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Demographic analysis of the effects of pollution on mortality in four French metropolises.

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Résumé Cette recherche est une contribution à la connaissance des effets de la pollution atmosphérique sur la population. Une mesure de la concentration en dioxyde d'azote et un suivi de la mortalité de la population ont été réalisés sur les mêmes communautés entre 1999 et 2011 en France. Il y a un gradient de mortalité croissant avec le niveau de pollution. Le risque relatif de mortalité entre une pollution moyenne et une faible pollution est estimé à 5%. Ces conclusions sont limitées par la taille de l'échantillon de l'enquête.

Introduction

Nitrogen dioxide (NO₂) is one of the most hazardous atmospheric pollutants. (Extrapol, 2006). It has adverse health effects because long-term exposure can impair lung function and increase the risk of respiratory problems (Crouse et al., 2015).

The arguments for an environmental health policy are built on the burden of mortality or morbidity. (European Environment Agency, 2016).

In this study we propose to measure :

- the life expectancies of generations exposed to different levels of NO₂ pollution,
- the number of deaths of the table
- the relative risk of mortality attributable to different levels of pollution.

Data & Methods

This study is based on data from the HID survey conducted in France in 1999 with a national representative sample of households whose vital status was followed up to 2012. (n = 16896).

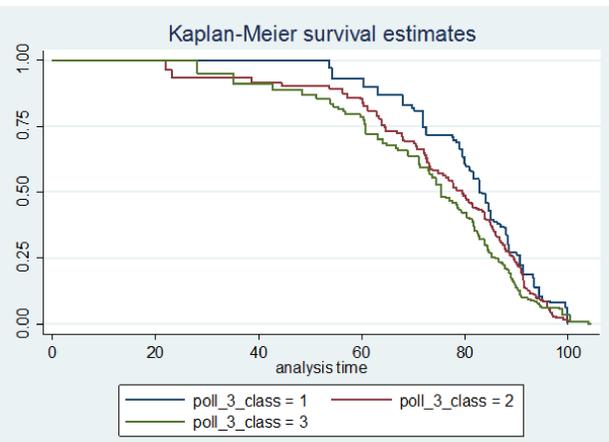
A sub-sample of the HID survey was created as part of the "DISPARITES" research program. It identifies the living area of people (iris 2000) thus allowing to determine a social deprivation score and a level of pollution. (n = 1283)

<http://www.equitarea.org/>

The vital status of those generations was followed by Civil registration between 1999 and 2011.

Results

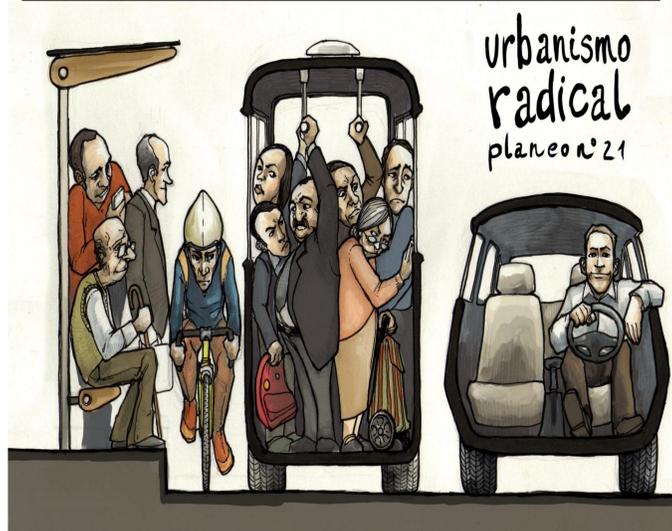
A) Age-specific mortality in sub-populations with different levels of exposure



B) Premature deaths due to NO₂ pollution

Table 1: Number and rate of death by level of NO₂ pollution in the stationary populations.

	Moderately polluted Class 1	Medium Level Class 2	Very polluted Class 3
Life expectancy at 30 years	58,14	57,21	54,11
Number of annual deaths in the 4 metropoles	120129	121560	126210
Avoidable mortality rate (less than 65 years) per 1000	0,70	0,83	1,16
Mortality rate all ages per 1000	12,03	12,17	12,64



C) Relative risk throughout lifespan by controlling competing variables.

Table 2: Cox regression applied to the distribution in terciles of pollution

	Haz. Ratio	95% Conf. Intervall
tercile of pollution	1,05	0,90 1,22
sex	0,62	0,50 0,77
disability	1,90	1,47 2,45
profession	1,16	1,08 1,24
social defavorisation	1,04	0,91 1,19

The specific effect of pollution is 5% when one passes from one class of the terciles to another.

Conclusions

There is a gradient of mortality, with a significant difference of 4 years of life expectancy between the extreme groups of pollution.

A generation of French population subject to heavy pollution would know during its history 42 350 deaths annually.

By controlling gender, socioprofessional status, social deprivation and disability, the relative risk of mortality between average and low pollution is estimated at 5%.

Discussion

Difference in life expectancy between pollution groups is a good indicator of public health but it omits other variables that could influence this difference.

Mortality rates and annual deaths are good variables to communicate on the pollution burden, but there is a possible bias on age.

The Cox regression, which measures a relative risk of mortality, is less relevant in terms of communication with the general public, but it provides better control over interpretation biases.

Great interest of the demographic approach, in a field where data are scarce; but the main limits of this study are:

- the insufficient sample size (n = 1283),
- characteristics of the population are measured at the beginning of observation, deaths are observed during 11 years and the level of pollution is measured at the end of the period.
- the assimilation of pollution to NO₂ to all atmospheric pollution is a final limitation to the results.

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