Health Impact Assessment of Long-term Exposure to Particulate Air Pollution: Sensitivity of Results to the Correction of PM_{10} Levels Measured with TEOM

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Introduction

Health Impact Assessments (HIA) of long-term exposure to PM_{10} have been conducted in 9 French cities as part of the APHEIS European project [1] and were based on exposure-response functions obtained using gravimetric measurements of PM_{10} levels [2].

In France, PM_{10} levels are routinely monitored using Tapered Element Oscillating Microbalances (TEOM). APHEIS recommended the use of correction factors in order to compensate for losses of volatile compounds.

Nevertheless, several corrective methods exist and there is for the moment no consensus regarding the method that should eventually be used for correction.

Objectives

The objective of this study was therefore to assess the sensitivity of HIA results to the use of various correction methods.

Methods

- Long-term HIAs for a reduction of PM_{10} annual mean level to 20 µg/m³ were conducted using both non-corrected and corrected PM_{10} levels, based on exposure-response functions obtained by Pope *et al* [2].

- Data on mortality and annual mean concentrations of PM_{10} for year 2001 were collected in 9 French cities:
  - annual deaths were provided by the National Institute of Health and Medical Research (Inserm),
  - air pollution data were obtained from the 9 local monitoring networks.

- Three correction methods were used:
  - the 1.3 default European correction factor [3],
  - local seasonal conversion factors,
  - local polynomial regressions derived from parallel gravimetric and TEOM measurements [4].

Results

• PM_{10} annual mean levels according to the method used

Among the 9 cities, local correction factors ranged from 1.00 to 1.18 during winter, and from 1.13 to 1.37 during summer.

Annual mean levels of PM_{10} measured with TEOM ranged from 21 to 29 µg/m³. Corrected annual mean levels ranged respectively from 27 to 38 µg/m³, 23 to 31 µg/m³ and 22 to 33 µg/m³ when European, local seasonal and local polynomial corrections were used (Table 1).

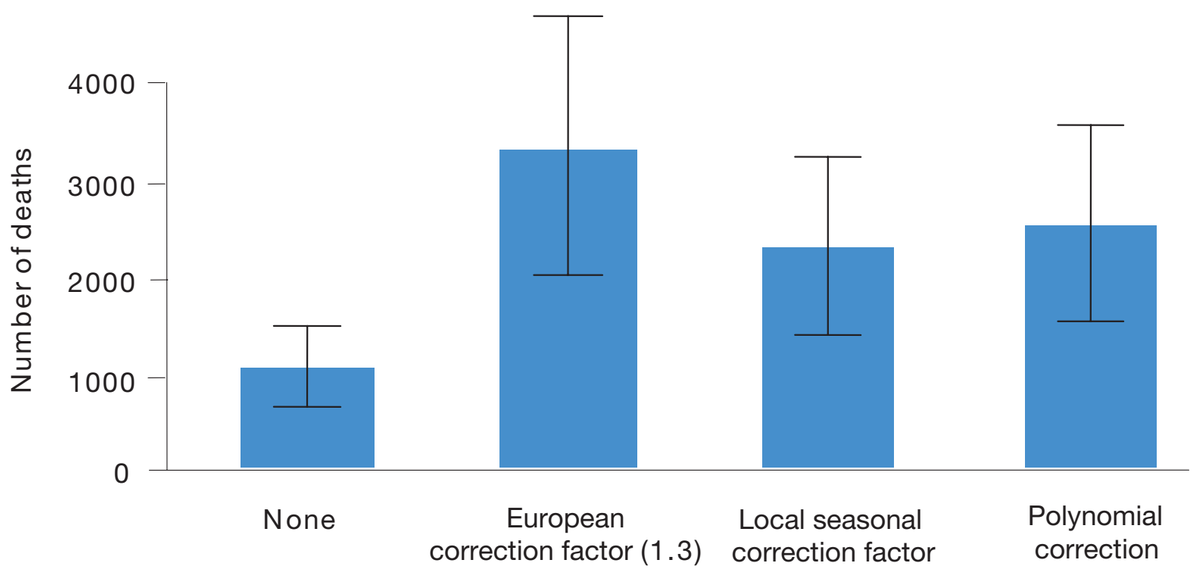
Table 1: Annual levels of PM_{10} (µg/m³) in 9 French cities according to the corrective method used.

City	PM_{10} measured with TEOM	Corrected PM_{10}		
		European factor (1.3)	Local seasonal factor	Polynomial correction
Bordeaux	21	27	24	25
Le havre	21	28	25	24
Lille	26	33	31	33
Lyon	22	29	26	26
Marseille	29	38	31	31
Paris	22	29	27	27
Rouen	21	28	23	22
Strasbourg	23	29	25	28
Toulouse	22	29	25	25
Total	**23**	**30**	**26**	**27**

• HIA results according to the method used

The use of a correction had a non-negligible impact on HIA results, as shown in Figure 1.

Figure 1: Potential benefit (number of deaths) of reducing annual mean values of PM_{10} to 20 µg/m³ according to the correction method used



When compared to the HIA results obtained using PM_{10} levels corrected with local seasonal correction factors, the direct use of levels measured with TEOM induced an underestimation varying from 17 to 82%, depending on the city. The total number of attributable cases over the 9 cities was estimated to 1034 when TEOM measures were used directly, whereas it was estimated to 3286, 2268 and 2501 when European, local seasonal or local polynomial corrections were used respectively.

Discussion and conclusion

- Although the use of a correction had a non-negligible impact on HIA results, the various correction methods led to results in the same order of magnitude.
- Non-specific correction factors do not seem appropriate, as the proportion of volatile matter varies according to localization-dependent factors (weather, particulate air pollution sources, ...).
- Local correction methods derived from parallel measurements seem more appropriate, but are not systematically available.
- For the future, the improvement of automatic methods of measurement minimizing losses of volatile compounds seems promising.

References

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