



# Air pollution: Sources and health effects

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- Alice Grgicak-Mannion
- Sara Martin
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- Jennifer Vanos
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- Vladislav Brion
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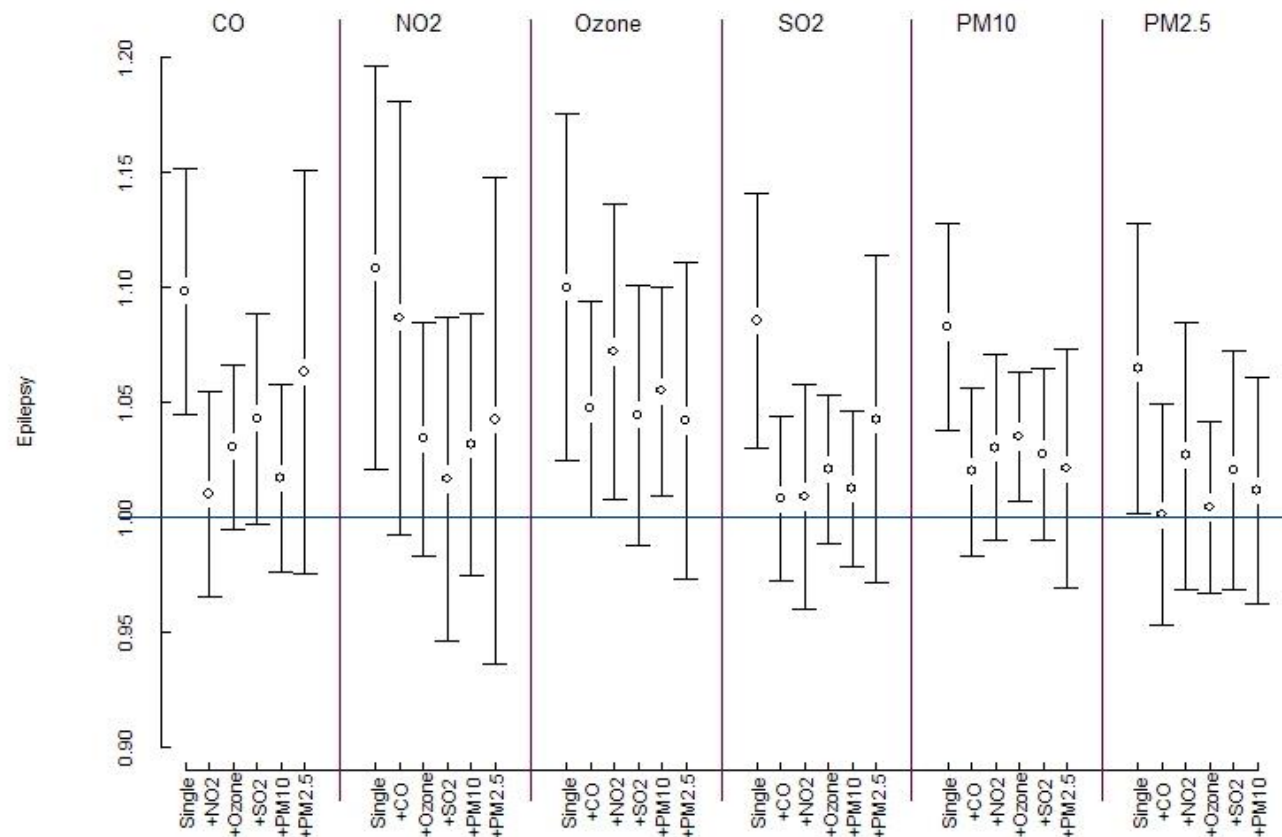


# Air pollution: Sources and health effects

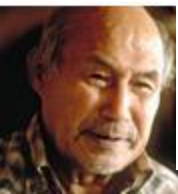
- Air pollution effect on neurological diseases
  - Epilepsy
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- Diabetes
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- Interaction with aeroallergens
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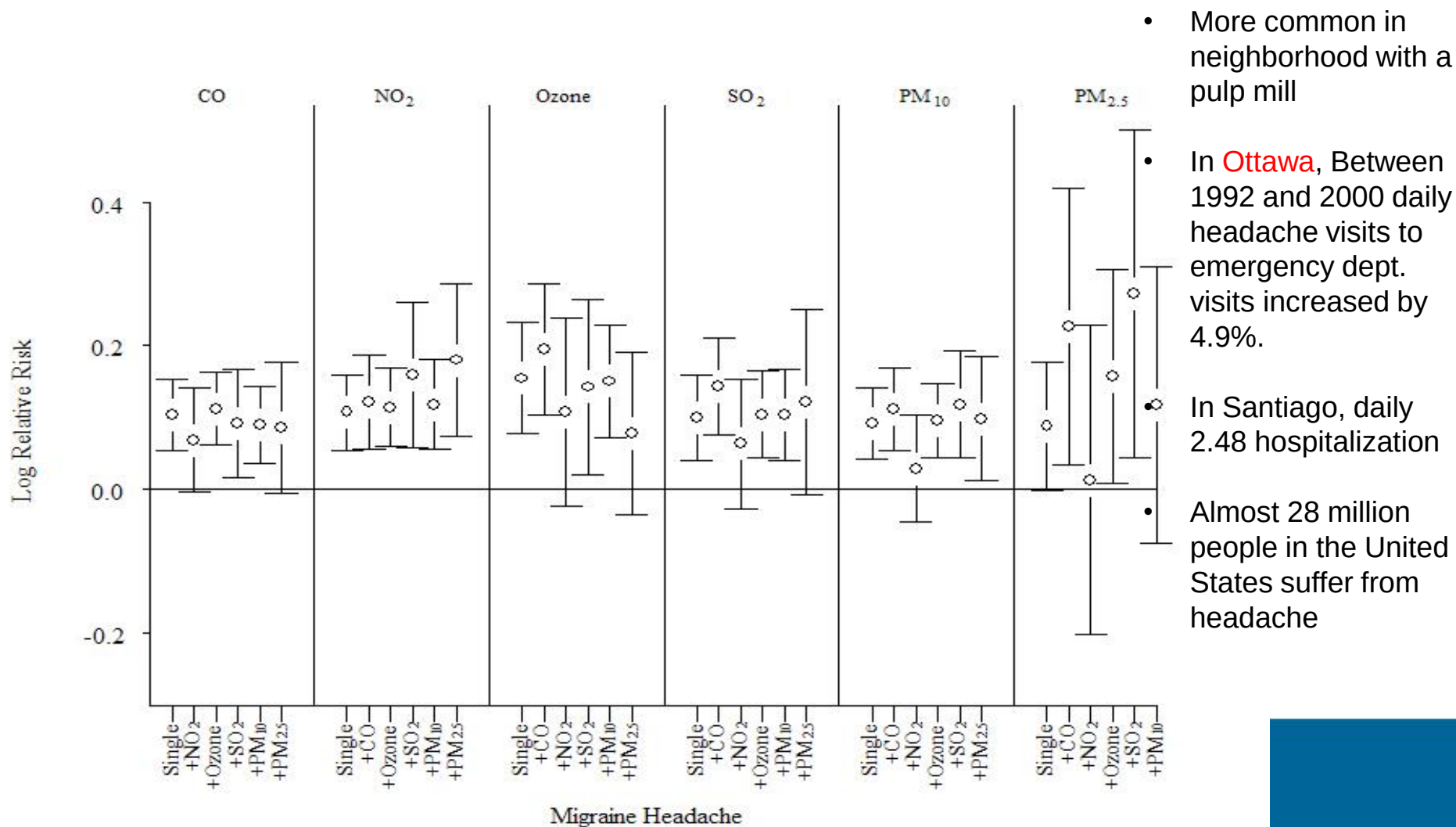
# Adjusted relative risk estimates and 95% CI in hospitalization for epilepsy at IQR, Santiago Province, 2001 through 2005.



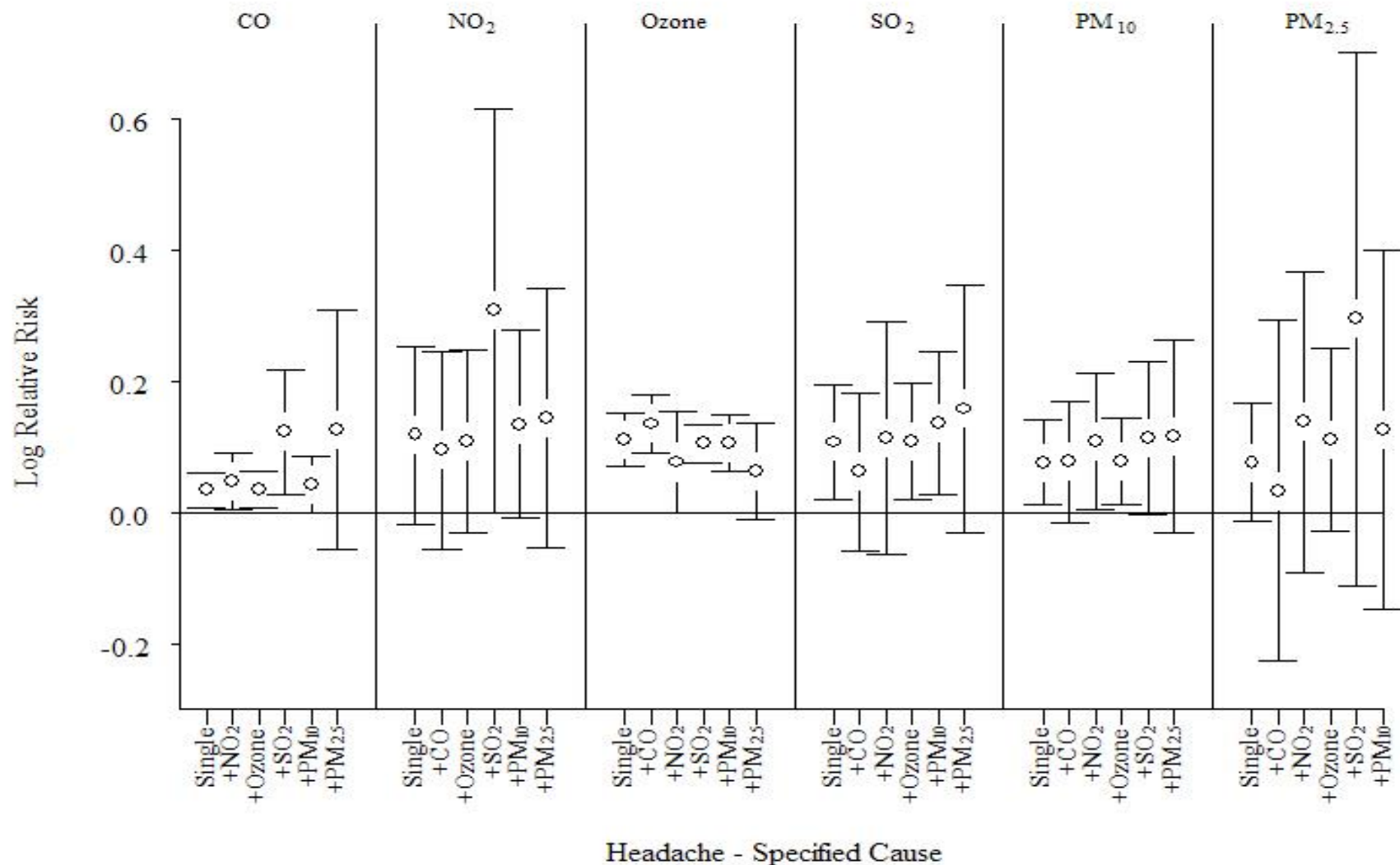
- 1.4% of adults in US had seizures and less edu and empl. And more unhappiness (2002 US Nat. H. S)
- In Ontario, 0.6% of population reported epilepsy.(1990 health survey)
- In Santiago, daily 2.9 hospitalization
- Almost 3 million people in the United States suffer from epilepsy



