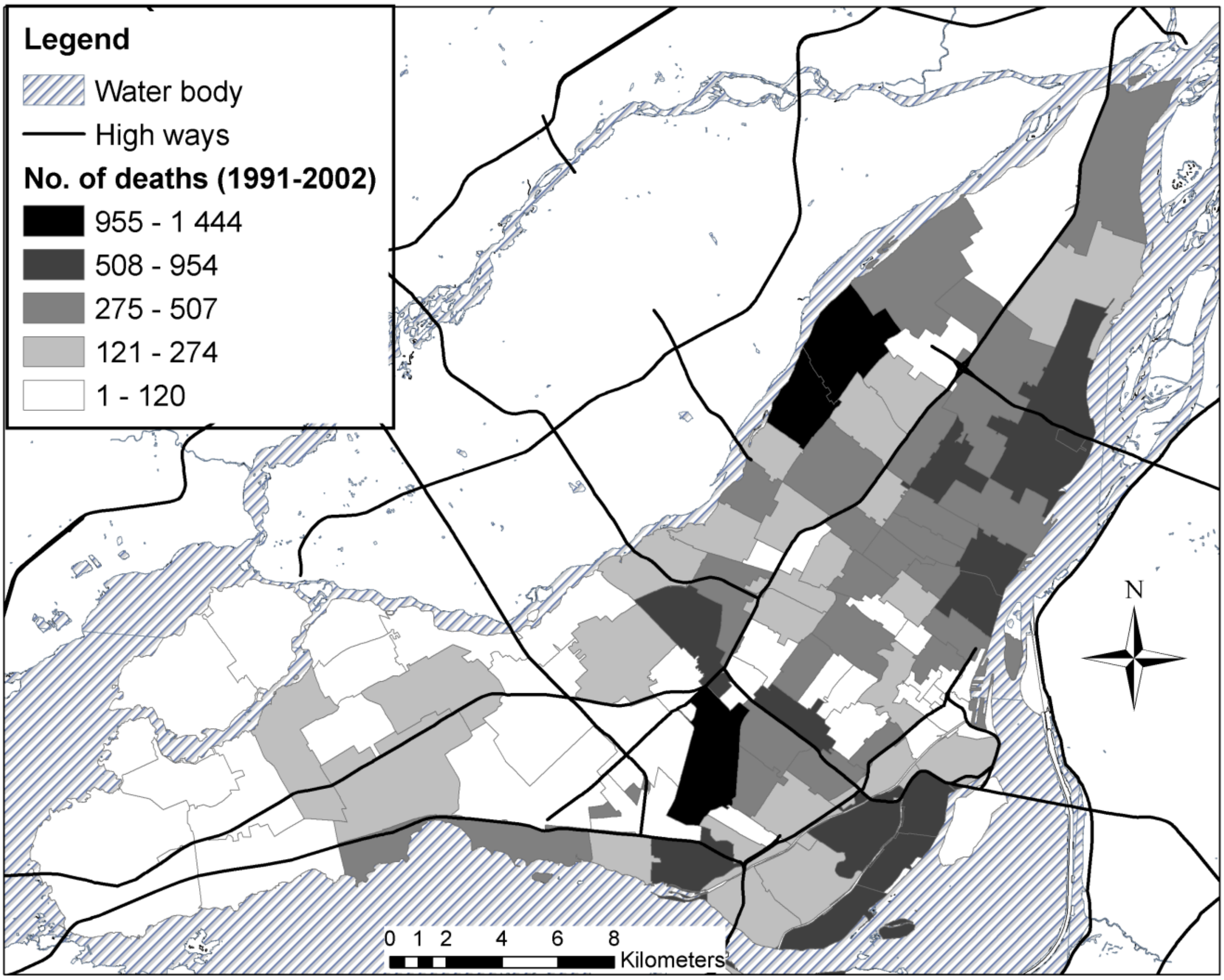

Fig. 1a. Map of Montreal showing the spatial distribution of all non-accidental mortality cases during the study period in the Forward Sortation Areas (FSA), with highways as black lines and three-digit FSA boundaries as gray lines. The categories were defined according to quintiles.

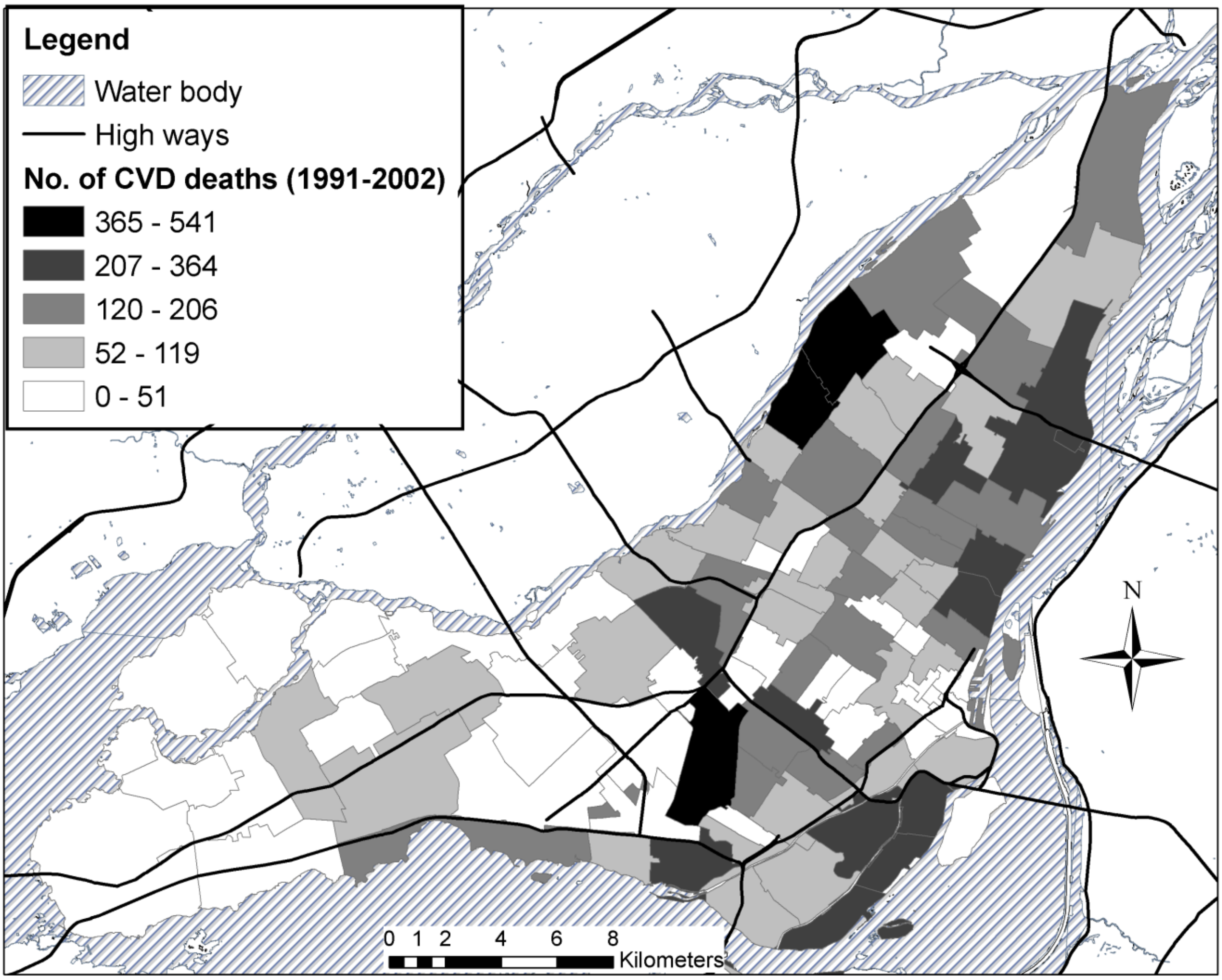

Fig. 1b. Map of Montreal showing the spatial distribution of cardiovascular diseases related mortality cases during the study period in the Forward Sortation Areas (FSA), with highways as black lines and three-digit FSA boundaries as gray lines. The categories were defined according to quintiles.

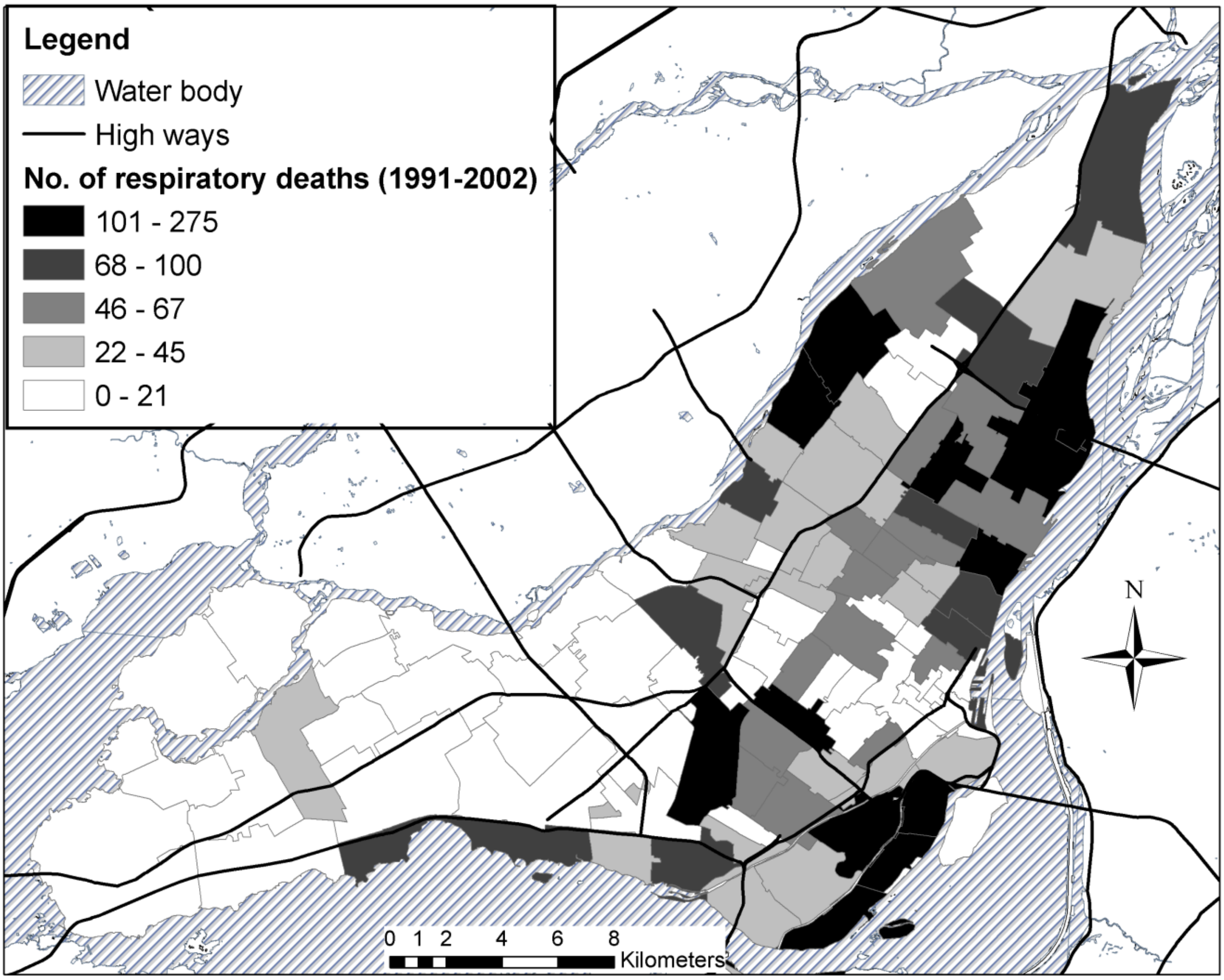

Fig. 1c. Map of Montreal showing the spatial distribution of respiratory diseases related mortality cases during the study period in the Forward Sortation Areas (FSA), with highways as black lines and three-digit FSA boundaries as gray lines. The categories were defined according to quintiles.

Table 1 - Description of the study population (cases only)

	All non-accidental causes	Cardiovascular diseases	Respiratory diseases
Male, n *(%)*	13,174 *(47.5)*	5,190 *(46.3)*	2,596 *(57.0)*
Age at death, mean *(SD)*	77 *(13)*	79 *(11)*	75 *(12)*
Total, n	27,718	11,211	4,511
O_3 ppb measurement for the AV, median *(IQR)*	19.7 *(14.5-26.7)*	19.5 *(14.2-26.3)*	20.0 *(14.7-26.6)*
O_3 ppb measurement for the NS model, median *(IQR)*	27.5 *(18.3-37.6)*	26.9 *(17.8-37.2)*	28.0 *(18.8-38.3)*
O_3 ppb measurement for the IDW model, median *(IQR)*	27.3 *(19.5-36.4)*	26.9 *(19.2-36.1)*	27.5 *(19.7-36.1)*
O_3 ppb measurement for the LUR-BE model, median *(IQR)*	18.4 *(11.3-27.4)*	18.1 *(11.1-27.0)*	18.2 *(11.5-26.9)*
O_3 ppb measurement for the BME model, median *(IQR)*	30.3 *(24.0-36.1)*	30.0 *(23.8-35.9)*	30.4 *(24.2-36.1)*
Temperature lag 0, median *(IQR)*	23.5 *(19.6-26.6)*	23.3 *(19.5-26.5)*	23.5 *(19.7-26.6)*
Temperature lag 0-2, median *(IQR)*	23.5 *(20-26.1)*	23.3 *(19.9-28.4)*	23.6 *(20.1-26.0)*
Relative humidity lag 0, median *(IQR)*	69.1 *(61.0-76.9)*	69.2 *(61.1-77.1)*	69.2 *(61.1-77.0)*
Relative humidity lag 0-2, median *(IQR)*	69.0 *(62.5-74.8)*	69.1 *(62.4-74.9)*	68.9 *(62.5-74.8)*
Prevalence of low income, mean % *(SD)*	50.3 *(22.7)*	50.4 *(22.6)*	51.3 *(22.5)*

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. SD: Standard deviation IQR: Inter-quartile range

Table 2 – Ozone concentrations in both categories of "Low Income" according to 5 modelling approaches of ozone for the 3 subpopulations (all non-accidental causes, cardiovascular causes, respiratory causes)