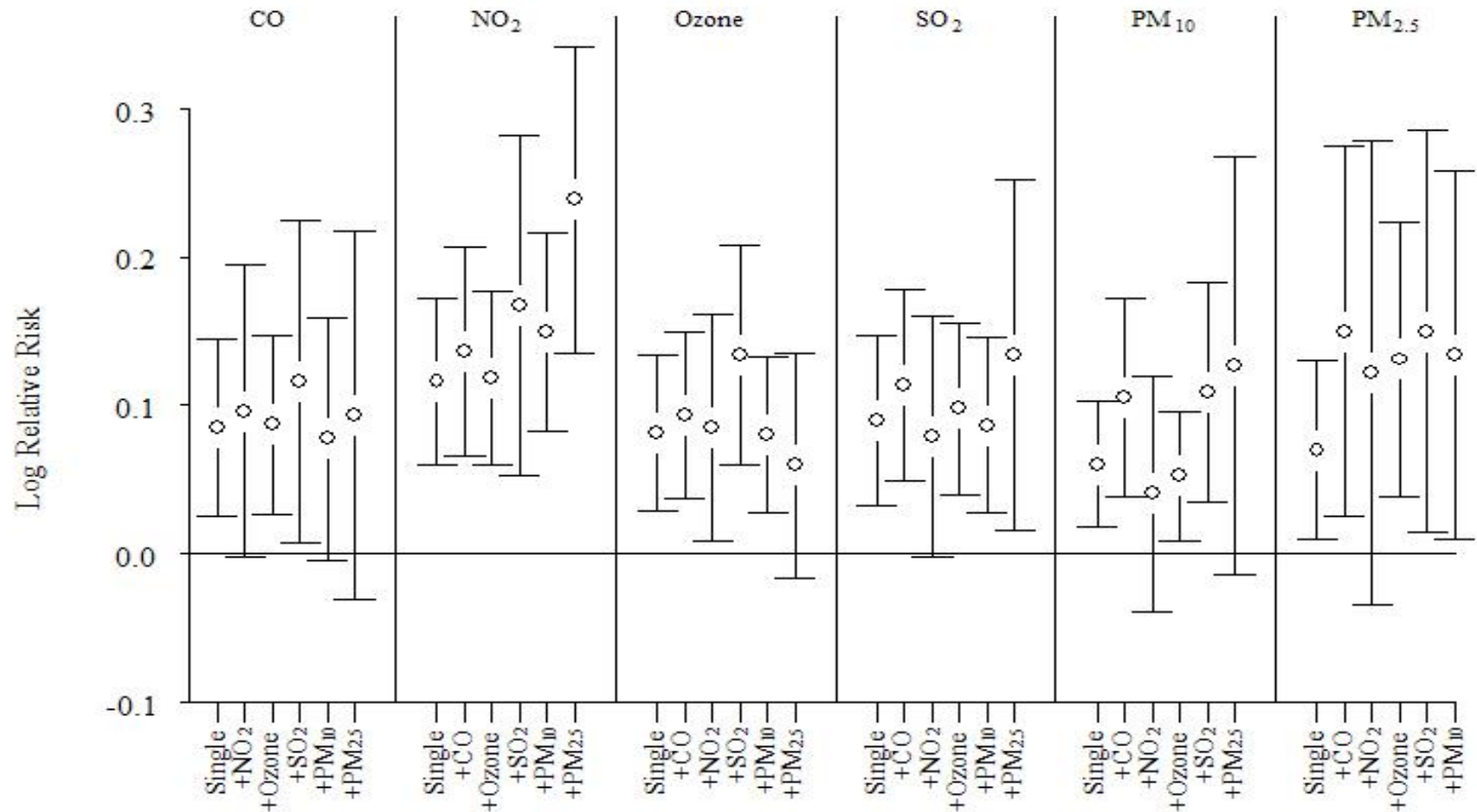
# Adjusted RR estimates for Migraine Headache, Santiago Province, 2001 through 2005.



# Adjusted RR estimates for Specific Cause Headache, Santiago Province, 2001 through 2005



# Adjusted RR estimates for Cause not specified Headache, Santiago Province, 2001 through 2005

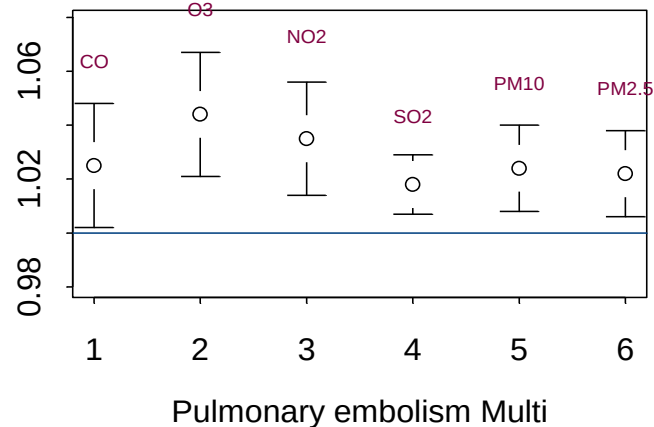
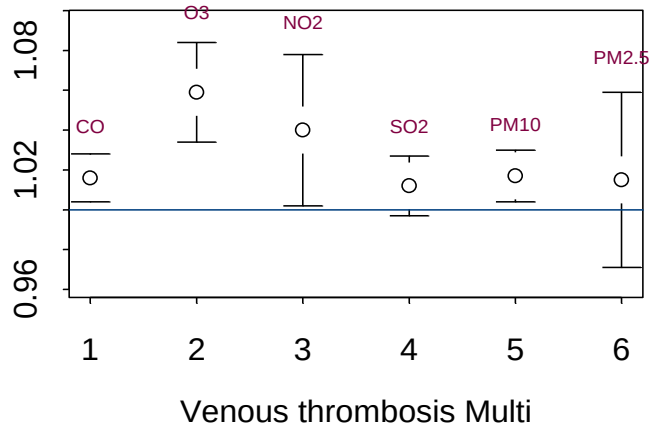
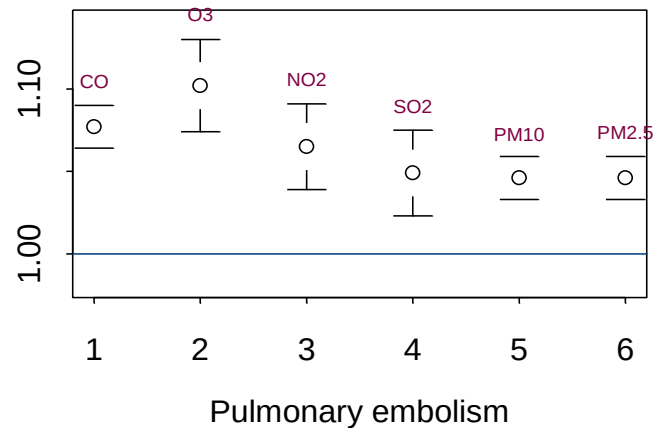
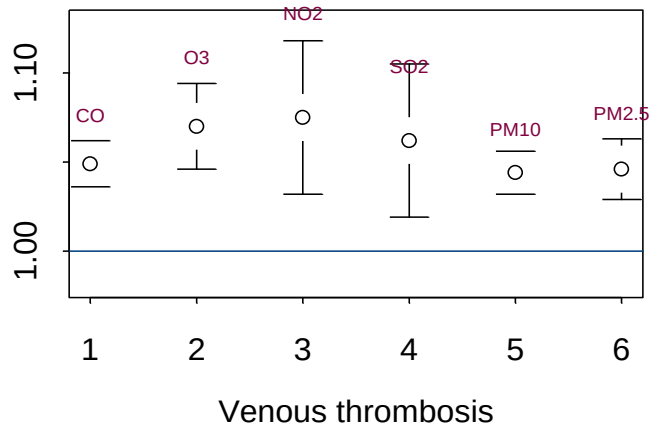


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## Pooled city estimates of relative risk and 95% CI of hospitalization associated with changes in pollutant concentrations equivalent to their IQR, Santiago 2001-2005



- Daily 2.3 admissions
- In USA 600,000 hospitalized each year

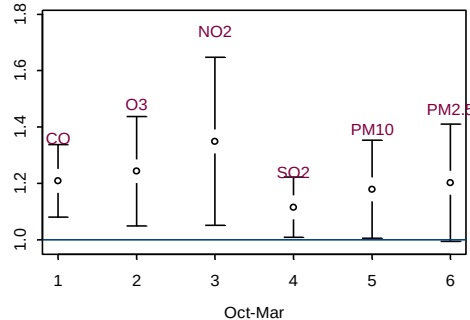
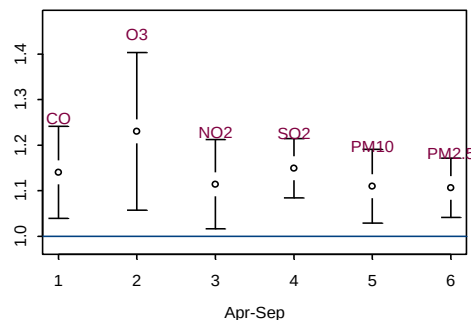
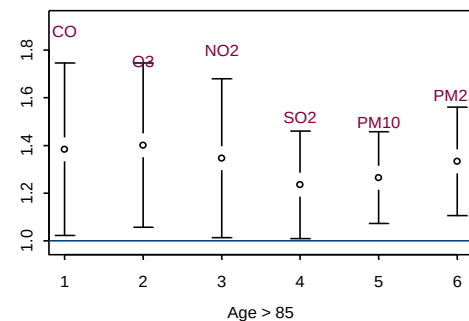
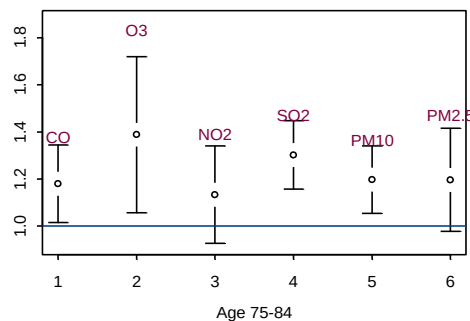
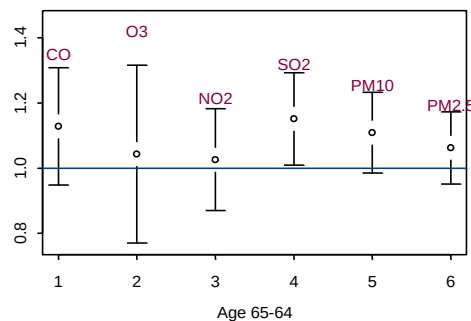
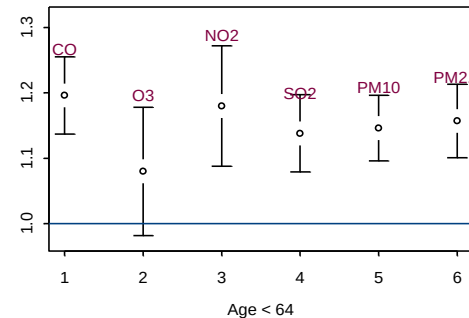
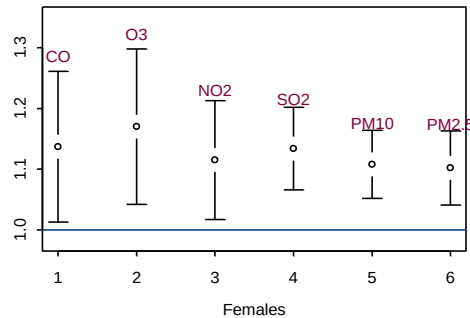
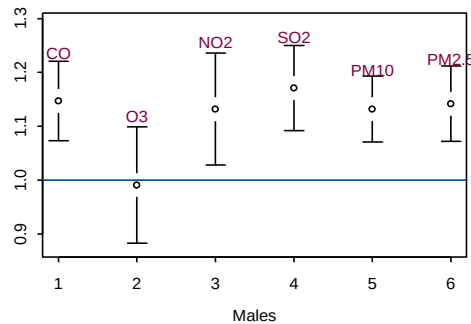
Journal of  
Thrombosis  
and  
Haemostasis,  
8: 669–674,  
2011

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- **Diabetes**
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# Pooled estimates of RR of hospitalization for diabetic ketoacidosis and coma associated with IQR changes of air pollution. Santiago Province 2001 through 2008.