All non-accidental causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.6	10.1	13,497	21.6	10.1	14,218	1.00	0.99 - 1.01
NS	28.9	15.1		29.3	15.5		0.99	0.97 - 1.00
IDW	28.8	13.4		29.2	13.3		0.99	0.98 - 1.00
LUR-BE	17.8	11.1		23.8	14.4		**0.75**	**0.74 - 0.76**
BME-LUR	30.9	10.3		30.6	9.1		**1.01**	**1.00 - 1.02**

Cardiovascular causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.2	10.0	5,444	21.3	10.1	5,765	1.00	0.98 - 1.02
NS	28.3	15.1		29.0	15.3		0.98	0.96 - 1.00
IDW	28.3	13.3		28.9	13.2		0.98	0.96 - 1.00
LUR-BE	17.4	10.9		23.5	14.3		**0.74**	**0.72 - 0.76**
BME-LUR	30.6	10.1		30.4	9.1		**1.01**	**0.99 - 1.02**

Respiratory causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	22.0	10.4	2270	21.4	10.0	2281	**1.03**	**1.00 - 1.05**
NS	29.9	15.3		29.5	15.6		1.01	0.98 - 1.04
IDW	29.3	13.5		29.1	13.3		1.01	0.98 - 1.04
LUR-BE	17.9	10.9		23.5	14.0		**0.76**	**0.74 - 0.79**
BME-LUR	31.3	10.3		30.7	9.1		**1.02**	**1.00 - 1.04**

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Less deprived vs. More deprived were 38.94% of households earning less than $20,000 a year, for all populations

Table 3 – Ozone concentrations in the highest and lowest categories of "Low Income" (3 categories) according to 5 modelling approaches of ozone for the 3 populations (all non-accidental causes, cardiovascular causes, respiratory causes)

All non-accidental causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.54	*10.08*	8,517	21.54	*10.01*	9,656	1.00	0.99 - 1.01
NS	27.65	*14.95*		29.03	*15.46*		**0.95**	**0.94 - 0.97**
IDW	28.18	*13.28*		29.24	*13.21*		**0.96**	**0.95 - 0.98**
LUR-BE	14.54	*9.11*		25.19	*15.79*		**0.58**	**0.57 - 0.59**
BME-LUR	31.05	*10.37*		30.36	*8.65*		**1.02**	**1.01 - 1.03**

Cardiovascular causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.11	*9.84*	3,464	21.20	*9.92*	3,928	1.00	0.97 - 1.02
NS	27.19	*14.90*		28.60	*15.15*		**0.95**	**0.93 - 0.97**
IDW	27.66	*13.16*		28.89	*13.08*		**0.96**	**0.94 - 0.98**
LUR-BE	14.31	*8.92*		24.85	*15.73*		**0.58**	**0.56 - 0.59**
BME-LUR	30.76	*10.17*		30.15	*8.56*		**1.02**	**1.01 - 1.03**

Respiratory Diseases	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	22.04	*10.52*	1402	21.36	*9.89*	1452	**1.03**	**1.00 - 1.07**
NS	28.72	*15.04*		29.50	*15.87*		0.97	0.94 - 1.01
IDW	28.72	*13.33*		29.16	*13.32*		0.98	0.95 - 1.02
LUR-BE	14.67	*8.70*		25.07	*15.61*		**0.58**	**0.56 - 0.61**
BME-LUR	31.49	*10.51*		30.54	*8.66*		**1.03**	**1.01 - 1.05**

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Table 4 - Mortality odds ratio (OR) for both categories of "Low Income" with their 95% CI for a 10-ppm increase in predicted ozone concentration and the ratio of odds ratios (ROR) corresponding to the OR for the More deprived category over the OR for the Less deprived category in 3 populations, according to 5 air pollution models and 3 statistical models

ALL NON-ACCIDENTAL CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.97 - 1.03	**1.03**	**1.01 - 1.05**	**1.03**	**1.01 - 1.05**
NS	1.01	0.99 - 1.03	**1.02**	**1.01 - 1.04**	**1.02**	**1.00 - 1.03**
IDW	1.00	0.98 - 1.03	**1.02**	**1.01 - 1.04**	**1.02**	**1.00 - 1.03**
LUR-BE	1.02	0.99 - 1.05	**1.04**	**1.01 - 1.06**	**1.02**	**1.00 - 1.03**
BME-LUR	1.01	0.98 - 1.04	**1.04**	**1.02 - 1.06**	**1.03**	**1.01 - 1.06**

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.99	0.95 - 1.03	1.02	0.99 - 1.04	**1.03**	**1.00 - 1.05**
NS	1.01	0.98 - 1.03	**1.02**	**1.00 - 1.04**	1.01	0.99 - 1.03
IDW	1.00	0.97 - 1.03	1.01	0.99 - 1.04	1.01	0.99 - 1.03
LUR-BE	1.02	0.98 - 1.07	**1.03**	**1.00 - 1.06**	1.01	0.98 - 1.03
BME-LUR	1.01	0.96 - 1.06	**1.03**	**1.00 - 1.07**	1.02	0.99 - 1.06

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.01	0.97 - 1.07	**1.04**	**1.00 - 1.07**	1.02	0.99 - 1.06
NS	1.01	0.97 - 1.05	**1.03**	**1.00 - 1.06**	1.02	0.99 - 1.05
IDW	1.01	0.96 - 1.05	**1.04**	**1.01 - 1.07**	**1.03**	**1.00 - 1.07**
LUR-BE	1.02	0.97 - 1.08	**1.05**	**1.01 - 1.10**	**1.03**	**1.00 - 1.07**
BME-LUR	1.02	0.96 - 1.09	**1.05**	**1.01 - 1.10**	1.03	0.98 - 1.08

CARDIOVASCULAR CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.96 - 1.05	1.01	0.98 - 1.04	1.01	0.98 - 1.04
NS	1.00	0.97 - 1.03	1.00	0.98 - 1.02	1.00	0.98 - 1.02
IDW	1.00	0.96 - 1.03	1.00	0.97 - 1.02	1.00	0.98 - 1.02
LUR-BE	1.01	0.96 - 1.06	1.00	0.97 - 1.04	1.00	0.97 - 1.03
BME-LUR	1.01	0.96 - 1.06	1.01	0.97 - 1.04	1.00	0.96 - 1.04

CARDIOVASCULAR CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.99	0.94 - 1.05	1.00	0.96 - 1.05	1.01	0.97 - 1.05
NS	1.00	0.96 - 1.04	1.00	0.97 - 1.03	1.00	0.97 - 1.03
IDW	0.99	0.94 - 1.04	0.99	0.95 - 1.03	1.00	0.96 - 1.03
LUR-BE	1.01	0.95 - 1.08	1.01	0.96 - 1.06	0.99	0.96 - 1.03
BME-LUR	1.01	0.94 - 1.09	1.00	0.95 - 1.05	0.99	0.94 - 1.05

CARDIOVASCULAR CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.04	0.96 - 1.12	**1.06**	**1.00 - 1.12**	1.02	0.96 - 1.08
NS	1.04	0.98 - 1.11	**1.05**	**1.00 - 1.09**	1.01	0.96 - 1.05
IDW	1.03	0.96 - 1.10	**1.05**	**1.00 - 1.11**	1.03	0.98 - 1.08
LUR-BE	1.05	0.96 - 1.14	**1.08**	**1.00 - 1.16**	1.03	0.98 - 1.09
BME-LUR	1.04	0.94 - 1.15	1.05	0.98 - 1.12	1.01	0.94 - 1.09

RESPIRATORY CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.08**	**1.01 - 1.16**	**1.09**	**1.04 - 1.15**	1.01	0.96 - 1.07
NS	**1.05**	**1.00 - 1.11**	**1.05**	**1.02 - 1.09**	1.00	0.97 - 1.04
IDW	**1.06**	**1.00 - 1.11**	**1.06**	**1.02 - 1.10**	1.00	0.96 - 1.04
LUR-BE	**1.07**	**1.00 - 1.15**	**1.08**	**1.02 - 1.14**	1.00	0.96 - 1.05
BME-LUR	1.04	0.96 - 1.13	**1.08**	**1.03 - 1.14**	1.04	0.98 - 1.10

RESPIRATORY CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.09	0.99 - 1.19	**1.08**	**1.02 - 1.15**	0.99	0.93 - 1.06
NS	1.05	0.98 - 1.13	1.04	0.99 - 1.09	0.99	0.94 - 1.04
IDW	1.06	0.98 - 1.15	1.05	0.99 - 1.10	0.99	0.93 - 1.04
LUR-BE	1.05	0.95 - 1.16	1.04	0.96 - 1.12	0.99	0.93 - 1.05
BME-LUR	1.03	0.92 - 1.15	1.06	0.99 - 1.14	1.03	0.95 - 1.13

RESPIRATORY CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.06	0.94 - 1.20	1.04	0.96 - 1.14	0.98	0.90 - 1.07
NS	1.01	0.92 - 1.11	1.01	0.95 - 1.08	1.00	0.94 - 1.07
IDW	1.02	0.92 - 1.14	1.03	0.95 - 1.11	1.00	0.93 - 1.09
LUR-BE	1.00	0.87 - 1.15	1.01	0.90 - 1.12	1.01	0.92 - 1.10
BME-LUR	1.00	0.86 - 1.16	1.05	0.95 - 1.15	1.04	0.93 - 1.17

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 38.94.8% of households earning less than $20,000 a year, for all populations

Table 5 - Mortality odds ratio (OR) for the highest and lowest category of "Low Income" (3 categories) with their 95% CI for a 10-ppm increase in predicted ozone concentration and the ratio of odds ratios (ROR) corresponding to the OR for the More deprived category over the OR for the Less deprived category in 3 populations, according to 5 air pollution models and 3 statistical models

ALL NON-ACCIDENTAL CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.96 - 1.04	**1.03**	**1.00 - 1.06**	**1.03**	**1.01 - 1.06**
NS	1.00	0.97 - 1.02	1.01	0.99 - 1.03	**1.02**	**1.00 - 1.03**
IDW	0.99	0.96 - 1.02	1.01	0.99 - 1.03	**1.02**	**1.00 - 1.04**
LUR-BE	1.01	0.97 - 1.05	1.02	0.99 - 1.06	**1.02**	**1.00 - 1.04**
BME-LUR	1.00	0.96 - 1.04	**1.03**	**1.01 - 1.06**	**1.03**	**1.00 - 1.07**

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.95 - 1.04	1.02	0.99 - 1.06	1.03	0.99 - 1.06
NS	1.00	0.96 - 1.03	1.01	0.98 - 1.03	1.01	0.99 - 1.04
IDW	0.99	0.95 - 1.03	1.00	0.97 - 1.03	1.02	0.99 - 1.04
LUR-BE	1.00	0.95 - 1.06	1.01	0.96 - 1.06	1.01	0.98 - 1.04
BME-LUR	1.01	0.95 - 1.08	1.04	1.00 - 1.08	1.02	0.98 - 1.07

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.03	0.96 - 1.09	**1.04**	**1.00 - 1.09**	1.02	0.98 - 1.06
NS	1.00	0.95 - 1.05	1.03	0.99 - 1.07	1.03	0.99 - 1.06
IDW	0.99	0.94 - 1.05	1.04	0.99 - 1.08	**1.04**	**1.00 - 1.09**
LUR-BE	1.03	0.96 - 1.12	**1.07**	**1.00 - 1.14**	1.03	0.99 - 1.07
BME-LUR	1.01	0.93 - 1.09	**1.06**	**1.01 - 1.11**	1.05	0.99 - 1.12

CARDIOVASCULAR CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.98	0.93 - 1.04	0.99	0.95 - 1.03	1.00	0.96 - 1.05
NS	0.99	0.95 - 1.03	0.99	0.96 - 1.01	1.00	0.97 - 1.03
IDW	0.97	0.93 - 1.02	0.98	0.95 - 1.01	1.00	0.97 - 1.03
LUR-BE	0.97	0.91 - 1.04	0.97	0.92 - 1.03	1.00	0.97 - 1.03
BME-LUR	0.99	0.93 - 1.06	0.99	0.95 - 1.03	1.00	0.95 - 1.05

CARDIOVASCULAR CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.99	0.92 - 1.06	0.99	0.93 - 1.04	1.00	0.95 - 1.05
NS	0.99	0.94 - 1.05	0.99	0.95 - 1.03	0.99	0.96 - 1.03
IDW	0.97	0.91 - 1.03	0.97	0.92 - 1.01	1.00	0.96 - 1.04
LUR-BE	0.98	0.90 - 1.07	0.97	0.90 - 1.05	0.99	0.95 - 1.04
BME-LUR	1.01	0.91 - 1.11	0.99	0.93 - 1.05	0.99	0.92 - 1.06

CARDIOVASCULAR CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.96 - 1.16	1.03	0.96 - 1.11	0.98	0.91 - 1.05
NS	1.04	0.96 - 1.12	1.03	0.97 - 1.09	0.99	0.94 - 1.05
IDW	1.02	0.93 - 1.12	1.03	0.96 - 1.10	1.00	0.94 - 1.07
LUR-BE	1.06	0.94 - 1.19	1.07	0.96 - 1.19	1.01	0.95 - 1.07
BME-LUR	1.07	0.94 - 1.22	1.04	0.96 - 1.13	0.97	0.88 - 1.08

RESPIRATORY CAUSES

	Unadjusted model			*More deprived*		*Less deprived*	
	ROR	95% CI	CI UL	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.10**	**1.01 -**	**1.21**	**1.11**	**1.04 - 1.18**	1.00	0.94 - 1.07
NS	1.03	0.97 -	1.10	**1.04**	**1.00 - 1.09**	1.01	0.96 - 1.06
IDW	1.04	0.97 -	1.12	**1.05**	**1.00 - 1.10**	1.01	0.96 - 1.06
LUR-BE	1.06	0.96 -	1.17	1.06	0.97 - 1.15	1.00	0.95 - 1.05
BME-LUR	1.05	0.95 -	1.17	**1.08**	**1.02 - 1.15**	1.03	0.95 - 1.11

RESPIRATORY CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.15**	**1.03 - 1.29**	**1.11**	**1.03 - 1.21**	0.97	0.89 - 1.05
NS	1.05	0.96 - 1.14	1.03	0.97 - 1.10	0.99	0.93 - 1.05
IDW	1.07	0.97 - 1.19	1.05	0.97 - 1.12	0.97	0.91 - 1.04
LUR-BE	1.05	0.91 - 1.20	1.01	0.90 - 1.14	0.97	0.90 - 1.04
BME-LUR	1.11	0.96 - 1.29	1.09	0.99 - 1.19	0.98	0.87 - 1.10

RESPIRATORY CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.14	0.98 - 1.32	1.09	0.98 - 1.21	0.96	0.86 - 1.07
NS	1.03	0.91 - 1.16	1.05	0.97 - 1.15	1.02	0.94 - 1.11
IDW	1.07	0.93 - 1.23	1.08	0.98 - 1.19	1.01	0.91 - 1.11
LUR-BE	1.09	0.90 - 1.32	1.09	0.93 - 1.29	1.00	0.90 - 1.10
BME-LUR	1.05	0.86 - 1.27	1.10	0.98 - 1.24	1.05	0.90 - 1.22

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Table 6 - Separate Cochran's Q for heterogeneity between the Ratio of exposure means for both categories of the "Low Income" variable when comparing the air pollution models two by two

All non-accidental causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*3.6*	*4.0*	*1021.6*	*2.1*
	p value		**0.06**	**0.05**	**0.00**	0.15
NS	*Cochran's Q*			*0.0*	*818.5*	*14.8*
	p value			0.98	**0.00**	**0.00**
IDW	*Cochran's Q*				*931.4*	*15.8*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*1735.2*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Cardiovascular causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*2.2*	*2.4*	*424.4*	*0.8*
	p value		0.14	0.12	**0.00**	0.38
NS	*Cochran's Q*			*0.0*	*329.2*	*7.6*
	p value			0.97	**0.00**	**0.01**
IDW	*Cochran's Q*				*376.0*	*8.0*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					721.52
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Respiratory causes population

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*0.5*	*0.7*	*171.4*	*0.3*
	p value		0.49	0.42	**0.00**	0.61
NS	*Cochran's Q*			*0.0*	*141.2*	*0.2*
	p value			0.94	**0.00**	0.69
IDW	*Cochran's Q*				*157.0*	*0.3*
	p value				**0.00**	0.60
LUR-BE	*Cochran's Q*					261.86
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression.

Table 7 - Joint Cochran's Q for heterogeneity of mortality ratios of odds ratios between the 5 air pollution models for the three populations and three statistical models, ***for the two-category "Low Income" variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

	All non-accidental causes		Cardiovascular causes		Respiratory causes	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	*0.03*	1.00	*0.01*	1.00	*0.07*	1.00

Model adjusted for temperature lag 0 and relative humidity lag 0

	All non-accidental causes		Cardiovascular causes		Respiratory causes	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	*0.21*	0.99	*0.06*	1.00	*0.05*	1.00

Unadjusted model

	All non-accidental causes		Cardiovascular causes		Respiratory causes	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	*0.12*	1.00	*0.04*	1.00	*0.04*	1.00

Low Income: prevalence of households earning less than \$20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 38.94.8% of households earning less than \$20,000 a year, for all populations.

Table 8 - Assessment of multiplicative interaction between ozone exposure and the socioeconomic variable "Low Income" using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10ppm increase in ozone concentration and three populations

All non-accidental causes

	Beta coefficient	p value	95% CI	
Average value	0.00	0.94	-0.03	0.03
Nearest Station	0.01	0.60	-0.01	0.03
IDW	0.00	0.73	-0.02	0.03
LUR-BE	0.02	0.24	-0.01	0.05
BME-LUR	0.01	0.56	-0.02	0.04

Cardiovascular causes

	Beta coefficient	p value	95% CI	
Average value	0.00	0.96	-0.05	0.05
Nearest Station	0.00	0.93	-0.03	0.03
IDW	0.00	0.84	-0.04	0.03
LUR-BE	0.00	0.86	-0.04	0.05
BME-LUR	0.01	0.62	-0.04	0.07

Respiratory causes

	Beta coefficient	p value	95% CI	
Average value	0.08	**0.04**	**0.01**	**0.15**
Nearest Station	0.05	**0.04**	**0.00**	**0.10**
IDW	0.06	**0.05**	**0.00**	**0.11**
LUR-BE	0.07	0.07	-0.01	0.14
BME-LUR	0.04	0.29	-0.04	0.12

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 38.94.8% of households earning less than $20,000 a year, for all populations

Table 9 - Assessment of additive interaction between ozone exposure and the socioeconomic variable "Low Income" with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppm increase in ozone concentration in three populations

All non-accidental causes

	RERI	p value	95% CI	
Average value	0.00	0.92	-0.02	0.03
Nearest Station	0.00	0.58	-0.01	0.02
IDW	0.00	0.68	-0.02	0.02
LUR-BE	0.01	0.36	-0.01	0.03
BME-LUR	0.01	0.46	-0.02	0.04

Cardiovascular causes

	RERI	p value	95% CI	
Average value	0.00	0.91	-0.04	0.04
Nearest Station	0.00	0.85	-0.03	0.03
IDW	0.00	0.86	-0.04	0.03
LUR-BE	0.00	0.88	-0.03	0.04
BME-LUR	0.01	0.67	-0.03	0.05

Respiratory causes

	RERI	p value	95% CI	
Average value	0.06	**0.02**	0.01	0.12
Nearest Station	0.04	**0.03**	0.00	0.08
IDW	0.05	**0.03**	0.01	0.09
LUR-BE	0.04	0.10	-0.01	0.09
BME-LUR	0.04	0.18	-0.02	0.10

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 38.94.8% of households earning less than $20,000 a year, for all populations

Contents

SUPPLEMENT 1 – LIST OF DEATH CAUSES BY SUBPOPULATION, LIST OF EXCLUDED DEATH CAUSES AND CORRESPONDING ICD-10 CODES

Cardiovascular causes:

- Diabetes
- Cardiovascular rheumatism
- Hypertensive diseases
- Cerebrovascular diseases
- Ischemic diseases
- Circulatory system disease
- Ischemic cardiomyopathy
- Other forms of ischemic cardiomyopathies
- Artery diseases
- Cardiac rhythm disorders

*ICD-10 codes for cardiovascular causes**

Chapter	Blocks
E	11, 14
I	05, 07-13, 20-22, 24-28, 30, 33-35, 38, 40, 42, 44-51, 60-64, 67, 69-74, 77, 80, 82, 85, 87

**ICD-10 codes were missing for 8,039 of the 11,211 cases (71.66%)*

Respiratory causes:

- Tuberculosis
- Whooping cough
- Measles
- Respiratory diseases
- Respiratory system disorder
- Tumor of the lung
- Tumor of the respiratory system
- Tumor of the pleura
- Tumor of the peritoneum
- Influenza
- Pneumonia
- Chronic affection of the inferior respiratory tract
- Pneumoconiosis and other pulmonary diseases
- Silicosis
- Asbestosis
- Berylliosis

*ICD-10 codes for respiratory causes**

Chapter	Blocks
A	16,18
C	30-34, 38, 45
J	11, 13, 18, 20, 22, 38-40, 42-45, 47, 61-62, 69, 80-82, 84, 86, 90, 93, 96, 98

ICD-10 codes were missing for 14,201 of the 20,225 cases (70.22%)

*ICD-10 codes for all non-accidental causes**

Chapter	Blocks
A	04, 08-09, 16, 18, 31-32, 41, 44, 49, 81, 86
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E	03, 05, 07, 10-11, 13-16, 22-23, 41, 43, 46, 66, 76, 78, 83-88
F	01, 03-07, 10, 17, 19-20, 22, 25, 31-32, 43, 45, 50, 79, 89
G	09, 11-12, 20, 23-24, 30-31, 35, 37, 40, 45, 47, 70-71, 80-82, 91-93, 95
H	35, 40
I	05, 07-13, 20-22, 24-28, 30, 33-35, 38, 40, 42, 44-51, 60-64, 67, 69-74, 77, 80, 82, 85, 87
J	11, 13, 18, 20, 22, 38-40, 42-45, 47, 61-62, 69, 80-82, 84, 86, 90, 93, 96, 98
K	20, 22, 25-29, 31, 35, 40, 42-44, 46, 50-52, 55-57, 59, 62-63, 65-66, 70, 72-76, 80-81, 83, 85, 92
L	03, 08, 12-13, 72, 89, 98
M	00, 05-06, 10, 13, 15, 17, 19, 21, 31-35, 41, 45, 47-48, 62, 80-81, 86, 88
N	10, 12-13, 17-19, 28, 32, 39-40, 42, 49, 82, 85, 94
R	02, 04, 09, 13, 31, 54, 57-58, 64, 75, 96, 98-99

ICD-10 codes were missing for 84,297 of the 123,320 cases (68.36%)

Excluded death causes:

- Road accidents
- Motorized vehicle accidents
- Suicides
- Accidental falls
- Medical or surgical accidents and complications
- Unintentional traumas
- Other unintentional traumas
- CO intoxication
- External causes of death
- Sudden infant death syndrome
- Other infantile death causes
- Congenital anomalies
- Congenital anomalies of the circulatory system
- Preterm birth and low birth weight
- Respiratory distress
- Hypoxia and Asphyxia
- Perinatal mortality
- Other perinatal affections
- Other perinatal causes of death

*ICD-10 codes for all excluded death causes**

Chapter	Blocks
A	39, 41
B	34
C	92
D	18, 68, 84
E	72, 87
G	00, 03, 12, 93
I	31, 42, 69, 74
J	18
K	70, 72-74, 76, 83
M	35
P	01-03, 05, 07, 11, 20-23, 25-29, 35-37, 39, 52, 55, 61, 74, 77-78, 83, 90, 96
Q	00-05, 07, 20-28, 31, 33, 41, 43-44, 60-61, 76-77, 79, 85, 87, 89-92, 98-99
R	95, 99
V	01, 03-05, 09, 12-14, 18-19, 23-24, 27-29, 43-45, 47-49, 57-59, 63-64, 67-68, 80, 86-87, 89-92, 95
W	01, 03, 06, 10-20, 23-25, 31, 34, 40, 65, 67, 69-70, 74-76, 78-81, 83-86, 92
X	00, 04-46, 09, 11, 30-31, 40-42, 44-45, 47, 49, 51, 59-62, 64-65, 67, 69, 70-74, 76, 78, 80-85, 91, 93-95, 99
Y	00, 04, 07, 09, 11, 12, 14-15, 17, 19-21, 24, 26, 30-33, 35, 42, 44, 49, 52, 56-57, 60, 65, 59, 74, 82-83, 85-86

**ICD-10 codes were missing for 9,641 of the 12,641 excluded cases (76.27%)*

SUPPLEMENT 2 – MAPS OF MONTREAL SHOWING THE SPATIAL DISTRIBUTION OF THE SOCIO-ECONOMIC INDICATORS ACCORDING TO THE THREE-DIGIT FSA

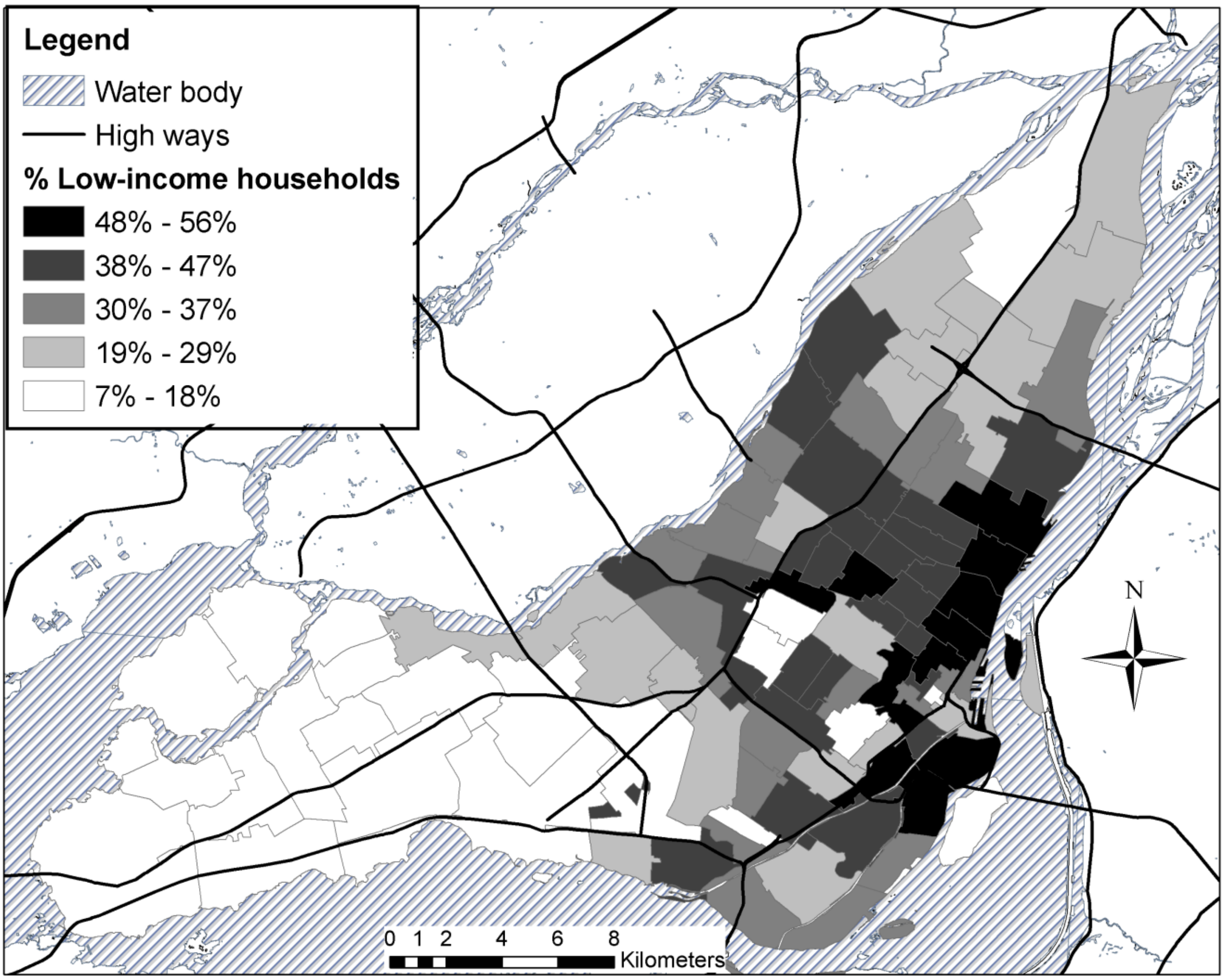

Fig. 1a. Map of Montreal showing the spatial distribution of the variable Low Income (prevalence of annual household income < $20,000) in the Forward Sortation Areas (FSA), with highways as black lines and three-digit FSA boundaries as gray lines. The categories were defined according to quintiles.