- Daily 1.79 hosp.
- In Chile, 11% of population between age of 45-64
- In USA, 25.8 million people have diabetes

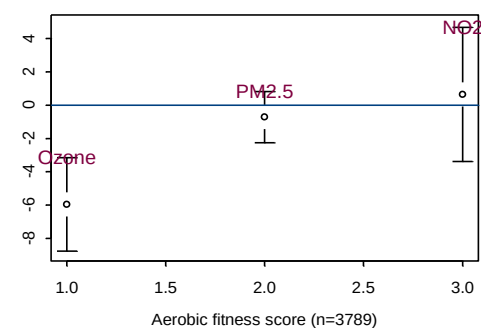
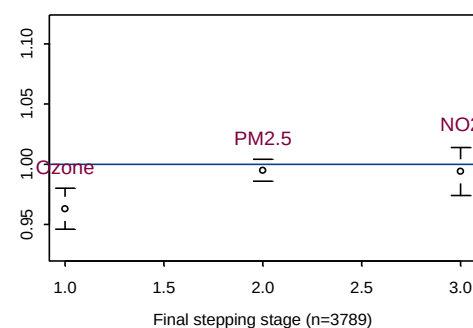
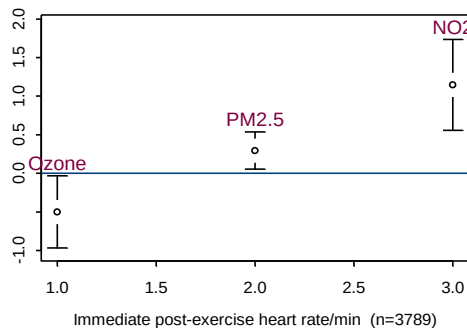
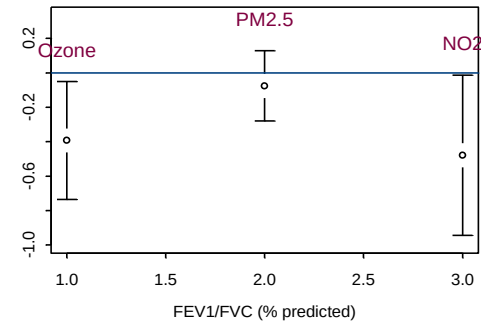
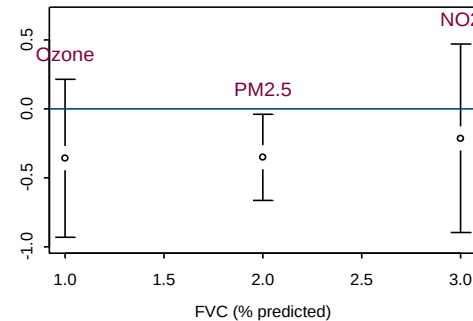
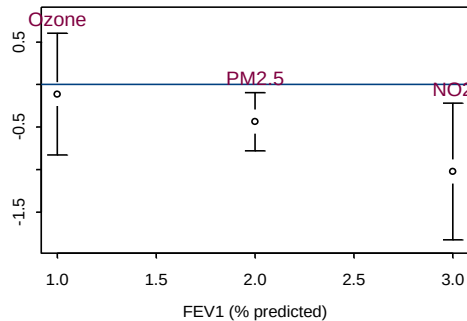
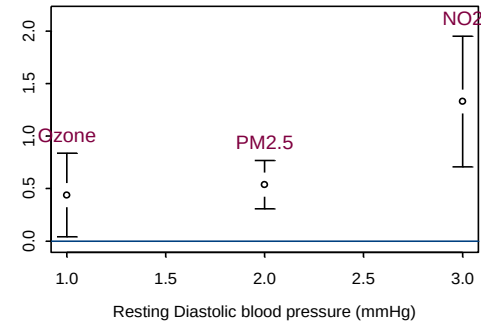
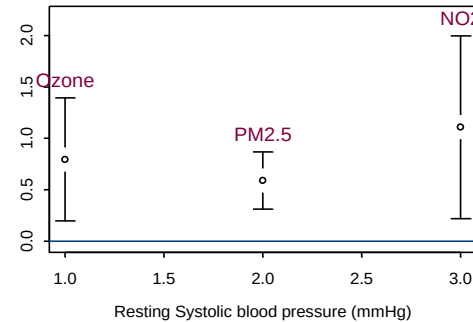
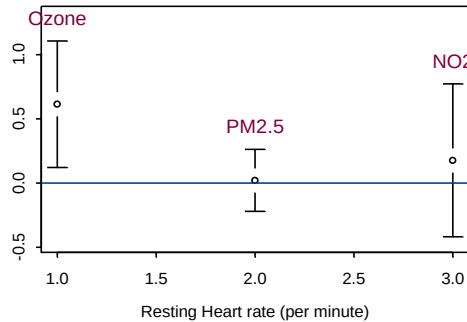
Environment International 2012, 46, 1–5

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# Change in physiologic characteristic for an IQR change in ambient air pollution concentration. Results are adjusted for smoking, income, age, sex and education, 5011 people in CHMS.



- 15 of 257 sites are selected
- Total of 5604 people were enrolled
- 5011 spirometry and 3789 had exercise

Environmental Research 2011; 1309–1312

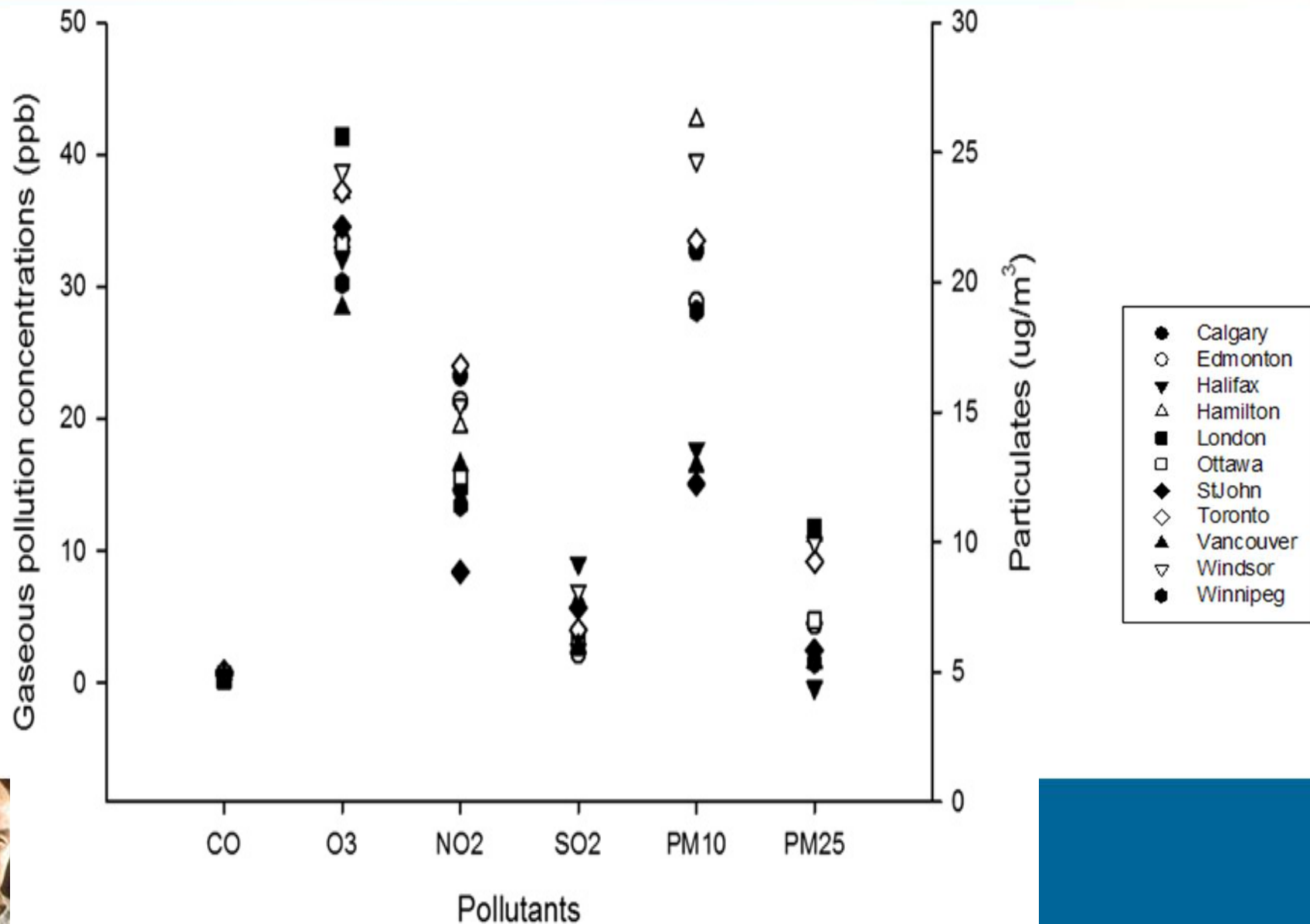
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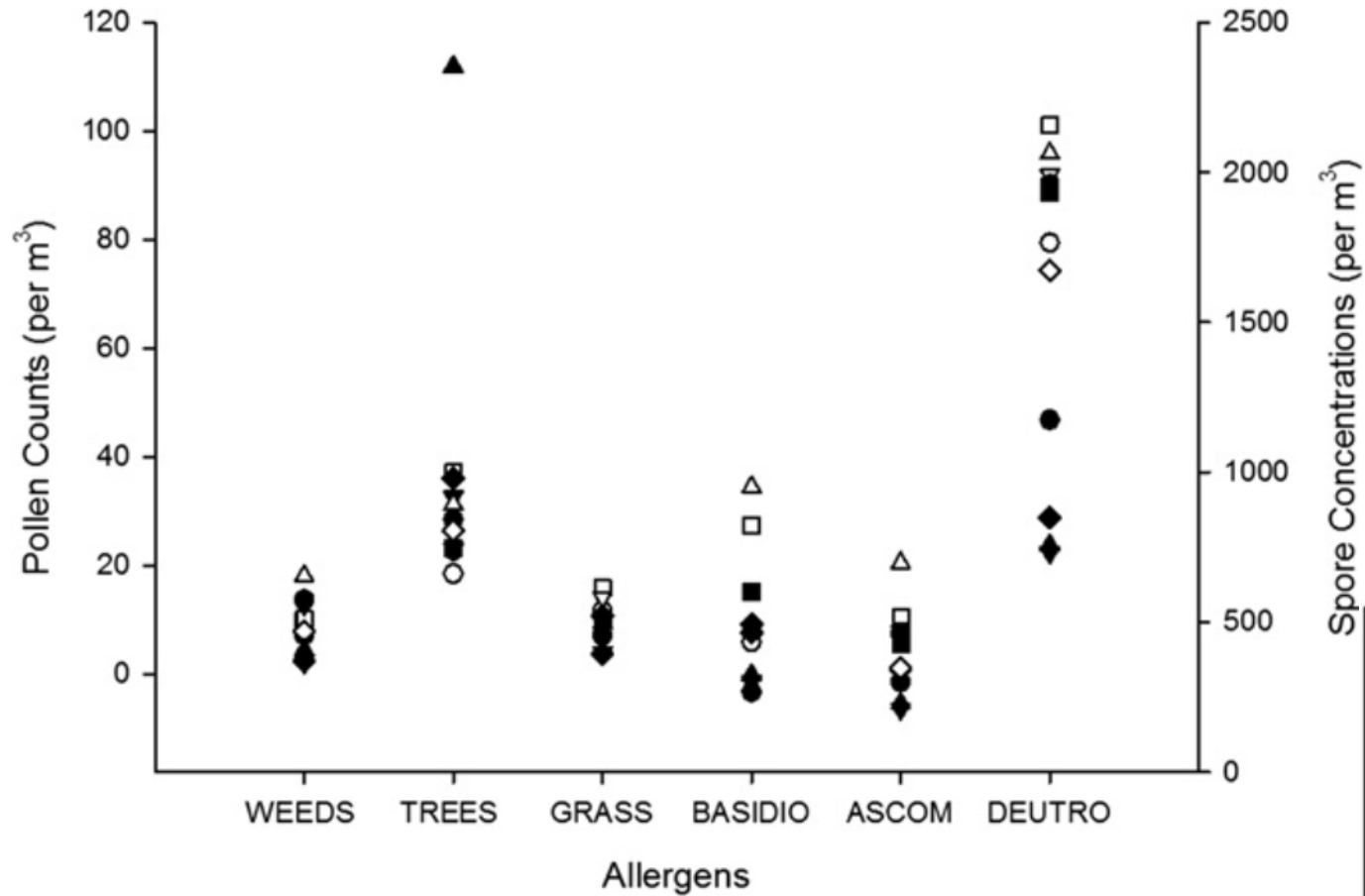


# Canada

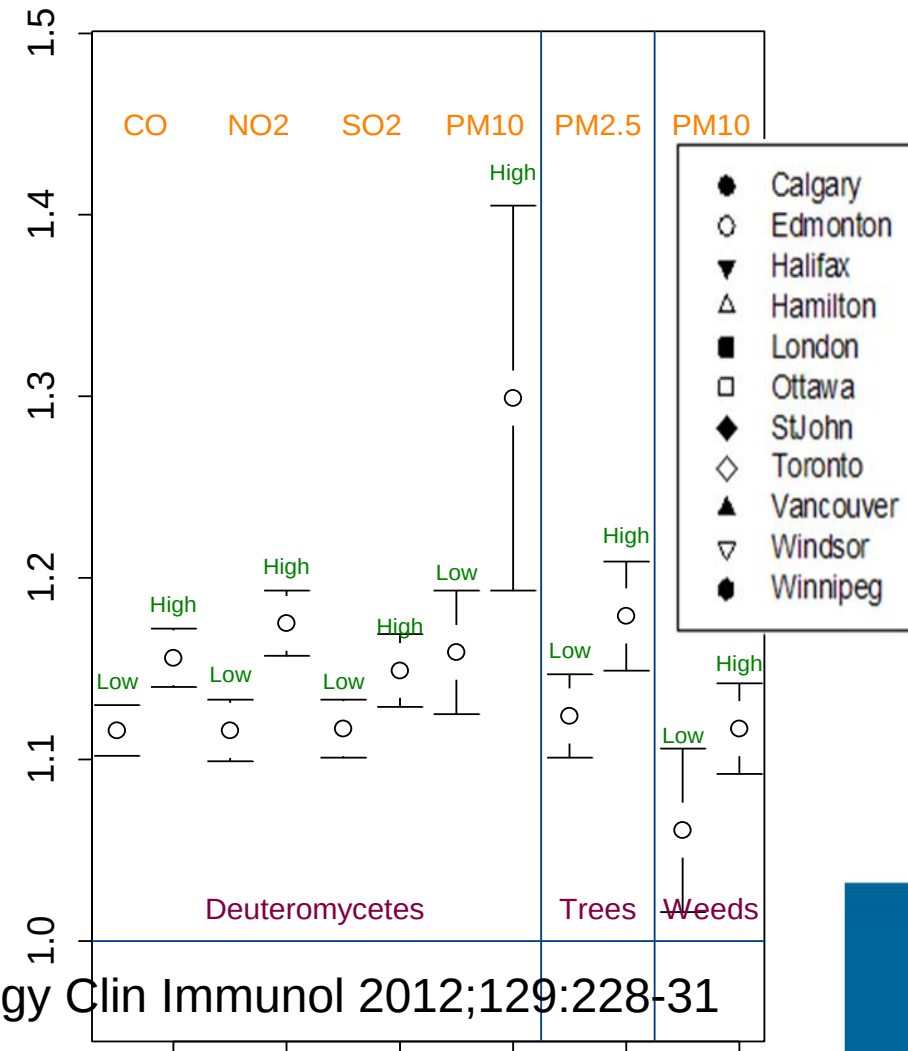
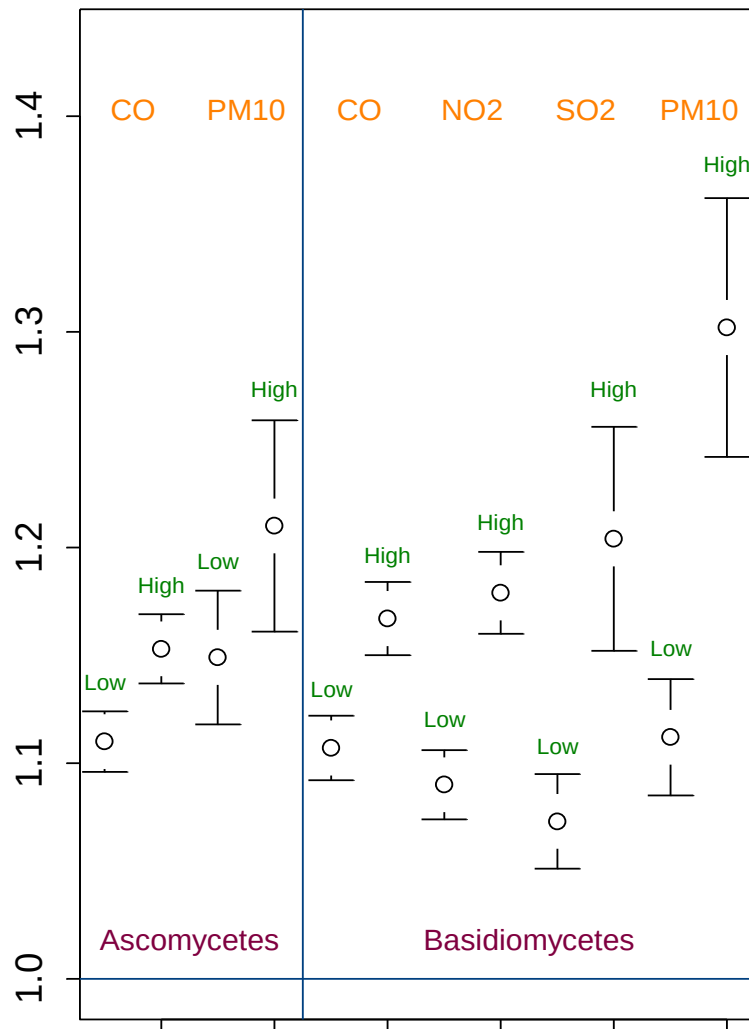
## Air Pollution Concentrations



## mean concentrations of aeroallergens



# Percent change in daily hospitalization and 95%CI with an increase in allergen concentrations equal to their pooled IQR

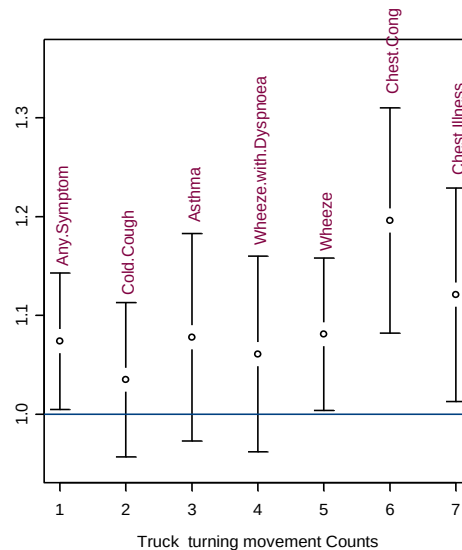
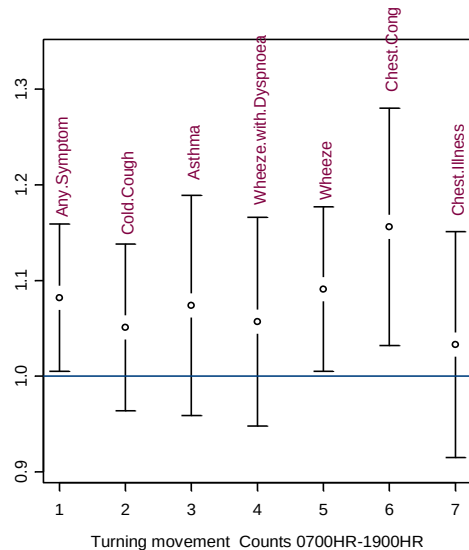
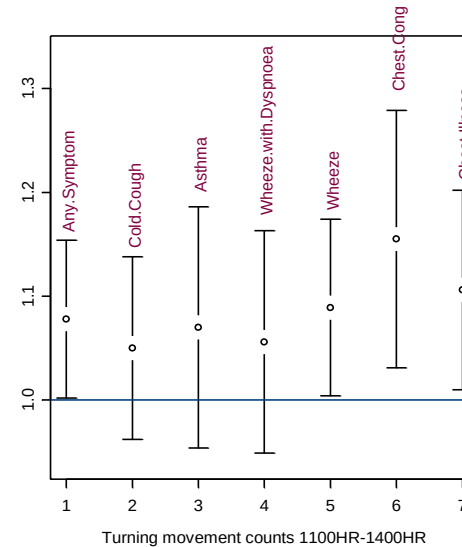
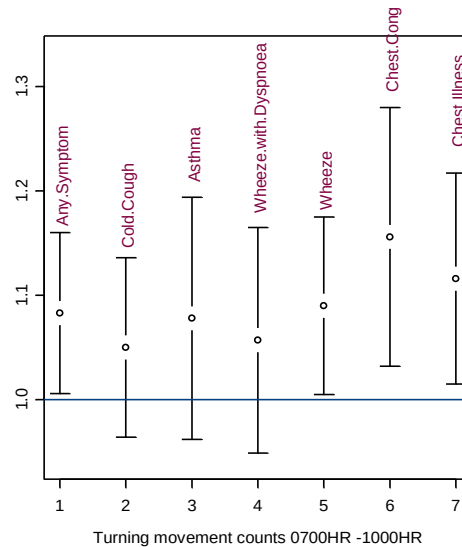
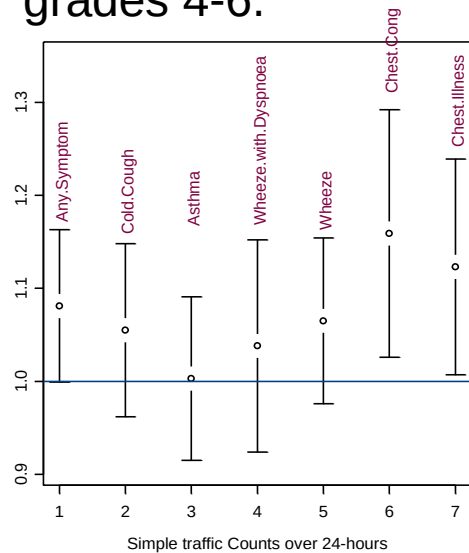