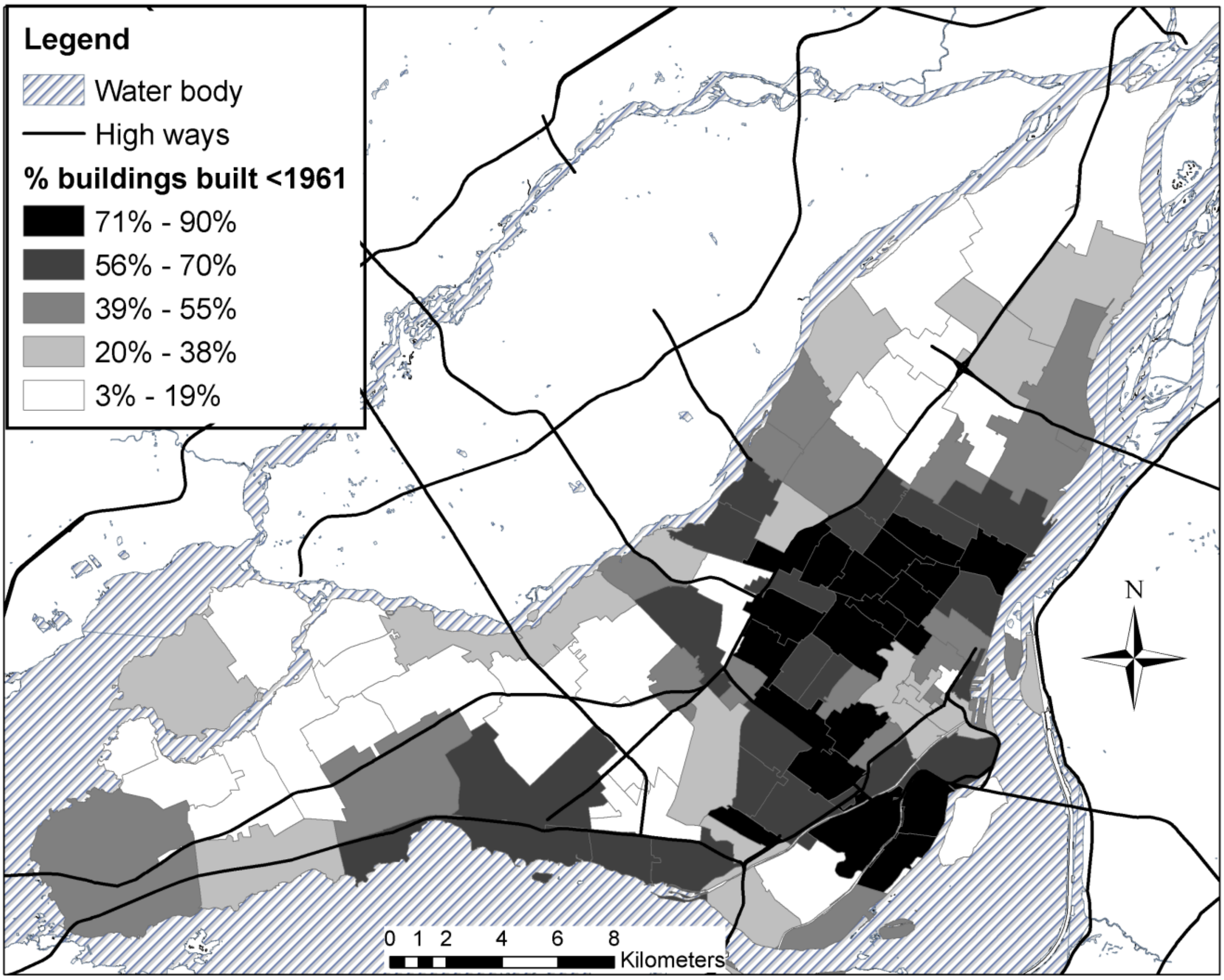

Fig. 1b. Map of Montreal showing the spatial distribution of the variable Old Buildings (prevalence of buildings older than 1961) in the Forward Sortation Areas (FSA), with highways as black lines and three-digit FSA boundaries as gray lines. The categories were defined according to quintiles.

SUPPLEMENT 3 – DESCRIPTION OF THE STUDY POPULATIONS ACCORDING TO THEIR SOCIO-ECONOMIC CATEGORY

Supplement 3a - Description of the study population (for cases only) ***according to both categories of "Low Income"***	**All non-accidental causes**		**Cardiovascular causes**		**Respiratory causes**	
	More deprived	**Less deprived**	**More deprived**	**Less deprived**	**More deprived**	**Less deprived**
Male, n *(%)*	6,433 (48)	6,740 (47)	2,514 (46)	2,675 (46)	1,315 (58)	1,281 (56)
Age at death, mean *(SD)*	76 (13)	77 (12)	78 (12)	79 (11)	74 (12)	75 (12)
Total, n	13,497	14,218	5,444	5,765	2,270	2,281
Prevalence of low income, mean % *(SD)*	45.1 (4.8)	28.3 (7.1)	45.2 (4.8)	28.2 (7.2	45.2 (4.8)	28.9 (7.0)
Prevalence of buildings built before 1961, mean % *(SD)*	57.7 (19.2)	43.3 (23.4)	57.9 (19.0)	43.4 (23.4)	58.3 (19.5)	44.3 (23.1)

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. SD: Standard deviation IQR: Inter-quartile range.

Supplement 3b - Description of the study population (for cases only) ***according to both categories of "Old Buildings"***	**All non-accidental causes**		**Cardiovascular causes**		**Respiratory causes**	
	More deprived	**Less deprived**	**More deprived**	**Less deprived**	**More deprived**	**Less deprived**
Male, n *(%)*	6,472 (47)	6,702 (48)	2,568 (46)	2,622 (46)	1,297 (56)	1,299 (58)
Age at death, mean *(SD)*	77 (13)	77 (12)	79 (11)	79 (11)	75 (12)	75 (11)
Total, n	13,747	13,971	5,560	5,651	2,301	2,250
Prevalence of low income, mean % *(SD)*	40.0 (10.0)	33.0 (9.6)	40.0 (10.0)	32.9 (9.7)	40.4 (9.8)	33.5 (9.2)
Prevalence of buildings built before 1961, mean % *(SD)*	69.2 (9.0)	31.7 (15.6)	69.2 (8.9)	31.9 (15.6)	69.7 (9.0)	32.5 (15.6)

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. SD: Standard deviation IQR: Inter-quartile range.

SUPPLEMENT 4 – SENSITIVITY ANALYSES WITH 3 CATEGORIES FOR "LOW INCOME"

*Supplement 4.1 - Separate Cochran's Q for heterogeneity between the Ratio of means **for the highest and lowest category of the "Low Income" variable** when comparing the air pollution models two by two in three populations*

All non-accidental causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*21.3*	*14.4*	*2439.4*	*8.4*
	p value		**0.00**	**0.00**	**0.00**	**0.00**
NS	*Cochran's Q*			*1.2*	*1798.0*	*75.8*
	p value			**0.27**	**0.00**	**0.00**
IDW	*Cochran's Q*				*2110.2*	*58.5*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*3879.2*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Cardiovascular causes population

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*7.7*	*6.4*	*970.2*	*4.0*
	p value		**0.01**	**0.01**	**0.00**	**0.04**
NS	*Cochran's Q*			*0.2*	*720.5*	*30.4*
	p value			**0.67**	**0.00**	**0.00**
IDW	*Cochran's Q*				*828.7*	*27.1*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					1574.02
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Respiratory causes population

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*4.7*	*3.5*	*415.4*	*0.0*
	p value		**0.03**	**0.06**	**0.00**	0.97
NS	*Cochran's Q*			*0.2*	*300.6*	*7.8*
	p value			**0.66**	**0.00**	**0.01**
IDW	*Cochran's Q*				*349.7*	*5.4*
	p value				**0.00**	**0.02**
LUR-BE	*Cochran's Q*					607.91
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Supplement 4.2 - Mortality odds ratio (OR) ***for the highest and lowest category of "Low Income"*** *with their 95% CI for a 10-ppm increase in predicted ozone concentration and the ratio of odds ratios (ROR) corresponding to the OR for the More deprived category over the OR for the Less deprived category in 3 populations, according to 5 air pollution models and 3 statistical models*

ALL NON-ACCIDENTAL CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.96 - 1.04	**1.03**	**1.00 - 1.06**	**1.03**	**1.01 - 1.06**
NS	1.00	0.97 - 1.02	1.01	0.99 - 1.03	**1.02**	**1.00 - 1.03**
IDW	0.99	0.96 - 1.02	1.01	0.99 - 1.03	**1.02**	**1.00 - 1.04**
LUR-BE	1.01	0.97 - 1.05	1.02	0.99 - 1.06	**1.02**	**1.00 - 1.04**
BME-LUR	1.00	0.96 - 1.04	**1.03**	**1.01 - 1.06**	**1.03**	**1.00 - 1.07**

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.00	0.95 - 1.04	1.02	0.99 - 1.06	1.03	0.99 - 1.06
NS	1.00	0.96 - 1.03	1.01	0.98 - 1.03	1.01	0.99 - 1.04
IDW	0.99	0.95 - 1.03	1.00	0.97 - 1.03	1.02	0.99 - 1.04
LUR-BE	1.00	0.95 - 1.06	1.01	0.96 - 1.06	1.01	0.98 - 1.04
BME-LUR	1.01	0.95 - 1.08	1.04	1.00 - 1.08	1.02	0.98 - 1.07

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.03	0.96 - 1.09	**1.04**	**1.00 - 1.09**	1.02	0.98 - 1.06
NS	1.00	0.95 - 1.05	1.03	0.99 - 1.07	1.03	0.99 - 1.06
IDW	0.99	0.94 - 1.05	1.04	0.99 - 1.08	**1.04**	**1.00 - 1.09**
LUR-BE	1.03	0.96 - 1.12	**1.07**	**1.00 - 1.14**	1.03	0.99 - 1.07
BME-LUR	1.01	0.93 - 1.09	**1.06**	**1.01 - 1.11**	1.05	0.99 - 1.12

CARDIOVASCULAR CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.98	0.93 - 1.04	0.99	0.95 - 1.03	1.00	0.96 - 1.05
NS	0.99	0.95 - 1.03	0.99	0.96 - 1.01	1.00	0.97 - 1.03
IDW	0.97	0.93 - 1.02	0.98	0.95 - 1.01	1.00	0.97 - 1.03
LUR-BE	0.97	0.91 - 1.04	0.97	0.92 - 1.03	1.00	0.97 - 1.03
BME-LUR	0.99	0.93 - 1.06	0.99	0.95 - 1.03	1.00	0.95 - 1.05

CARDIOVASCULAR CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	0.99	0.92 - 1.06	0.99	0.93 - 1.04	1.00	0.95 - 1.05
NS	0.99	0.94 - 1.05	0.99	0.95 - 1.03	0.99	0.96 - 1.03
IDW	0.97	0.91 - 1.03	0.97	0.92 - 1.01	1.00	0.96 - 1.04
LUR-BE	0.98	0.90 - 1.07	0.97	0.90 - 1.05	0.99	0.95 - 1.04
BME-LUR	1.01	0.91 - 1.11	0.99	0.93 - 1.05	0.99	0.92 - 1.06

CARDIOVASCULAR CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.96 - 1.16	1.03	0.96 - 1.11	0.98	0.91 - 1.05
NS	1.04	0.96 - 1.12	1.03	0.97 - 1.09	0.99	0.94 - 1.05
IDW	1.02	0.93 - 1.12	1.03	0.96 - 1.10	1.00	0.94 - 1.07
LUR-BE	1.06	0.94 - 1.19	1.07	0.96 - 1.19	1.01	0.95 - 1.07
BME-LUR	1.07	0.94 - 1.22	1.04	0.96 - 1.13	0.97	0.88 - 1.08

RESPIRATORY CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI CI UL	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.10**	**1.01 - 1.21**	**1.11**	**1.04 - 1.18**	1.00	0.94 - 1.07
NS	1.03	0.97 - 1.10	**1.04**	**1.00 - 1.09**	1.01	0.96 - 1.06
IDW	1.04	0.97 - 1.12	**1.05**	**1.00 - 1.10**	1.01	0.96 - 1.06
LUR-BE	1.06	0.96 - 1.17	1.06	0.97 - 1.15	1.00	0.95 - 1.05
BME-LUR	1.05	0.95 - 1.17	**1.08**	**1.02 - 1.15**	1.03	0.95 - 1.11

RESPIRATORY CAUSES

	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.15**	**1.03 - 1.29**	**1.11**	**1.03 - 1.21**	0.97	0.89 - 1.05
NS	1.05	0.96 - 1.14	1.03	0.97 - 1.10	0.99	0.93 - 1.05
IDW	1.07	0.97 - 1.19	1.05	0.97 - 1.12	0.97	0.91 - 1.04
LUR-BE	1.05	0.91 - 1.20	1.01	0.90 - 1.14	0.97	0.90 - 1.04
BME-LUR	1.11	0.96 - 1.29	1.09	0.99 - 1.19	0.98	0.87 - 1.10

RESPIRATORY CAUSES

	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.14	0.98 - 1.32	1.09	0.98 - 1.21	0.96	0.86 - 1.07
NS	1.03	0.91 - 1.16	1.05	0.97 - 1.15	1.02	0.94 - 1.11
IDW	1.07	0.93 - 1.23	1.08	0.98 - 1.19	1.01	0.91 - 1.11
LUR-BE	1.09	0.90 - 1.32	1.09	0.93 - 1.29	1.00	0.90 - 1.10
BME-LUR	1.05	0.86 - 1.27	1.10	0.98 - 1.24	1.05	0.90 - 1.22

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Supplement 4.3 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value for three populations and three statistical models, ***for the "Low Income" three-category variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.97	0.93	0.92	0.97
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.99	0.93	0.92	0.93
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.84	0.86	0.88	0.87