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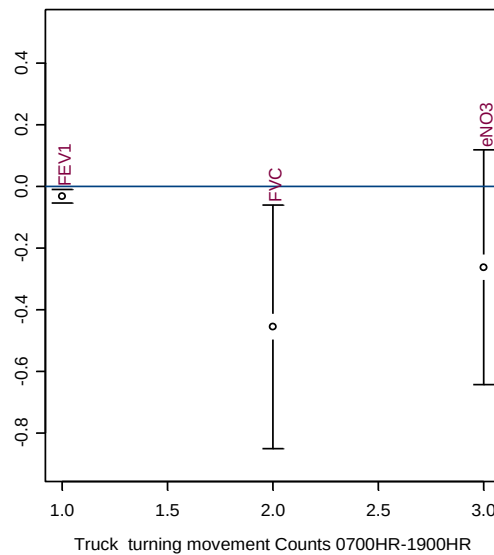
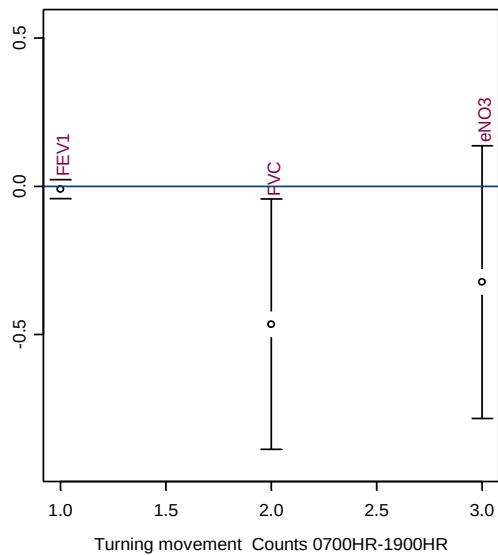
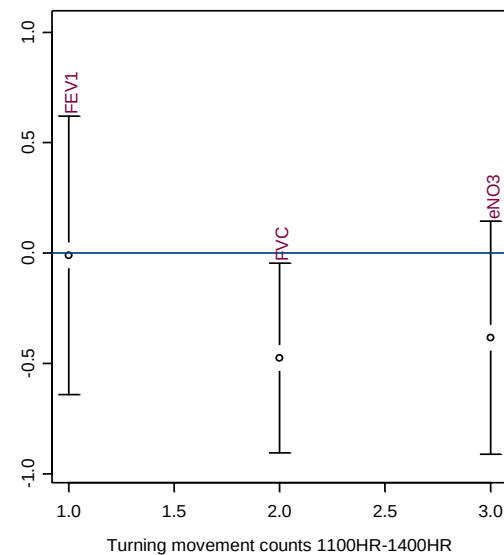
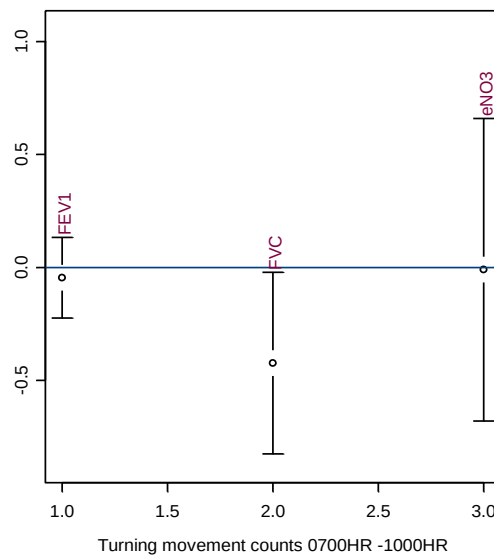
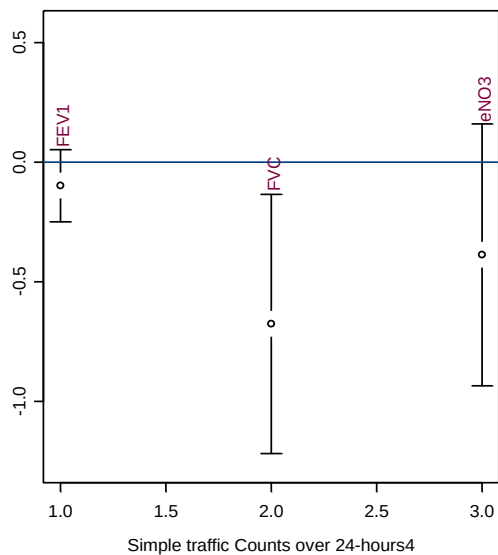
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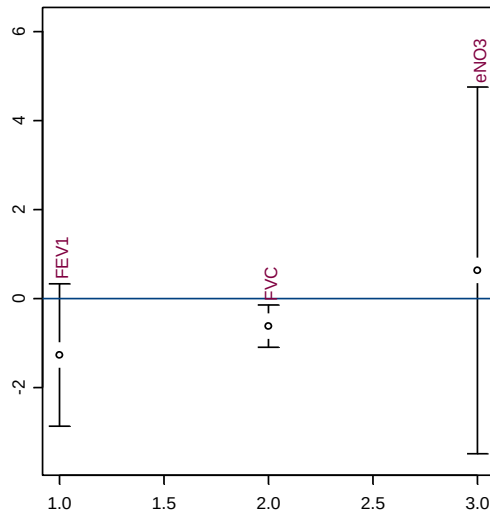
The odds ratios and 95% CI between traffic counts within 200 meters of the neighboured and resp symptoms among 15128 Windsor public school students in grades 4-6.



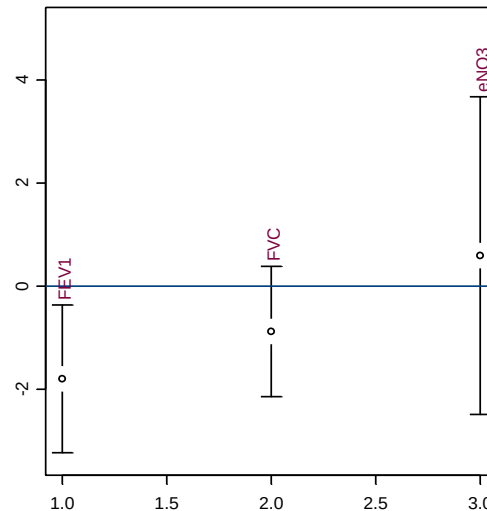
# Change in respiratory function for an IQR change in traffic counts.1528 children.



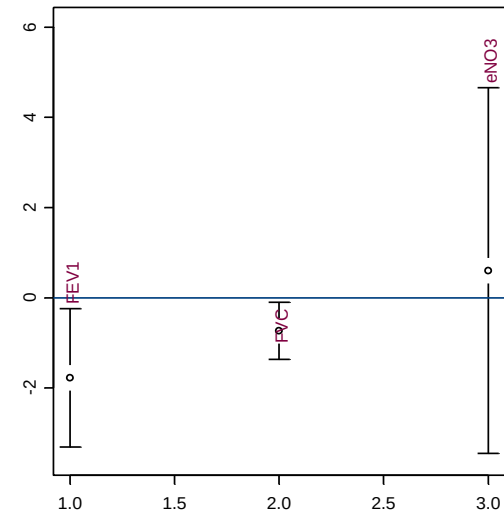
# Change in respiratory function for an IQR change in traffic counts among those with a previous diagnosis of asthma, (275 students)



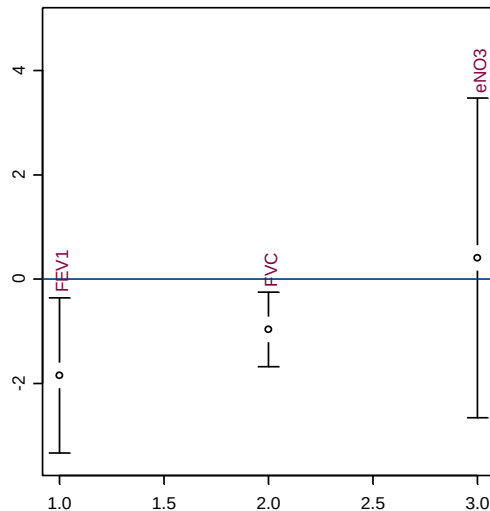
Simple traffic Counts over 24-hours4



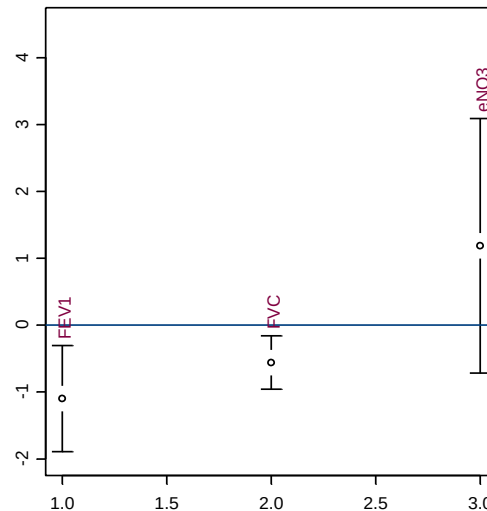
Turning movement counts 0700HR -1000HR



Turning movement counts 1100HR-1400HR



Turning movement Counts Counts 0700HR-1900HR



Truck turning movement Counts 0700HR-1900HR

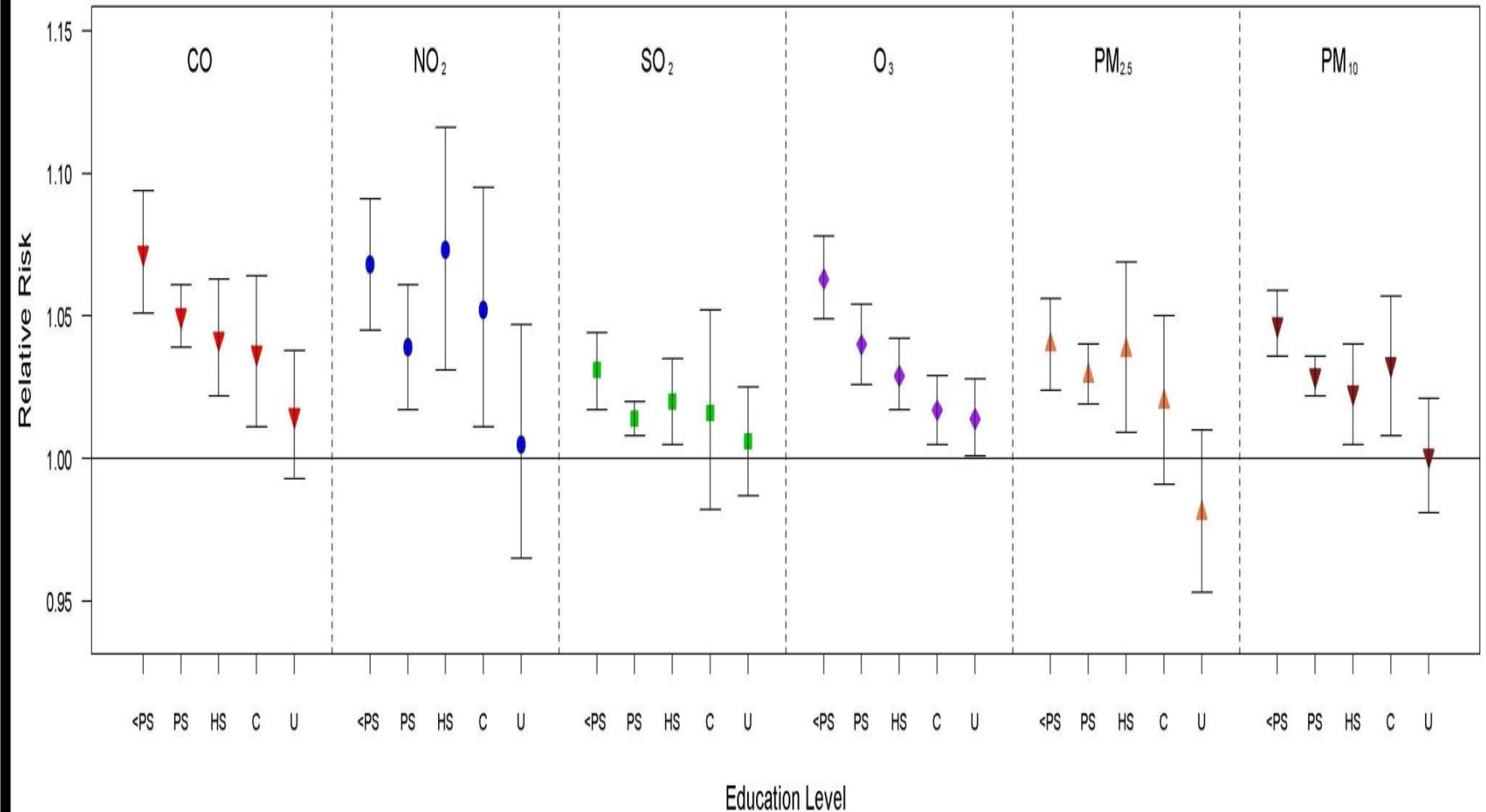
Environment International 2012, 39, 128–132

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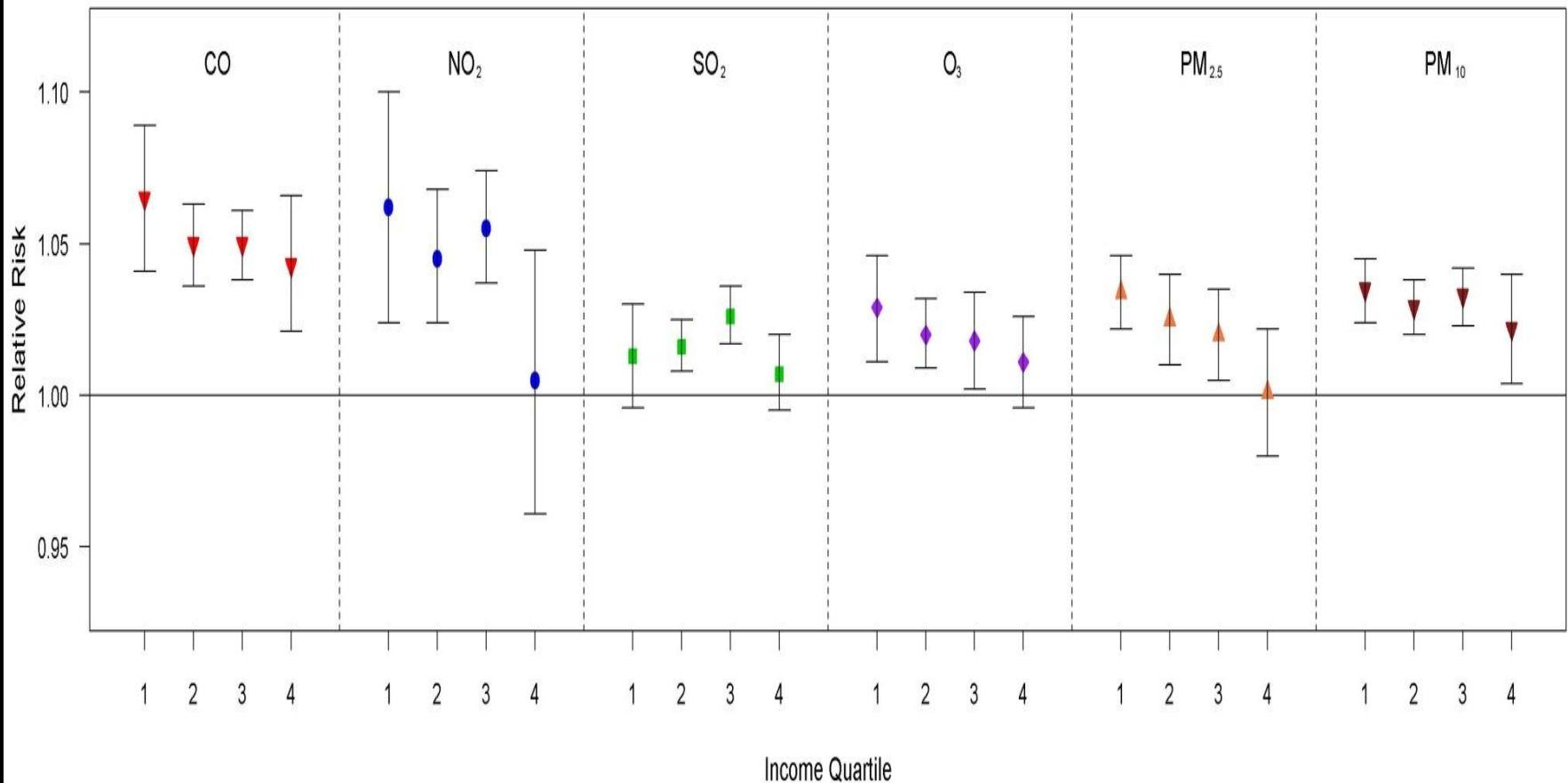
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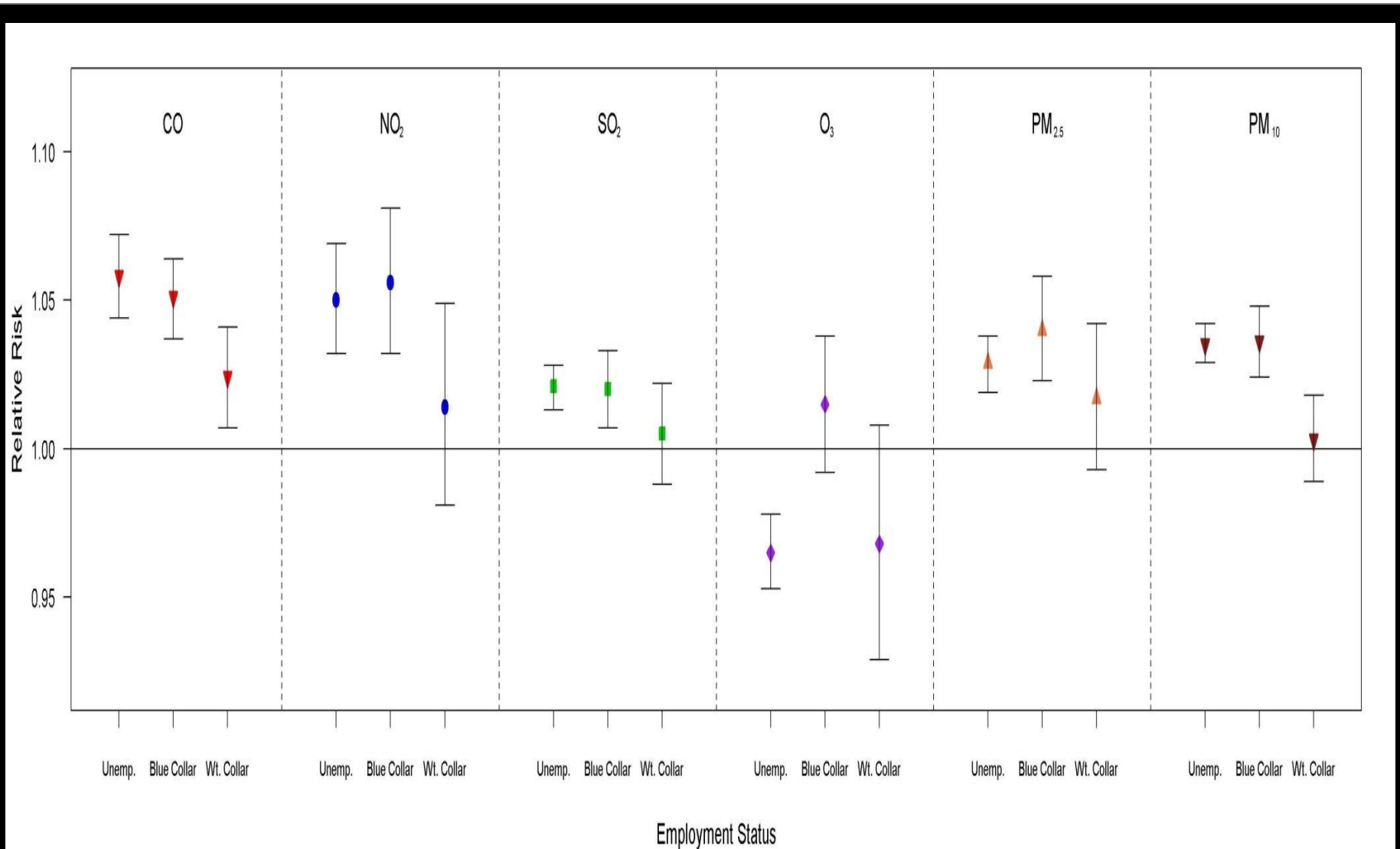
# Relative Risk of Mortality from Air Pollutants by Level of Education, Santiago,



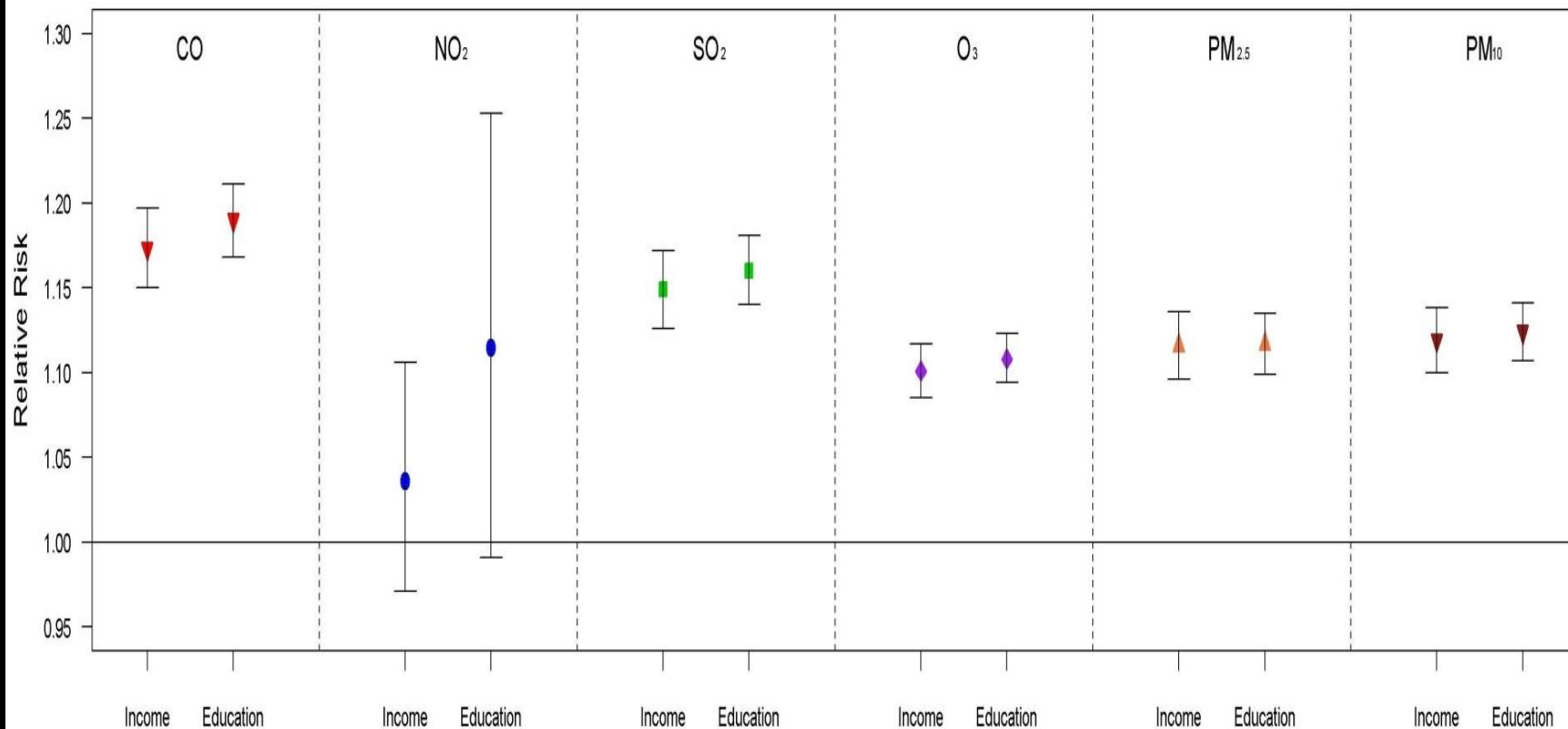
# Relative Risk of Mortality from Air Pollutants by Income