Model adjusted for temperature lag 0 and relative humidity lag 0

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		1.00	0.97	1.00	0.96
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.96	0.90	0.96	0.88
Respiratory causes population	*Cochran's Q*		*0.1*	*0.0*	*0.1*	*0.0*
	p value		0.82	0.86	0.79	0.93

Unadjusted model

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.87	0.83	0.95	0.90
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.95	0.90	0.99	0.95
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.83	0.89	0.93	0.85

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Supplement 4.4 - Assessment of ***multiplicative interaction between ozone exposure and the socioeconomic three-category variable "Low Income"*** *using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10 ppb increase in ozone concentration and three populations*

All non-accidental causes

	Beta coefficient	p value	95% CI	
AV	0.00	0.93	-0.04	0.03
NS	0.00	0.75	-0.03	0.02
IDW	-0.01	0.52	-0.04	0.02
LUR-BE	0.00	0.99	-0.04	0.04
BME-LUR	0.00	0.84	-0.04	0.05

Cardiovascular causes

	Beta coefficient	p value	95% CI	
AV	-0.02	0.58	-0.07	0.04
NS	-0.01	0.48	-0.06	0.03
IDW	-0.03	0.23	-0.07	0.02
LUR-BE	-0.03	0.30	-0.10	0.03
BME-LUR	0.00	0.95	-0.07	0.06

Respiratory causes

	Beta coefficient	p value	95% CI	
AV	0.10	**0.04**	**0.01**	**0.19**
NS	0.03	0.32	-0.03	0.10
IDW	0.04	0.22	-0.03	0.11
LUR-BE	0.04	0.39	-0.06	0.14
BME-LUR	0.05	0.31	-0.05	0.16

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

Supplement 4.5 - Assessment of ***additive interaction between ozone exposure and the socioeconomic three-category variable "Low Income"*** *with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppb increase in ozone concentration in three populations*

All non-accidental causes

	RERI	p value	95% CI	
AV	0.00	0.86	-0.03	0.04
NS	0.00	0.96	-0.02	0.02
IDW	0.00	0.70	-0.03	0.02
LUR-BE	0.00	0.79	-0.02	0.03
BME-LUR	0.01	0.61	-0.02	0.04

Cardiovascular causes

	RERI	p value	95% CI	
AV	-0.01	0.76	-0.06	0.05
NS	-0.01	0.56	-0.05	0.03
IDW	-0.02	0.34	-0.06	0.02
LUR-BE	-0.01	0.58	-0.06	0.03
BME-LUR	0.00	0.98	-0.06	0.06

Respiratory causes

	RERI	p value	95% CI	
AV	0.08	**0.02**	**0.01**	**0.15**
NS	0.03	0.27	-0.02	0.08
IDW	0.04	0.16	-0.02	0.09
LUR-BE	0.03	0.32	-0.03	0.10
BME-LUR	0.05	0.18	-0.02	0.12

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 32.8% and more than 41.75% of households earning less than $20,000/year, for all populations.

SUPPLEMENT 5 – SENSITIVITY ANALYSES WITH 2 CATEGORIES FOR "OLD BUILDINGS"

Table 5.1 – Description of the study population (for cases only)

	All non-accidental causes	**Cardiovascular diseases**	**Respiratory diseases**
Male, n *(%)*	13,174 *(47.5)*	5,190 *(46.3)*	2,596 *(57.0)*
Age at death, mean *(SD)*	77 *(13)*	79 *(11)*	75 *(12)*
Total, n	27,718	11,211	4,511
O_3 ppb measurement for the AV, median *(IQR)*	19.7 *(14.5-26.7)*	19.5 *(14.2-26.3)*	20.0 *(14.7-26.6)*
O_3 ppb measurement for the NS model, median *(IQR)*	27.5 *(18.3-37.6)*	26.9 *(17.8-37.2)*	28.0 *(18.8-38.3)*
O_3 ppb measurement for the IDW model, median *(IQR)*	27.3 *(19.5-36.4)*	26.9 *(19.2-36.1)*	27.5 *(19.7-36.1)*
O_3 ppb measurement for the LUR-BE model, median *(IQR)*	18.4 *(11.3-27.4)*	18.1 *(11.1-27.0)*	18.2 *(11.5-26.9)*
O_3 ppb measurement for the BME model, median *(IQR)*	30.3 *(24.0-36.1)*	30.0 *(23.8-35.9)*	30.4 *(24.2-36.1)*
Temperature lag 0, median *(IQR)*	23.5 *(19.6-26.6)*	23.3 *(19.5-26.5)*	23.5 *(19.7-26.6)*
Temperature lag 0-2, median *(IQR)*	23.5 *(20-26.1)*	23.3 *(19.9-28.4)*	23.6 *(20.1-26.0)*
Relative humidity lag 0, median *(IQR)*	69.1 *(61.0-76.9)*	69.2 *(61.1-77.1)*	69.2 *(61.1-77.0)*
Relative humidity lag 0-2, median *(IQR)*	69.0 *(62.5-74.8)*	69.1 *(62.4-74.9)*	68.9 *(62.5-74.8)*
Prevalence of low income, mean % *(SD)*	50.3 *(22.7)*	50.4 *(22.6)*	51.3 *(22.5)*
Prevalence of buildings built before 1961, mean % *(SD)*	36.5 *(10.4)*	36.4 *(10.5)*	37.0 *(10.1)*

Low Income: prevalence of households earning less than $20,000/year. Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. SD: Standard deviation IQR: Inter-quartile range.

Table 5.2 – Ozone concentrations for cases **in both categories of "Old Buildings"** according to 5 modelling approaches of ozone for 3 populations

All non-accidental causes	**More deprived**			**Less deprived**				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	21.6	10.2	13,747	21.5	10.1	13,971	1.00	0.99 - 1.01
NS	27.9	15.1		30.3	15.4		**0.92**	**0.91 - 0.93**
IDW	28.5	13.2		29.5	13.5		**0.97**	**0.96 - 0.98**
LUR-BE	16.7	11.0		24.9	14.0		**0.67**	**0.66 - 0.68**
BME-LUR	30.7	9.6		30.8	9.8		1.00	0.99 - 1.00

Cardiovascular causes	**More deprived**			**Less deprived**				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	21.4	10.1	5,560	21.2	9.9	5,651	1.01	0.99 - 1.03
NS	27.6	15.3		29.7	15.1		**0.93**	**0.91 - 0.95**
IDW	28.2	13.2		29.0	13.3		**0.97**	**0.96 - 0.99**
LUR-BE	16.5	11.1		24.5	13.8		**0.67**	**0.66 - 0.69**
BME-LUR	30.6	9.5		30.5	9.7		1.00	0.99 - 1.01

Respiratory causes	**More deprived**			**Less deprived**				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	21.8	10.3	2,301	21.6	10.1	2,250	1.01	0.98 - 1.04
NS	28.5	15.4		30.9	15.4		**0.92**	**0.89 - 0.95**
IDW	28.7	13.2		29.7	13.5		**0.96**	**0.94 - 0.99**
LUR-BE	16.8	10.7		24.7	13.6		**0.68**	**0.66 - 0.70**
BME-LUR	30.9	9.7		31.1	9.7		1.00	0.98 - 1.01

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 5.3 - Separate Cochran's Q for heterogeneity between the Ratio of exposure means ***for both categories of the "Old buildings" variable*** *when comparing the air pollution models two by two*

All non-accidental causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*104.4*	*22.9*	*1998.2*	*1.1*
	p value		**0.00**	**0.00**	**0.00**	0.29
NS	*Cochran's Q*			*33.8*	*1099.6*	*146.0*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*1661.4*	*24.7*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*2969.7*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Cardiovascular causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*37.3*	*8.9*	*779.5*	*0.4*
	p value		**0.00**	**0.00**	**0.00**	0.51
NS	*Cochran's Q*			*11.2*	*436.5*	*52.4*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*645.8*	*9.7*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					1171.82
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Respiratory causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*17.6*	*4.9*	*311.5*	*0.5*
	p value		**0.00**	**0.03**	**0.00**	0.49
NS	*Cochran's Q*			*4.6*	*169.3*	*22.4*
	p value			**0.03**	**0.00**	**0.00**
IDW	*Cochran's Q*				*250.1*	*4.5*
	p value				**0.00**	**0.03**
LUR-BE	*Cochran's Q*					454.79
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Old Buildings: prevalence of buildings built before 1961 in the neighbourhood. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression.

Supplement 5.4 - Mortality odds ratio (OR) ***for both categories of "Old Buildings"*** *with their 95% CI for a 10-ppm increase in predicted ozone concentration and the ratio of odds ratios (ROR) corresponding to the OR for the More deprived category over the OR for the Less deprived category in 3 populations, according to 5 air pollution models and 3 statistical models*

ALL NON-ACCIDENTAL CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.02	0.99 - 1.05	**1.04**	**1.02 - 1.06**	1.02	1.00 - 1.04
NS	1.02	1.00 - 1.04	**1.03**	**1.01 - 1.04**	1.01	1.00 - 1.02
IDW	1.01	0.99 - 1.03	**1.02**	**1.01 - 1.04**	1.01	1.00 - 1.03
LUR-BE	1.02	0.99 - 1.05	**1.04**	**1.01 - 1.06**	**1.02**	**1.00 - 1.04**
BME-LUR	1.02	0.99 - 1.05	**1.05**	**1.02 - 1.07**	**1.03**	**1.00 - 1.05**

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.03	0.99 - 1.06	**1.03**	**1.01 - 1.06**	1.01	0.98 - 1.03
NS	1.02	0.99 - 1.05	**1.02**	**1.00 - 1.04**	1.00	0.98 - 1.02
IDW	1.01	0.98 - 1.04	1.02	0.99 - 1.04	1.01	0.99 - 1.03
LUR-BE	1.01	0.97 - 1.05	1.02	0.99 - 1.06	1.01	0.99 - 1.04
BME-LUR	1.02	0.97 - 1.07	**1.04**	**1.00 - 1.07**	1.02	0.99 - 1.05

ALL NON-ACCIDENTAL CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.06**	**1.01 - 1.11**	**1.06**	**1.02 - 1.10**	1.00	0.96 - 1.03
NS	**1.05**	**1.01 - 1.09**	**1.05**	**1.02 - 1.08**	1.00	0.97 - 1.03
IDW	**1.05**	**1.00 - 1.09**	**1.06**	**1.03 - 1.10**	1.01	0.98 - 1.05
LUR-BE	**1.06**	**1.00 - 1.12**	**1.08**	**1.03 - 1.13**	1.02	0.99 - 1.06
BME-LUR	1.05	0.98 - 1.11	**1.07**	**1.02 - 1.12**	1.02	0.98 - 1.07

CARDIOVASCULAR CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	1.00 - 1.10	1.03	1.00 - 1.07	0.99	0.95 - 1.02
NS	**1.03**	**1.00 - 1.07**	1.02	0.99 - 1.04	0.98	0.96 - 1.01
IDW	1.03	0.99 - 1.06	1.01	0.99 - 1.04	0.99	0.96 - 1.01
LUR-BE	**1.05**	**1.00 - 1.10**	1.03	0.99 - 1.07	0.98	0.96 - 1.01
BME-LUR	1.05	1.00 - 1.11	1.03	0.99 - 1.07	0.98	0.95 - 1.01

CARDIOVASCULAR CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.99 - 1.11	1.03	0.99 - 1.08	0.98	0.94 - 1.03
NS	1.04	0.99 - 1.08	1.02	0.99 - 1.05	0.98	0.95 - 1.01
IDW	1.03	0.98 - 1.08	1.01	0.97 - 1.04	0.98	0.95 - 1.02
LUR-BE	1.06	0.99 - 1.13	1.04	0.99 - 1.10	0.98	0.94 - 1.02
BME-LUR	1.06	0.98 - 1.14	1.03	0.97 - 1.08	0.97	0.92 - 1.02

CARDIOVASCULAR CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.11**	**1.03 - 1.20**	**1.09**	**1.03 - 1.15**	0.98	0.93 - 1.04
NS	**1.11**	**1.04 - 1.18**	**1.08**	**1.03 - 1.13**	0.98	0.94 - 1.02
IDW	**1.12**	**1.04 - 1.20**	**1.10**	**1.05 - 1.16**	0.99	0.94 - 1.04
LUR-BE	**1.17**	**1.07 - 1.28**	**1.17**	**1.09 - 1.25**	0.99	0.94 - 1.05
BME-LUR	**1.12**	**1.01 - 1.23**	**1.09**	**1.02 - 1.17**	0.98	0.92 - 1.05

RESPIRATORY CAUSES

	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.97 - 1.12	1.08	1.02 - 1.13	1.03	0.98 - 1.08
NS	1.02	0.97 - 1.07	1.04	1.00 - 1.07	1.02	0.99 - 1.06
IDW	1.01	0.96 - 1.07	1.04	1.00 - 1.08	1.03	0.99 - 1.06
LUR-BE	1.01	0.94 - 1.09	1.04	0.98 - 1.10	1.02	0.98 - 1.07
BME-LUR	1.04	0.96 - 1.12	1.09	1.03 - 1.15	1.04	0.99 - 1.10

RESPIRATORY CAUSES

	Model adjusted for temperature lag 0 and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.96 - 1.15	1.06	1.00 - 1.13	1.02	0.95 - 1.08
NS	1.01	0.94 - 1.08	1.02	0.97 - 1.07	1.01	0.97 - 1.06
IDW	1.00	0.92 - 1.08	1.01	0.96 - 1.07	1.02	0.96 - 1.08
LUR-BE	0.98	0.88 - 1.08	0.99	0.91 - 1.07	1.01	0.95 - 1.08
BME-LUR	1.04	0.93 - 1.16	1.08	0.99 - 1.17	1.04	0.96 - 1.12

RESPIRATORY CAUSES

	Model adjusted for temperature lag 0-2 and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.05	0.93 - 1.19	1.04	0.96 - 1.13	0.99	0.91 - 1.08
NS	0.99	0.90 - 1.09	1.01	0.94 - 1.08	1.01	0.95 - 1.08
IDW	0.99	0.89 - 1.11	1.01	0.93 - 1.10	1.02	0.94 - 1.10
LUR-BE	0.99	0.86 - 1.14	1.01	0.90 - 1.13	1.02	0.93 - 1.11
BME-LUR	1.05	0.91 - 1.22	1.08	0.97 - 1.20	1.02	0.92 - 1.13

Old Buildings: Prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 5.5 - Joint Cochran's Q for heterogeneity of mortality ratios of odds ratios between the 5 air pollution models for the three populations and three statistical models, ***for the two-category "Old Buildings" socio-economic variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

	All non-accidental causes		**Cardiovascular causes**		**Respiratory causes**	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	0.02	1.00	0.05	1.00	0.13	1.00

Model adjusted for temperature lag 0 and relative humidity lag 0

	All non-accidental causes		**Cardiovascular causes**		**Respiratory causes**	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	0.07	1.00	0.07	1.00	0.20	1.00

Unadjusted model

	All non-accidental causes		**Cardiovascular causes**		**Respiratory causes**	
	Cochran's Q	*p*	*Cochran's Q*	*p*	*Cochran's Q*	*p*
AV **NS** **IDW** **LUR-BE** **BME-LUR**	0.06	1.00	0.07	1.00	0.08	1.00

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 5.6 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value for three populations and three statistical models, ***for the two-category "Old Buildings" variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.94	0.88	0.96	0.96
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.93	0.90	0.98	0.98
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.89	0.88	0.87	0.98

Model adjusted for temperature lag 0 and relative humidity lag 0

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.99	0.98	0.98	0.98
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.96	0.90	0.95	0.95
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.1*	*0.0*
	p value		0.87	0.84	0.76	0.97

Unadjusted model

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.96	0.92	0.98	0.93
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.98	0.99	0.84	0.99
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.86	0.84	0.83	1.00

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

Table 5.7 - Assessment of ***multiplicative interaction between ozone exposure and the socioeconomic variable "Old Buildings"*** *using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10ppm increase in ozone concentration and three populations*

All non-accidental causes

	Beta coefficient	p value	95% CI	
Average value	0.02	0.13	-0.01	0.05
Nearest Station	0.02	0.12	0.00	0.04
IDW	0.01	0.42	-0.01	0.03
LUR-BE	0.02	0.31	-0.01	0.05
BME-LUR	0.02	0.25	-0.01	0.05

Cardiovascular causes

	Beta coefficient	p value	95% CI	
Average value	0.04	0.06	0.00	0.09
Nearest Station	0.03	**0.05**	**0.00**	**0.06**
IDW	0.03	0.14	-0.01	0.06
LUR-BE	0.05	0.06	0.00	0.09
BME-LUR	0.05	0.07	0.00	0.10

Respiratory causes

	Beta coefficient	p value	95% CI	
Average value	0.04	0.23	-0.03	0.12
Nearest Station	0.01	0.57	-0.04	0.06
IDW	0.01	0.67	-0.04	0.07
LUR-BE	0.01	0.84	-0.07	0.08
BME-LUR	0.04	0.33	-0.04	0.12

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

Table 5.8 - Assessment of ***additive interaction between ozone exposure and the socioeconomic variable "Old Buildings"*** *with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppm increase in ozone concentration in three populations*

All non-accidental causes

	RERI	p value	95% CI	
Average value	0.02	0.15	-0.01	0.04
Nearest Station	0.01	0.15	0.00	0.03
IDW	0.01	0.46	-0.01	0.03
LUR-BE	0.01	0.50	-0.01	0.03
BME-LUR	0.02	0.25	-0.01	0.04

Cardiovascular causes

	RERI	p value	95% CI	
Average value	0.03	0.09	-0.01	0.07
Nearest Station	0.02	0.09	0.00	0.05
IDW	0.02	0.19	-0.01	0.05
LUR-BE	0.02	0.17	-0.01	0.06
BME-LUR	0.04	0.08	0.00	0.08

Respiratory causes

	RERI	p value	95% CI	
Average value	0.04	0.23	-0.02	0.09
Nearest Station	0.01	0.56	-0.03	0.05
IDW	0.01	0.66	-0.04	0.06
LUR-BE	0.00	0.86	-0.05	0.06
BME-LUR	0.03	0.33	-0.03	0.09

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood, for all populations.

SUPPLEMENT 6 – SENSITIVITY ANALYSES WITH 3 CATEGORIES FOR "OLD BUILDINGS"

*Supplement 6.1 – Ozone concentrations in the **highest and lowest category of "Old Buildings"** according to 5 modelling approaches of ozone for the 3 populations (all non-accidental causes, cardiovascular causes, respiratory causes)*

All non-accidental causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.45	*10.11*	9,117	21.47	*9.96*	9,694	1.00	0.99 - 1.01
NS	27.27	*15.17*		30.33	*15.38*		**0.90**	**0.89 - 0.91**
IDW	28.14	*13.16*		29.67	*13.40*		**0.95**	**0.94 - 0.96**
LUR-BE	14.42	*9.05*		26.43	*14.24*		**0.55**	**0.54 - 0.55**
BME-LUR	30.70	*9.68*		30.58	*9.42*		**1.00**	**1.00 - 1.01**

Cardiovascular causes	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.05	*9.93*	3,728	20.96	*9.73*	3,902	1.00	0.98 - 1.03
NS	26.78	*15.07*		29.60	*15.00*		**0.90**	**0.88 - 0.93**
IDW	27.59	*13.03*		29.03	*13.12*		**0.95**	**0.93 - 0.97**
LUR-BE	14.15	*8.93*		25.84	*14.10*		**0.55**	**0.53 - 0.56**
BME-LUR	30.45	*9.58*		30.14	*9.26*		**1.01**	**1.00 - 1.02**

Respiratory Diseases	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95% CI*
AV	21.80	*10.47*	1587	21.73	*10.06*	1533	1.00	0.97 - 1.04
NS	28.08	*15.51*		31.28	*15.61*		**0.90**	**0.87 - 0.93**
IDW	28.49	*13.37*		30.22	*13.63*		**0.94**	**0.91 - 0.97**
LUR-BE	14.91	*9.07*		26.57	*13.97*		**0.56**	**0.54 - 0.58**
BME-LUR	31.06	*9.88*		30.98	*9.32*		**1.00**	**0.98 - 1.02**

Old Buildings: prevalence of buildings built before 1961.AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 6.2 - Separate Cochran's Q for heterogeneity between the Ratio of exposure means ***for the highest and lowest category of the "Old Buildings" variable*** *when comparing the air pollution models two by two in three populations*

All non-accidental causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*104.1*	*29.6*	*3417.6*	*0.4*
	p value		**0.00**	**0.00**	**0.00**	0.55
NS	*Cochran's Q*			*27.1*	*2039.8*	*186.1*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*2820.1*	*55.4*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*4867.3*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Cardiovascular causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*41.0*	*13.4*	*1364.8*	*0.2*
	p value		**0.00**	**0.00**	**0.00**	0.63
NS	*Cochran's Q*			*9.2*	*815.1*	*75.7*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*1108.6*	*26.0*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					1966.89
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Respiratory causes

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*18.9*	*6.8*	*525.7*	*0.0*
	p value		**0.00**	**0.01**	**0.00**	0.95
NS	*Cochran's Q*			*3.7*	*304.4*	*31.0*
	p value			**0.05**	**0.00**	**0.00**
IDW	*Cochran's Q*				*414.6*	*10.6*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					745.03
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 6.3 - Mortality odds ratio (OR) ***for the highest and lowest category of "Old Buildings"*** *with their 95% CI for a 10-ppm increase in predicted ozone concentration and the ratio of odds ratios (ROR) corresponding to the OR for the More deprived category over the OR for the Less deprived category in 3 populations, according to 5 air pollution models and 3 statistical models*

	ALL NON-ACCIDENTAL CAUSES					
	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.02	0.99 - 1.06	**1.03**	**1.00 - 1.06**	1.01	0.98 - 1.03
NS	1.01	0.98 - 1.03	**1.01**	**1.00 - 1.03**	1.01	0.99 - 1.03
IDW	1.00	0.97 - 1.03	1.01	0.99 - 1.03	1.01	0.99 - 1.03
LUR-BE	1.01	0.97 - 1.05	1.02	0.99 - 1.06	**1.02**	**1.00 - 1.04**
BME-LUR	1.01	0.97 - 1.06	**1.03**	**1.00 - 1.06**	1.02	0.99 - 1.05

	ALL NON-ACCIDENTAL CAUSES					
	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.03	0.99 - 1.08	1.02	0.99 - 1.06	0.99	0.96 - 1.02
NS	1.01	0.98 - 1.05	1.01	0.98 - 1.04	1.00	0.97 - 1.02
IDW	1.00	0.96 - 1.04	1.00	0.97 - 1.03	1.00	0.97 - 1.03
LUR-BE	1.00	0.95 - 1.06	1.01	0.96 - 1.06	1.00	0.98 - 1.03
BME-LUR	1.03	0.97 - 1.09	1.03	0.98 - 1.07	1.00	0.96 - 1.04

	ALL NON-ACCIDENTAL CAUSES					
	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.07**	**1.00 - 1.13**	**1.05**	**1.01 - 1.09**	0.98	0.94 - 1.03
NS	1.04	0.99 - 1.09	**1.04**	**1.00 - 1.07**	0.99	0.96 - 1.03
IDW	1.03	0.98 - 1.09	**1.04**	**1.00 - 1.08**	1.01	0.97 - 1.05
LUR-BE	1.04	0.96 - 1.12	**1.06**	**1.00 - 1.13**	1.02	0.98 - 1.06
BME-LUR	1.04	0.96 - 1.12	**1.06**	**1.00 - 1.12**	1.02	0.96 - 1.08

	CARDIOVASCULAR CAUSES					
	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.04	0.98 - 1.10	1.00	0.96 - 1.04	0.96	0.92 - 1.00
NS	1.00	0.97 - 1.04	0.98	0.96 - 1.01	0.98	0.95 - 1.01
IDW	1.00	0.96 - 1.04	0.98	0.95 - 1.01	0.98	0.95 - 1.01
LUR-BE	0.99	0.93 - 1.05	0.97	0.92 - 1.03	0.98	0.95 - 1.01
BME-LUR	1.03	0.97 - 1.10	0.99	0.95 - 1.04	0.96	0.92 - 1.01

	CARDIOVASCULAR CAUSES					
	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.06	0.99 - 1.14	1.01	0.96 - 1.06	0.95	0.90 - 1.00
NS	1.01	0.96 - 1.07	0.99	0.95 - 1.03	0.97	0.94 - 1.01
IDW	1.00	0.94 - 1.06	0.97	0.93 - 1.02	0.97	0.93 - 1.02
LUR-BE	1.00	0.91 - 1.09	0.98	0.90 - 1.05	0.98	0.94 - 1.02
BME-LUR	1.07	0.98 - 1.17	1.01	0.94 - 1.07	0.94	0.88 - 1.00

	CARDIOVASCULAR CAUSES					
	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	**1.13**	**1.03 - 1.25**	**1.07**	**1.01 - 1.15**	0.95	0.89 - 1.02
NS	**1.09**	**1.01 - 1.18**	**1.05**	**1.00 - 1.11**	0.96	0.91 - 1.01
IDW	**1.10**	**1.00 - 1.20**	**1.06**	**1.00 - 1.13**	0.97	0.91 - 1.03
LUR-BE	1.12	0.99 - 1.26	1.10	0.99 - 1.22	0.98	0.92 - 1.05
BME-LUR	**1.13**	**1.00 - 1.28**	1.08	0.99 - 1.18	0.95	0.87 - 1.04

	RESPIRATORY CAUSES					
	Unadjusted model		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.04	0.95 - 1.13	**1.08**	**1.01 - 1.14**	1.04	0.98 - 1.11
NS	1.00	0.94 - 1.06	1.03	0.99 - 1.08	1.03	0.99 - 1.08
IDW	0.99	0.93 - 1.06	1.03	0.99 - 1.08	1.04	0.99 - 1.09
LUR-BE	1.00	0.91 - 1.10	1.04	0.96 - 1.12	1.04	0.99 - 1.09
BME-LUR	1.03	0.93 - 1.13	**1.08**	**1.01 - 1.15**	1.05	0.98 - 1.13

	RESPIRATORY CAUSES					
	Model adjusted for temperature and humidity lag 0		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.09	0.98 - 1.21	**1.08**	**1.00 - 1.16**	0.99	0.92 - 1.07
NS	1.03	0.95 - 1.12	1.03	0.97 - 1.09	0.99	0.94 - 1.05
IDW	1.03	0.93 - 1.13	1.03	0.96 - 1.10	1.00	0.93 - 1.07
LUR-BE	1.01	0.88 - 1.15	1.00	0.89 - 1.12	0.99	0.92 - 1.06
BME-LUR	1.11	0.97 - 1.27	1.09	0.99 - 1.20	0.98	0.89 - 1.08

	RESPIRATORY CAUSES					
	Model adjusted for temperature and humidity lag 0-2		*More deprived*		*Less deprived*	
	ROR	95% CI	*OR*	*95% CI*	*OR*	*95% CI*
AV	1.09	0.95 - 1.26	1.06	0.96 - 1.17	0.97	0.87 - 1.07
NS	1.01	0.90 - 1.14	1.01	0.93 - 1.10	1.00	0.92 - 1.08
IDW	1.02	0.89 - 1.17	1.03	0.93 - 1.13	1.01	0.92 - 1.10
LUR-BE	1.03	0.86 - 1.24	1.04	0.89 - 1.21	1.00	0.91 - 1.11
BME-LUR	1.09	0.91 - 1.31	1.10	0.97 - 1.25	1.00	0.88 - 1.14

Old Buildings: Prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 6.4 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value for three populations and three statistical models, ***for the "Old Buildings" three-category variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.89	0.84	0.88	0.94
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.1*	*0.0*
	p value		0.86	0.83	0.77	0.98
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.89	0.86	0.86	0.96

Model adjusted for temperature lag 0 and relative humidity lag 0

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.97	1.00	0.99	0.99
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.1*	*0.1*	*0.0*
	p value		0.84	0.79	0.76	0.96
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.1*	*0.0*
	p value		0.87	0.85	0.80	0.95

Unadjusted model

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.91	0.87	0.90	0.90
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.91	0.92	0.97	1.00
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.85	0.86	0.88	1.00

Old Buildings: Prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 6.5 - Assessment of ***multiplicative interaction between ozone exposure and the socioeconomic three-category variable "Old Buildings"*** *using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10 ppb increase in ozone concentration and three populations*