# Relative Risk of Mortality from Air Pollutants by Employment Status



# Relative Risks among Lowest Income and Education Elderly



Environmental Health Perspectives • Volume 119 | Number 3 | March 2011 388–393

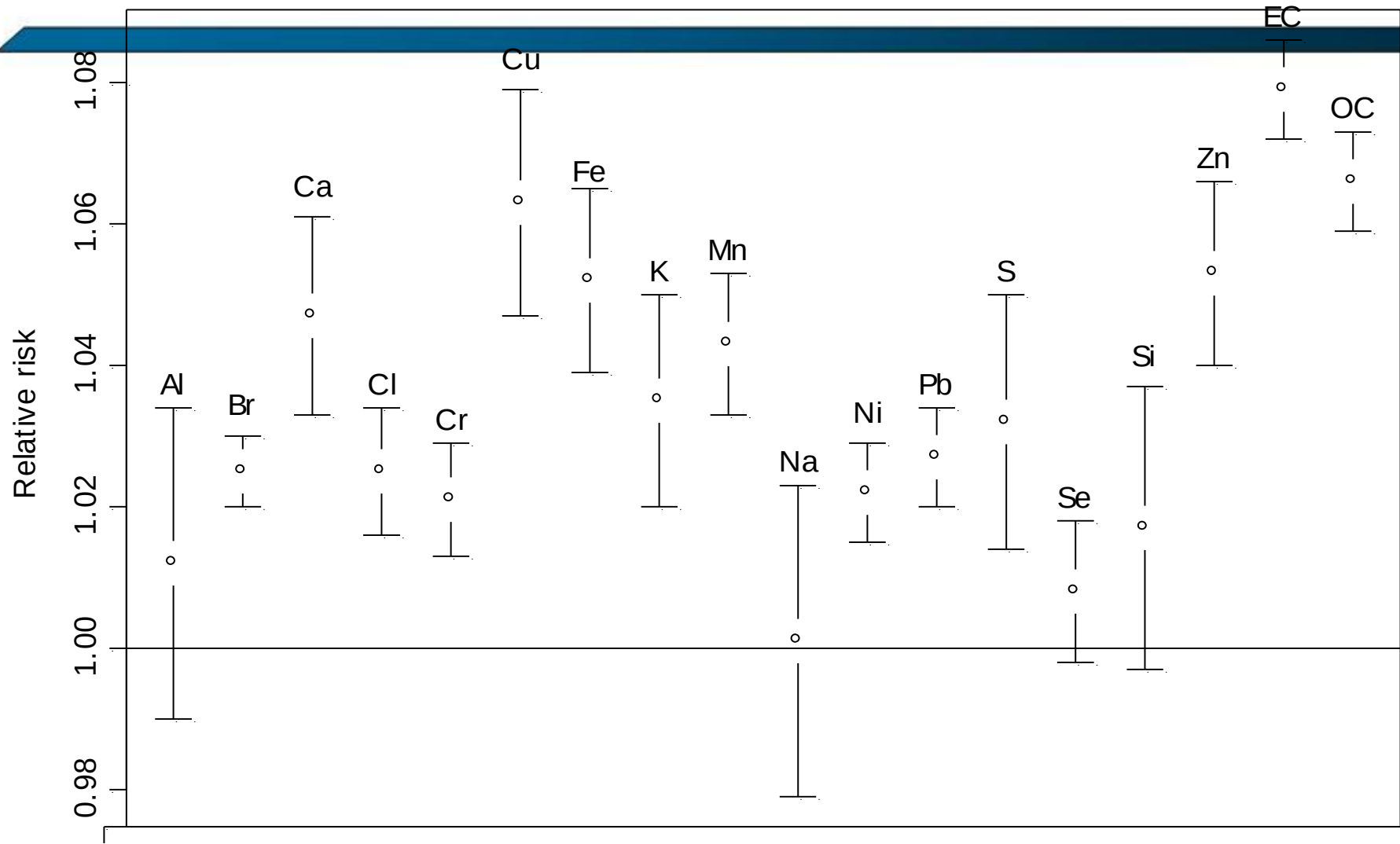


# Air pollution: Sources and health effects

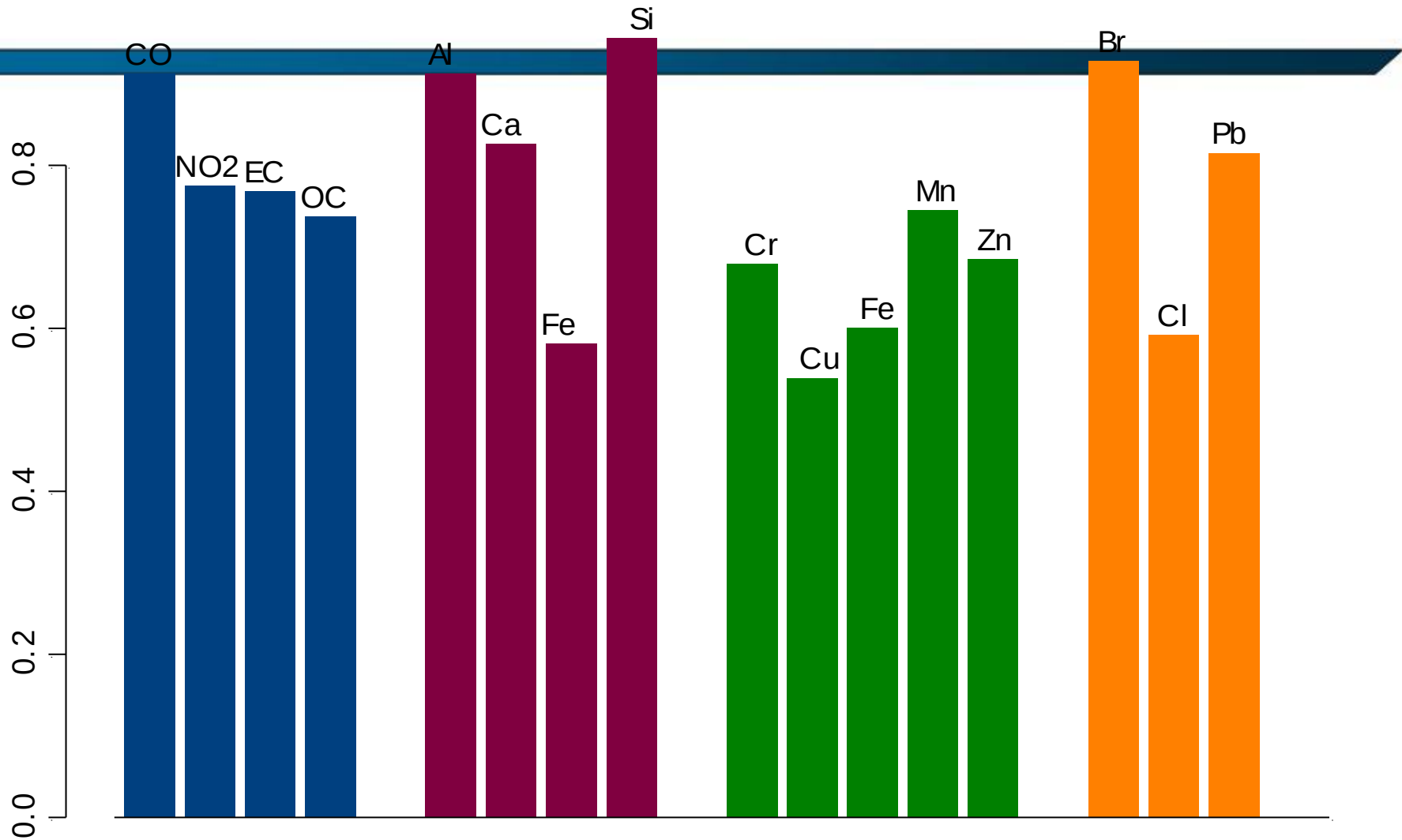
- Air pollution (AP) effect on neurological diseases
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- Diabetes
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# Mortality: Single pollutant model - Total



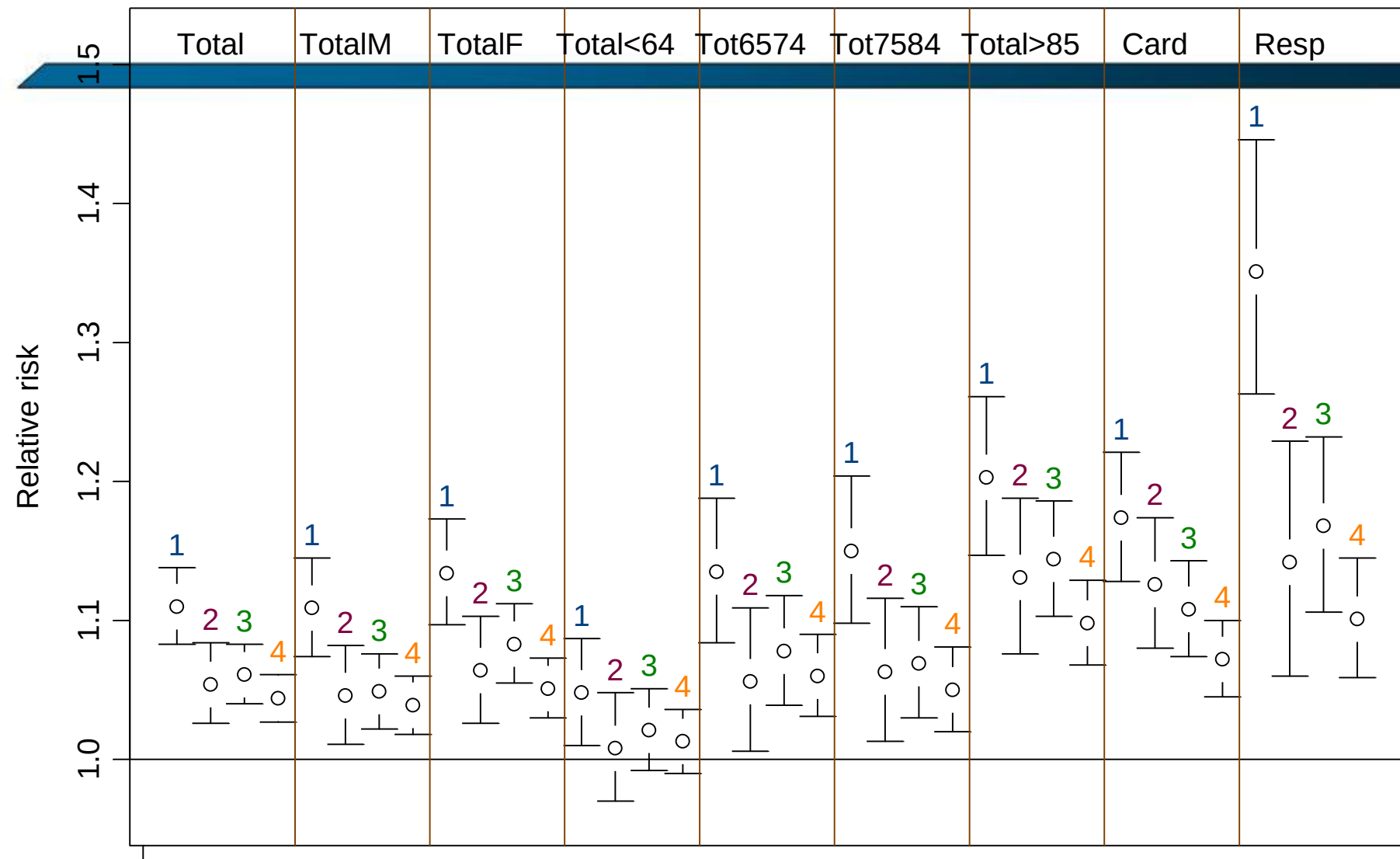
# Element loadings of the factors



Data from Santiago , Chile between 1998 and 2006.



# Factor effects - Total



INT J OCCUP ENVIRON HEALTH  
15:152–158

# Mechanisms

- Air pollution generate inflammatory mediators in the lungs which then circulate, influencing vascular function and blood-brain barrier function.
- Trigeminovascular reflex may lead to peptide release, and subsequent inflammation , vasodilation and pain from headaches.
- Studies supporting an adverse effect of traffic-related air pollution on hospitalization and death from stroke and heart attack suggesting that air pollution influencing coagulation.
- AP can trigger oxidative stress and inflammation of adipose tissue (in mice) and that might increase insulin resistance ( inhibits insulin responsiveness), and thus increasing hospitalization for diabetes on days with higher air pollution.



# Mechanisms

- Ability to exercise depends on the ventilatory and gas-exchanging capacity of lungs, and the heart and vessels delivering oxygen to cells to produce energy. Inflammation and oxidative stress can narrow bronchial airway and decrease arterial oxygenation.
- AP might increase mucosal permeability and thereby penetration of allergens.
- Metals might enhance the allergic response.
- Traffic pollution include the mixture of motor vehicle products, asphalt, rubber etc and traffic count may capture this composite better than any single pollutant.



# Summary

- AP influence mortality and morbidity.
- Elemental carbon (EC) had the strongest effect which persisted despite adjustment for other elements
- Elemental carbon is considered to be a marker of motor vehicle traffic and may be more indicative of traffic than organic carbon. This suggests that the traffic-sourced pollution mix are toxic.
- Air pollution can be modified through legislation. This observation should be considered when calculating the health burden and costs to society of air pollution.



# Summary

- The burden of mortality due to short term changes in air pollution is disproportionately experienced by those who are elderly, have lower educational attainment, live in areas of lower income, and especially those who are poor and elderly.
- These findings suggest that the determination of air quality guidelines designed to protect the general population may be insufficient to protect the elderly and those with lower income and educational attainment.
- Decreasing air pollution levels might reduce the severity of allergic asthma



# Next Steps

- We investigated Climate change and Temperature related mortality in Canada. Int J Biometeorol (2012) 56:605–619
  - Further investigate the relative risk of mortality (RR) due to air pollution, and determine which combination of atmospheric conditions pose a greater health threat in multiple age groups (weather, air pollution interactions)
  - Examine by season, age, pollutant and weather type



# Spatial Synoptic Classification<sup>a</sup> (SSC)

- SSC = semi-automated daily air mass classification system; based on 4 daily measurements of **air pressure, temperature, dew point, cloud cover, and wind velocity**

## **SEVEN SSC CATEGORIES:**

- Dry Moderate (DM)
- Dry Polar (DP)
- Dry Tropical (DT)
- Moist Moderate (MM)
- Moist Polar (MP)
- Moist Tropical (MT)
- Transition (TR) – frontal passage

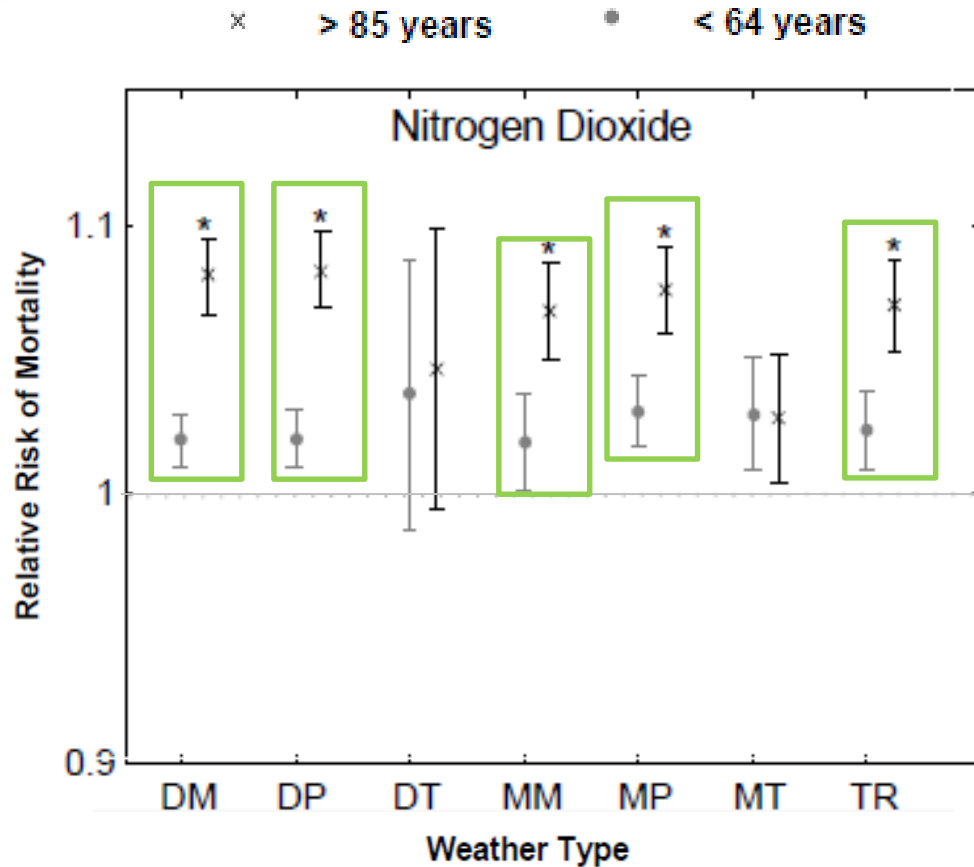
## **Model:**

- piece-wise Poisson General Linear Model to estimate relative risks associated with air pollution and weather type



<sup>a</sup>Sheridan (2002), <http://sheridan.geog.kent.edu/ssc.html>

# Age Effect Example: *Nitrogen Dioxide Estimates*



- In all air masses excluding MT and DT, the elderly  $\geq 85$  years are significantly more likely to die of air pollution
- The same result was found for Carbon Monoxide and Sulphur Dioxide
- Ozone did not have significant differences by age





# VOC's

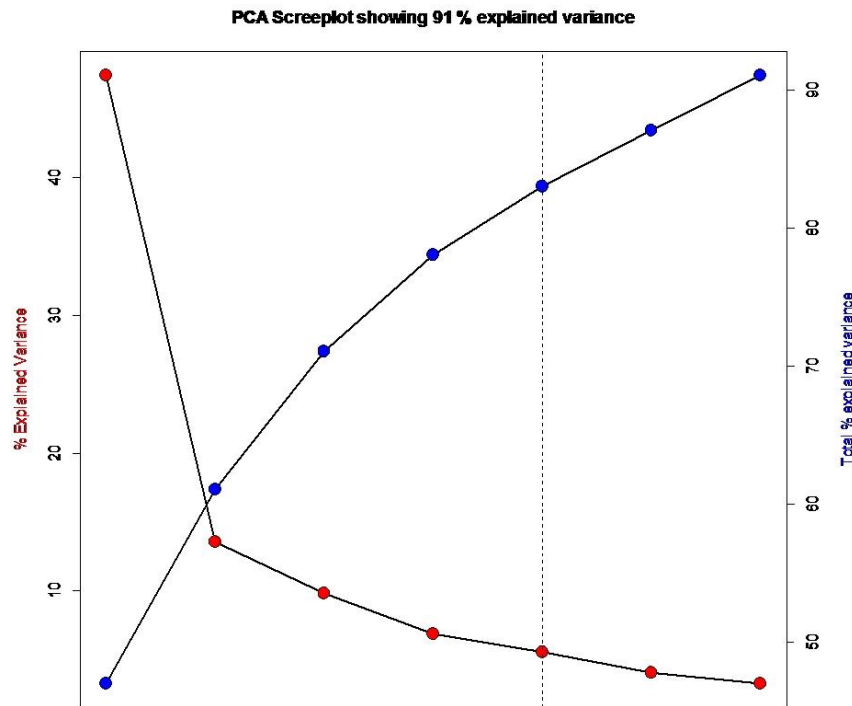
## Explanatory analysis



Date:

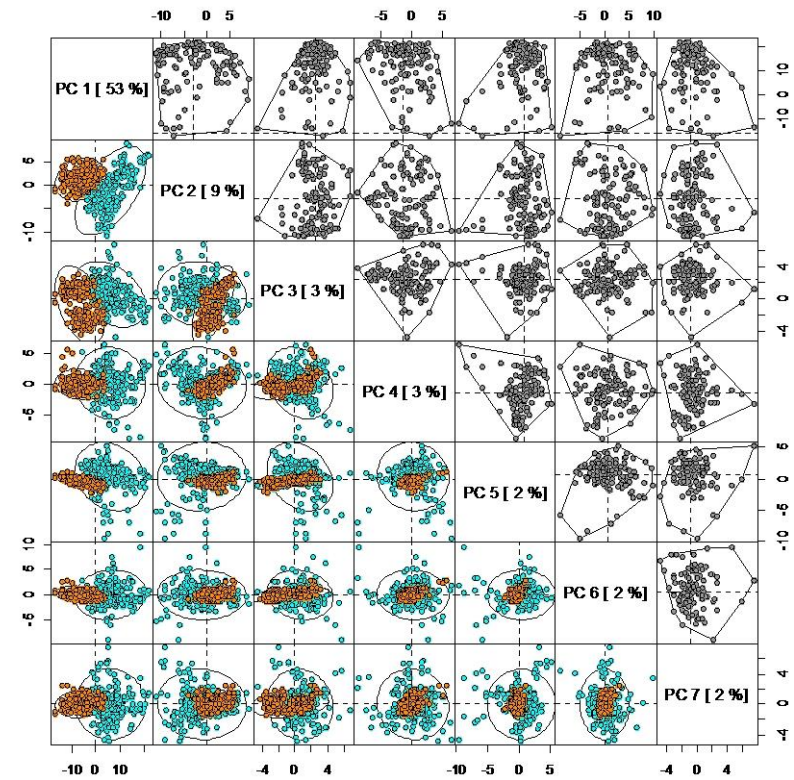
# 188 VOC's from Windsor

## Principle component



Principal components: (n = 7)

Cyan= indoor, dark orange= outdoor.



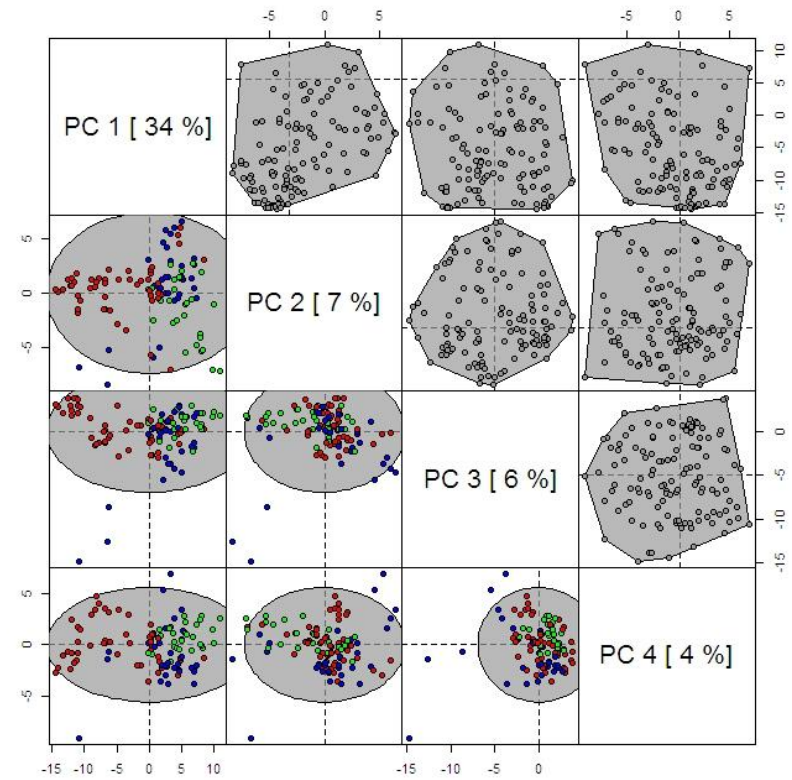
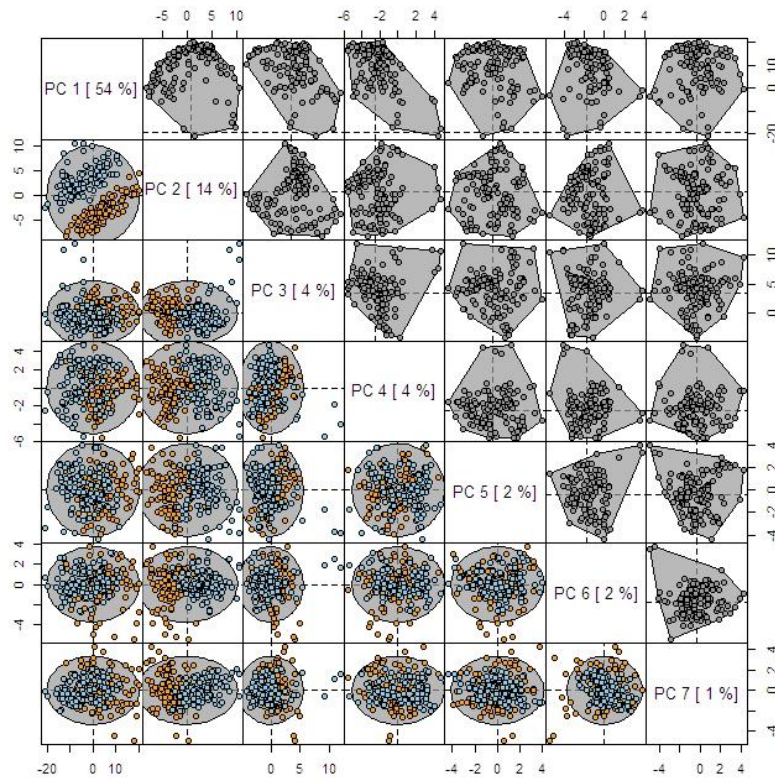
# By Season and garage type

## Indoor Summer

Outdoor:

Skyblue= winter, orange = summer.

Red= attached garage, blue= no garage, green= detached garage.



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# THANK YOU.