All non-accidental causes

	Beta coefficient	p value	95% CI	
Average value	0.02	0.25	-0.02	0.06
Nearest Station	0.01	0.64	-0.02	0.03
IDW	0.00	0.95	-0.03	0.03
LUR-BE	0.00	0.93	-0.04	0.04
BME-LUR	0.01	0.49	-0.03	0.05

Cardiovascular causes

	Beta coefficient	p value	95% CI	
Average value	0.03	0.24	-0.02	0.09
Nearest Station	0.00	0.85	-0.04	0.04
IDW	0.00	0.84	-0.05	0.04
LUR-BE	-0.02	0.59	-0.08	0.05
BME-LUR	0.03	0.34	-0.03	0.10

Respiratory causes

	Beta coefficient	p value	95% CI	
Average value	0.03	0.43	-0.05	0.12
Nearest Station	0.00	0.99	-0.06	0.06
IDW	-0.01	0.85	-0.07	0.06
LUR-BE	-0.01	0.80	-0.11	0.08
BME-LUR	0.03	0.61	-0.07	0.12

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

Supplement 6.6 - Assessment of ***additive interaction between ozone exposure and the socioeconomic three-category variable "Old Buildings"*** *with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppb increase in ozone concentration in three populations*

All non-accidental causes

	RERI	p value	95% CI	
Average value	0.02	0.25	-0.01	0.05
Nearest Station	0.01	0.56	-0.01	0.03
IDW	0.00	0.95	-0.02	0.02
LUR-BE	0.00	0.76	-0.02	0.03
BME-LUR	0.01	0.40	-0.02	0.05

Cardiovascular causes

	RERI	p value	95% CI	
Average value	0.03	0.26	-0.02	0.08
Nearest Station	0.00	0.78	-0.03	0.04
IDW	0.00	0.92	-0.04	0.04
LUR-BE	0.01	0.77	-0.04	0.05
BME-LUR	0.03	0.31	-0.02	0.08

Respiratory causes

	RERI	p value	95% CI	
Average value	0.03	0.39	-0.04	0.10
Nearest Station	0.00	0.88	-0.05	0.05
IDW	0.00	0.96	-0.06	0.06
LUR-BE	-0.01	0.76	-0.08	0.06
BME-LUR	0.02	0.50	-0.05	0.10

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Low Deprivation vs. High deprivation were respectively less than 42.0% and more than 61.6% of buildings built before 1961 in the neighbourhood, for all populations.

SUPPLEMENT 7 – SEPARATE COCHRAN'S Q TEST FOR HETEROGENEITY OF EXPOSURE IN THE MAIN ANALYSIS

Supplement 7 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value for three populations and three statistical models, ***for the two-category "Low Income" variable***

Model adjusted for temperature lag 0-2 and relative humidity lag 0-2

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.1*	*0.0*
	p value		0.91	0.93	0.72	0.88
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.98	0.96	0.95	0.93
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.91	0.92	0.98	0.87

Model adjusted for temperature lag 0 and relative humidity lag 0

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.1*	*0.0*
	p value		0.96	0.99	0.75	0.92
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.96	1.00	0.85	0.89
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.91	0.93	0.90	0.84

Unadjusted model

		AV	NS	IDW	LUR-BE	BME-LUR
All non-accidental causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.97	0.94	0.94	0.96
Cardiovascular causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.99	0.96	0.96	1.00
Respiratory causes population	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.87	0.91	0.84	0.85

Low Income: prevalence of households earning less than $20,000/year. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The unadjusted model included ozone lag 0. The model adjusted for temperature lag 0 and humidity lag 0 included ozone lag 0. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 38.94.8% of households earning less than $20,000 a year, for all populations.

SUPPLEMENT 8 – FORMULAS USED IN THE ARTICLE

1. **Cochran's Q test**

$$Cochran's\ Q = \frac{(\beta_1 - \beta_{pooled})^2}{VAR(\beta_1)} + \frac{\left(\beta_2 - \beta_{pooled}\right)^2}{VAR(\beta_2)}$$

$$\text{with } \beta_{pooled} = \frac{\frac{\beta_1}{VAR(\beta_1)} + \frac{\beta_2}{VAR(\beta_2)}}{\frac{1}{VAR(\beta_1)} + \frac{1}{VAR(\beta_2)}}$$

From Kaufman JS, MacLehose RF. Which of these things is not like the others? Cancer. 2013 Dec 15;119(24):4216–22.

2. **RERI (Relative Excess Risk due to Interaction)**

<u>For two-category variables, e.g "Low Income" and a continuous ozone exposure</u>

Two-category "Low Income" is a variable called XLIN, taking the values 1 or 2

Ozone exposure lag 0 according to the nearest station model is a continuous variable called o3_near0 and we want to compute the RERI for an increase from 0 to 10 ppb

We posit:

g1=2 g0=1

e1=10 e0=0 Ige = XLIN*o3_near0

We run a conditional logistic regression with mortality as an outcome and two-category "Low Income", ozone exposure lag 0, temperature lag 0 and relative humidity lag 0 as independent variables.

The beta coefficients for XLIN o3_near0 and Ige are respectively: _b[XLIN], _b[o3_near0] and _b[Ige].

$$RERI = exp^{((\mathrm{g1}-\mathrm{g0})*\_\mathrm{b[XLIN]}+(\mathrm{e1}-\mathrm{e0})*\_\mathrm{b[o3\_near0]}+(\mathrm{g1}*\mathrm{e1}-\mathrm{g0}*\mathrm{e0})*\_\mathrm{b[Ige]})-\exp((\mathrm{g1}-\mathrm{g0})*\_\mathrm{b[XLIN]}+(\mathrm{g1}-\mathrm{g0})*\mathrm{e0}*\_\mathrm{b[Ige]})} - exp^{((\mathrm{e1}-\mathrm{e0})*\_\mathrm{b[o3\_near0]}+(\mathrm{e1}-\mathrm{e0})*\mathrm{g0}*\_\mathrm{b[Ige]})} + 1$$

The corresponding STATA command is

logit case XLIN o3_near0 Ige temp_maxlag3d rhum3d

*nlcom exp((g1-g0)*_b[XLIN]+(e1-e0)*_b[o3_near0]+(g1*e1-g0*e0)*_b[Ige])-exp((g1-g0)*_b[XLIN]+(g1-g0)*e0*_b[Ige])-exp((e1-e0)*_b[o3_near0]+(e1-e0)*g0*_b[Ige])+1*

From Explanation in Causal Inference: Methods for Mediation and Interaction - Tyler Vanderweele

SUPPLEMENT 9 – SENSITIVITY ANALYSES STRATIFYING ON THE PERIOD OF STUDY FOR THE “OLD BUILDINGS” VARIABLE WITH TWO CATEGORIES

Supplement 9.1 – Ozone concentrations for cases in both categories of "Old Buildings" according to 5 modelling approaches of ozone for all non-accidental causes, during two time periods

Before 31st December 1996

	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	19.3	8.8	5,752	19.1	9.2	5,203	**1.01**	**1.00 - 1.03**
NS	26.1	14.4		28.1	14.9		**0.93**	**0.91 - 0.95**
IDW	26.5	12.1		27.2	12.7		**0.98**	**0.96 - 0.99**
LUR-BE	14.7	9.5		21.3	12.1		**0.69**	**0.67 - 0.70**
BME-LUR	30.0	9.6		29.7	9.7		**1.01**	**1.00 - 1.02**

After 1st January 1997

	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	23.3	10.7	7,995	23.0	10.3	8,768	**1.01**	**1.00 - 1.03**
NS	29.2	15.5		31.6	15.5		**0.92**	**0.91 - 0.94**
IDW	30.0	13.7		30.9	13.8		**0.97**	**0.96 - 0.98**
LUR-BE	18.1	11.8		27.1	14.6		**0.67**	**0.66 - 0.68**
BME-LUR	31.3	9.5		31.5	9.8		**0.99**	**0.98 - 1.00**

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 9.2 - Separate Cochran's Q for heterogeneity between the Ratio of means when comparing the air pollution models two by two in the all non-accidental causes population regarding both categories of "Old buildings", during two time periods

Before 31st December 1996

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*39.2*	*8.7*	*719.8*	*0.1*
	p value		**0.00**	**0.00**	**0.00**	0.78
NS	*Cochran's Q*			*12.7*	*379.1*	*58.1*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*590.9*	*11.3*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*1051.6*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

After 1st January 1997

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*74.9*	*18.0*	*1310.2*	*5.7*
	p value		**0.00**	**0.00**	**0.00**	0.02
NS	*Cochran's Q*			*22.1*	*699.0*	*77.6*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*1055.4*	*8.8*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*1828.1*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression.

Supplement 9.3 - Mortality odds ratio (OR) for both categories of "Old Buildings" with their 95% CI for a 10 ppb increase in predicted ozone concentration and the ratio of odds ratios for all non-accidental causes of mortality, using the statistical model adjusted on lag 0-2, according to 5 air pollution models, during two time periods

Before 31st December 1996

					More deprived				*Less deprived*			
	ROR	95% CI			*OR*	*95% CI*			*OR*	*95% CI*		
AV	1.00	0.92	-	1.09	1.02	0.96	-	1.08	1.02	0.96	-	1.09
NS	1.01	0.95	-	1.08	1.03	0.99	-	1.08	1.02	0.98	-	1.07
IDW	1.00	0.93	-	1.07	1.03	0.98	-	1.08	1.03	0.98	-	1.09
LUR-BE	0.98	0.89	-	1.09	1.04	0.96	-	1.12	1.06	0.99	-	1.12
BME-LUR	1.00	0.91	-	1.09	1.04	0.98	-	1.11	1.04	0.98	-	1.11

After 1st January 1997

					More deprived				*Less deprived*			
	ROR	95% CI			*OR*	*95% CI*			*OR*	*95% CI*		
AV	**1.10**	**1.03**	**-**	**1.16**	**1.08**	**1.03**	**-**	**1.13**	**0.98**	**0.94**	**-**	**1.03**
NS	**1.08**	**1.03**	**-**	**1.14**	**1.06**	**1.02**	**-**	**1.10**	**0.98**	**0.95**	**-**	**1.02**
IDW	**1.08**	**1.02**	**-**	**1.14**	**1.08**	**1.04**	**-**	**1.13**	1.00	0.96	-	1.04
LUR-BE	**1.10**	**1.03**	**-**	**1.18**	**1.11**	**1.04**	**-**	**1.17**	1.00	0.96	-	1.05
BME-LUR	**1.10**	**1.01**	**-**	**1.19**	**1.10**	**1.03**	**-**	**1.17**	1.00	0.95	-	1.06

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios (More deprived over Less deprived). The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 9.4 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value in all non-accidental causes of mortality, using the statistical model adjusted on lag 0-2, for the "Old Buildings" variable, during two time periods

Before 31st December 1996		**AV**	**NS**	**IDW**	**LUR-BE**	**BME-LUR**
All non-accidental causes	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.96	0.97	0.92	0.97

After 1st January 1997		**AV**	**NS**	**IDW**	**LUR-BE**	**BME-LUR**
All non-accidental causes	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.95	0.95	0.97	1.00

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression.The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 9.5 - Assessment of multiplicative interaction between ozone exposure and the socioeconomic variable "Old Buildings" using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10 ppb increase in ozone concentration, for all non-accidental causes of mortality, during two time periods

Before 31st December 1996

	Beta coefficient	P value	CI LL	CI UL
Average value	0.01	0.70	-0.04	0.06
Nearest Station	0.01	0.72	-0.03	0.04
IDW	0.00	0.98	-0.04	0.04
LUR-BE	0.01	0.85	-0.05	0.06
BME-LUR	0.02	0.42	-0.03	0.07

After 1st January 1997

	Beta coefficient	P value	CI LL	CI UL
Average value	0.03	0.10	-0.01	0.07
Nearest Station	0.02	0.09	0.00	0.05
IDW	0.01	0.29	-0.01	0.04
LUR-BE	0.02	0.27	-0.02	0.06
BME-LUR	0.02	0.39	-0.02	0.06

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 9.6 - Assessment of additive interaction between ozone exposure and the socioeconomic variable "Old Buildings" with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppb increase in ozone concentration for all non-accidental causes of mortality, during two time periods

Before 31st December 1996

	RERI	p value	CI LL	CI UL
Average value	0.01	0.72	-0.04	0.06
Nearest Station	0.00	0.73	-0.02	0.03
IDW	0.00	0.99	-0.03	0.03
LUR-BE	0.00	0.83	-0.04	0.04
BME-LUR	0.01	0.48	-0.03	0.06

After 1st January 1997

	RERI	p value	CI LL	CI UL
Average value	0.02	0.12	-0.01	0.06
Nearest Station	0.02	0.12	0.00	0.04
IDW	0.01	0.32	-0.01	0.04
LUR-BE	0.01	0.49	-0.02	0.04
BME-LUR	0.02	0.37	-0.02	0.05

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

SUPPLEMENT 10 – SENSITIVITY ANALYSES STRATIFYING ON THE PERIOD OF STUDY FOR THE "OLD BUILDINGS" VARIABLE WITH THREE CATEGORIES

Supplement 10.1 – Ozone concentrations for cases in the highest and lowest category of "Old Buildings" according to 5 modelling approaches of ozone for all non-accidental causes, during two time periods

Before 31st December 1996

	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	19.2	8.8	5,752	19.0	9.0	5,203	1.01	0.99 - 1.03
NS	25.4	14.3		28.2	15.1		**0.90**	**0.88 - 0.92**
IDW	26.1	12.2		27.3	12.6		**0.95**	**0.94 - 0.97**
LUR-BE	12.9	8.0		22.6	12.4		**0.57**	**0.56 - 0.58**
BME-LUR	29.9	10.0		29.2	9.2		**1.02**	**1.01 - 1.04**

After 1st January 1997

	More deprived			Less deprived				
	Mean	*SD*	*N*	*Mean*	*SD*	*N*	*ROM*	*95CI*
AV	23.1	10.7	5,198	22.9	10.2	6,072	1.01	0.99 - 1.03
NS	28.7	15.7		31.6	15.4		**0.91**	**0.89 - 0.93**
IDW	29.7	13.6		31.1	13.7		**0.96**	**0.94 - 0.97**
LUR-BE	15.6	9.6		28.7	14.8		**0.54**	**0.53 - 0.55**
BME-LUR	31.3	9.4		31.4	9.4		**1.00**	**0.99 - 1.01**

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROM: Ratio of means (More deprived over Less deprived). Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 10.2 - Separate Cochran's Q for heterogeneity between the Ratio of means when comparing the air pollution models two by two in the all non-accidental causes population regarding the highest and lowest category of "Old buildings", during two time periods

Before 31st December 1996

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*48.3*	*13.1*	*1188.1*	*1.4*
	p value		**0.00**	**0.00**	**0.00**	0.23
NS	*Cochran's Q*			*13.2*	*645.3*	*96.1*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*950.1*	*31.8*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*1709.0*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

After 1st January 1997

		AV	NS	IDW	LUR-BE	BME-LUR
AV	*Cochran's Q*		*65.1*	*20.7*	*2279.2*	*2.0*
	p value		**0.00**	**0.00**	**0.00**	0.16
NS	*Cochran's Q*			*14.9*	*1372.6*	*82.9*
	p value			**0.00**	**0.00**	**0.00**
IDW	*Cochran's Q*				*1855.0*	*19.1*
	p value				**0.00**	**0.00**
LUR-BE	*Cochran's Q*					*3063.7*
	p value					**0.00**
BME-LUR	*Cochran's Q*					
	p value					

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression.

Supplement 10.3 - Mortality odds ratio (OR) for the highest and lowest category of "Old Buildings" with their 95% CI for a 10 ppb increase in predicted ozone concentration and the ratio of odds ratios for all non-accidental causes of mortality, using the statistical model adjusted on lag 0-2, according to 5 air pollution models, during two time periods

Before 31st December 1996

						More deprived				*Less deprived*			
	ROR	95% CI				*OR*	*95% CI*			*OR*	*95% CI*		
AV	1.01	0.91	-	1.12		1.02	0.95	-	1.10	1.01	0.94	-	1.09
NS	0.99	0.92	-	1.07		1.02	0.96	-	1.07	1.02	0.97	-	1.08
IDW	1.00	0.91	-	1.09		1.02	0.96	-	1.09	1.02	0.96	-	1.09
LUR-BE	0.98	0.86	-	1.11		1.02	0.92	-	1.14	1.05	0.98	-	1.12
BME-LUR	1.02	0.91	-	1.14		1.05	0.97	-	1.13	1.03	0.95	-	1.11

After 1st January 1997

						More deprived				*Less deprived*			
	ROR	95% CI				*OR*	*95% CI*			*OR*	*95% CI*		
AV	**1.10**	**1.02**	**-**	**1.18**		**1.06**	**1.01**	**-**	**1.12**	0.97	0.92	-	1.02
NS	**1.08**	**1.01**	**-**	**1.14**		**1.05**	**1.00**	**-**	**1.10**	0.98	0.94	-	1.02
IDW	1.06	0.99	-	1.14		**1.05**	**1.00**	**-**	**1.11**	1.00	0.95	-	1.05
LUR-BE	1.08	0.98	-	1.19		**1.09**	**1.00**	**-**	**1.18**	1.00	0.96	-	1.05
BME-LUR	1.06	0.95	-	1.18		1.07	0.99	-	1.16	1.01	0.94	-	1.08

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. ROR: ratio of odds ratios (More deprived over Less deprived). The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 10.4 - Separate Cochran's Q for heterogeneity of mortality between the ratios of odds ratios when comparing each air pollution model to the use of the average value in all non-accidental causes of mortality, using the statistical model adjusted on lag 0-2, for the three-category variable "Old Buildings" , during two time periods

Before 31st December 1996		**AV**	**NS**	**IDW**	**LUR-BE**	**BME-LUR**
All non-accidental causes	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.93	0.95	0.86	0.98

After 1st January 1997		**AV**	**NS**	**IDW**	**LUR-BE**	**BME-LUR**
All non-accidental causes	*Cochran's Q*		*0.0*	*0.0*	*0.0*	*0.0*
	p value		0.94	0.89	0.96	0.90

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 10.5 - Assessment of multiplicative interaction between ozone exposure and the three-category variable "Old Buildings" using an interaction term in a conditional logistic regression involving the model adjusted on temperature and relative humidity lag 0-2 for a 10 ppb increase in ozone concentration, for all non-accidental causes of mortality, during two time periods

Before 31st December 1996

	Beta coefficient	p value	CI LL	CI UL
Average value	0.00	0.99	-0.06	0.06
Nearest Station	-0.02	0.27	-0.06	0.02
IDW	-0.02	0.35	-0.07	0.02
LUR-BE	-0.03	0.41	-0.10	0.04
BME-LUR	0.01	0.66	-0.05	0.08

After 1st January 1997

	Beta coefficient	p value	CI LL	CI UL
Average value	0.03	0.15	-0.01	0.08
Nearest Station	0.02	0.15	-0.01	0.05
IDW	0.01	0.51	-0.02	0.04
LUR-BE	0.02	0.47	-0.03	0.07
BME-LUR	0.02	0.54	-0.04	0.07

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

Supplement 10.6 - Assessment of additive interaction between ozone exposure and the three-category variable "Old Buildings" with a RERI for continuous exposures in a conditional logistic regression involving the model adjusted for temperature and relative humidity lag 0-2 for a 0 to 10 ppb increase in ozone concentration for all non-accidental causes of mortality, during two time periods

Before 31st December 1996	**RERI**	**p value**	**CI LL**	**CI UL**
Average value	0.00	0.92	-0.05	0.06
Nearest Station	-0.02	0.41	-0.05	0.02
IDW	-0.02	0.47	-0.06	0.03
LUR-BE	-0.01	0.77	-0.06	0.04
BME-LUR	0.01	0.64	-0.04	0.06

After 1st January 1997	**RERI**	**p value**	**CI LL**	**CI UL**
Average value	0.03	0.16	-0.01	0.06
Nearest Station	0.02	0.15	-0.01	0.04
IDW	0.01	0.49	-0.02	0.04
LUR-BE	0.01	0.54	-0.02	0.04
BME-LUR	0.01	0.49	-0.03	0.06

Old Buildings: prevalence of buildings built before 1961. AV: Use of the Average value method NS: Nearest Station model IDW: Inverse Distance Weighting interpolation model LUR-BE: Land-use regression model with a Back-extrapolation BME-LUR: Bayesian maximum entropy model based on a land-use regression. The model adjusted for temperature lag 0-2 and relative humidity lag 0-2 included ozone lag 0-2. Cut-offs for Less deprived vs. More deprived were 54.8% of buildings built before 1961 in the neighbourhood.

SUPPLEMENT 11 – SEARCH STRATEGY FOR THE LITERATURE REVIEW

We searched Web of Science for articles written between January 1, 2000 and May 26, 2017, written in the English language, using a case-crossover study design, and assessing the effect measure modification by socio-economic factors of the relationship between ozone and its health impact

The search was performed using the Web of Science database.

Inclusion criteria:

Articles written between January 1st, 2000 and May 26th, 2017, in the English language, using a case-crossover study design, and assessing the effect measure modification by socio-economic factors of the relationship between ozone and its health impact

Exclusion criteria:

Absence of ozone measurement or use of ozone as a confounder only, use of a different outcome than morbidity or mortality, non-human studies

Search algorithm

- Search 1: 197 results
  (modification or modify or modifie*) AND (effect*) AND (air pollut*) AND ("* crossover")*

- Search 2: 3083 results
  (modification or modify or modifie*) AND (effect*) AND (ozone or o3 or "o(3)")*

- Search 3: 310 results
  *("emergency *" "hospital*" or "mortality" or "morbidity" or "adverse") AND ("ozone" or "O3" or "O(3)") AND ("* crossover")*

- Search 4: 1074 results
  ("air pollut" or "ozone" or "O3" or "O(3)") AND (susceptib* or vulnerab*) AND ("emergency *" or "hospital*" or "morbidity" or "mortality")*

- Search 5: 146 results
  ("ozone" OR "O3" OR "O(3)") AND (age OR sex OR gender OR SES OR income OR education OR depriv) AND ("emergency *" or "hospital*" or "morbidity" or "mortality") AND "* crossover"*

4810 results were first scanned on their title alone, duplicates were removed and a first exclusion was performed. 235 articles were then scanned on their abstract and a second exclusion was performed. 79 articles were then read and a last exclusion was performed.

The final 17 results are described in **Supplement 12** (9,10,43–57)**.**

SUPPLEMENT 12 – FINDINGS FROM THE LITERATURE REVIEW OF CASE-CROSSOVER STUDIES OF GROUND-LEVEL OZONE EXPOSURE AND ITS HEALTH IMPACT WITH AN ASSESSMENT OF EFFECT MEASURE MODIFICATION BY SOCIO-ECONOMIC STATUS

Study	Location and Time Frame	Exposure and longest lag structure	Outcome	Potential SES Modifiers	Air pollution model	Conclusions
Bravo et al. (2016)	São Paulo, Brazil (1996-2010)	Daily 8-hour moving average concentration and Daily maximum 8-hour concentration Lag 0-3 days	Mortality (all non-accidental causes, CVD, respiratory causes)	Education, Ethnicity, Marital status, Area-level SES index (population density, median age, family income, housing characteristics, infant mortality rate, external cause mortality rate)	Average value and Nearest Station	Effect Measure Modification was suggested for Ethnicity and Marital Status regarding respiratory diseases in the average value model
Carbajal-Arroyo (2011)	Mexico City Metropolitan Area (1997-2005)	Daily 1-hour maximum ozone concentration Lag 0-2 days	Mortality (all non-accidental causes, respiratory causes)	Area-based socioeconomic index (education, income, housing conditions)	Average value	Effect measure modification was significant for Low SES regarding respiratory diseases
Glad et al. (2012)	Greater Pittsburgh area, USA (2002-2005)	Daily 1-hour ozone concentration Lag 0-5 days	Asthma-related emergency department visits	Ethnicity	Nearest Station (single monitor)	Effect measure modification was suggested for Ethnicity
Jones et al. (2013)	New York City, USA (2001-2005)	Daily 8-hour average ozone concentration Lag 0-4 days	Hospital admissions for respiratory diseases	Ethnicity	SHEDS Stochastic Human Exposure and Dose Simulation (hybrid model)	Effect measure modification was significant for Ethnicity
Kim et al. (2007)	Seoul, Korea (2002)	Daily mean concentration Lag 0-4 days	Asthma-related emergency department visits	Percentage of premium contributed to health insurance (district-level and individual contribution)	Average value	Effect Measure Modification was suggested for lower levels of district-level SES
Kim et al. (2015)	Seoul, Korea (2001-2011)	Daily hourly average concentration Lag 6-72 hours	Asthma-related emergency department visits	Type of health insurance	?	Effect measure modification was significantly positive for Lower SES.

Malig et al. (2016)	California, USA (2005-2008)	Daily 1-hour maximum values Lag 0 and Lag 1-3 days	Emergency department visit regarding a respiratory disease	Ethnicity, Type of health insurance	Nearest Station	Effect measure modification was significant for Ethnicity and Type of health insurance
Medina-Ramón (2006)	Thirty-six cities in the USA (1986-1999)	Daily mean concentration Lag 0-1 days	Hospital admissions for COPD* or pneumonia	Presence of central air conditionning	Average value	Effect Measure Modification was significant for the presence of central air conditionning
O'Lenick et al. (2017)	Three cities in the USA (2002-2008)	Daily 8-h maximum concentration 3-day moving average	Emergency department visit regarding a respiratory disease	Education, Poverty, Neighborhood Deprivation Index (household income, occupation, poverty, gender of the head of the household, crowding, household on public assistance, unemployment)	Integrated meteorological-emission model	Effect modification was suggested for Poverty and Neighborhood Deprivation Index
Ren et al. (2010)	Eastern Massachusetts, USA (1995-2002)	Daily maximum 8-hour moving average Lag 0-6 days	Mortality (all non-accidental causes, CVD, diabetes, respiratory causes)	Education, Ethnicity, Household income, Marital status, Population density, Poverty.	Average value	No effect modification by SES was found.
Romieu et al. (2004)	Ciudad Juarez, Mexico (1997-2001)	Daily maximum 8-hour moving average and one-hour maximum concentration Lag 0-2 days	Mortality (respiratory diseases)	Three social deprivation indexes	Average value	No effect modification by SES was found.
Sacks et al. (2014)	North Carolina, USA (2006-2008)	Daily maximum 8-hour average concentration Lag 0-2 days	Asthma-related emergency department visits	Urbanicity categories (Metro Urban counties, Non-Metro Urban counties, Less urbanized counties, Rural counties)	Integrated meteorological-emission model	Less Urbanized counties seemed to positively modify the risk

Son et al. (2012)	Seoul, Korea (2000-2007)	Daily maximum 8-hour moving average Lag 0-2 days	Mortality (all non-accidental causes, CVD, respiratory causes)	Education, Occupation	Average value	Effect measure modification was significant for Lower SES in Education and Occupation regarding cardiovascular diseases and all causes mortality
Stafoggia et al. (2010)	Ten Italian cities (2001-2005)	Daily maximum 8-hour moving average Lag 0-5 days	Mortality (all non-accidental causes, CVD, respiratory, cerebrovascular causes)	Income level	Average value?	No effect modification by SES was found.
Wendt et al. (2014)	Harris County, Texas, USA (2005-2007)	Daily maximum 8-hour average concentration Lag 0-5 days	Asthma cases	Ethnicity	Average value	Effect measure modification was significant for Ethnicity
Willers et al. (2016)	Rotterdam (1995-2009)	Daily average concentration Lag 0-2 days	Mortality (all non-accidental causes)	Ethnicity ,Marital status, Household income	Dispersion model	Effect Measure Modification was suggested for Ethnicity, Marital status and Income
Yang et al. (2003)	Vancouver, Canada (1986-1998)	Daily average concentration and daily 1-hour maximum concentration Lag 0-5 days	Hospital admissions for respiratory diseases	Household income	Average value	No effect modification by SES was found.

All but one of the final 17 studies (that of Bravo et al. (43) which used two), used a single air pollution model to get information about distinct exposure values. Use of the Average Value was by far the most frequent method used, involved in 10 studies out of 17, followed by the Nearest Station model (three studies). More complex models were used in four studies. Thus, the more advanced air pollution models available are not yet routinely used when studying inequality of susceptibility through a case-crossover design. Moreover; the influence of the air pollution model was not assessed in the only study that used two models.