

LILLE CITY REPORT

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Summary of the main findings

In the urban community of Lille, the main source of air pollution is road traffic. As long term benefit, we estimated that a reduction of the daily pollution levels of PM_{2.5} by 3.5 µg/m³ would reduce the non specific mortality in Lille by 8 years deaths per. As well, if all the daily means of PM₁₀ would be kept to 20 µg/m³, 190 deaths and around 600 hospital admissions could have been avoided per year in Lille.

A new policy for urban transports currently in preparation will aim to improve air quality. This Aphis-3 study would constitute its pre-intervention assessment .

Background

In the North of France, the metropolitan area of Lille called LMCU (Lille Métropole Communauté Urbaine) has a population slightly more than 1 million inhabitants. 612 km² in size, Lille has 86 municipalities but the central activity is mainly around four major municipalities: Lille, Roubaix, Tourcoing and Villeneuve d'Ascq.

Its population is relatively young compared to other French cities with only 12.8% of people aged 65 years +.

The study area of Lille is flat, widely swept by prevailing winds from the west. It has moderate climate under the influence of the sea, with a relatively wide of range of temperatures. With moderates rains, foggy or cloudy, Lille has little sunshine (generally, 1900 hours of sunshine per year).

Situated in the heart of Europe, the traffic in the metropolitan area of Lille is very heavy due to the intersecting of national and international traffic motorways (A1, A22, A23, A25) and regional and international traffic. There is also a heavy traffic between the suburbs and the town centre. In 1997, around 4.7 millions of journeys are done in the Lille-Metropole, 61% by private car and only 8% through the public transport system.

Relevance of this HIA

Since 1999 and according to the regulatory aspects, the Nord-Pas-de-Calais region has an Air Quality Regional Plan (PRQA). In January 2001, an Atmospheric Protection Plan (PPA) has been established in the Lille-Metropole area. The objective of this plan is to set up different ways to respect the european reference values in terms of air pollution for SO₂, NO_x, PM, BS, CO, O₃ by comprehensives measures for a long term reduction of the pollutant emissions and by a policy for urban transports : the Plan de Déplacements Urbains (PDU). This PDU is currently in revision: this Aphis-3 study would constitute its pre-intervention air pollution health impact assessment .

Sources of air pollution

In 1994, data on the various types of emissions sources in the urban community of Lille, provided by the CITEPA has been presented in the previous Apehis city report. As far as now, this data were not yet updated.

In 1994, in the urban community of Lille, the main source of air pollution was traffic 72% of NO_x emissions 66% of CO emissions and 42 % of non methane volatile organic compound. Industries continue to play major role in pollution with 49% of SO₂ emissions.

Table 1. Main sources of air pollution in the Lille metropole *

Pollutant	Road (%)	Heating (%)	Industry (%)
NO _x	72	10	18
CO	66	32	2
VOC	42	26	33
SO ₂	24	27	49

* sources CITEPA 1994

Exposure data

Air pollution data was provided by the Lille metropole air quality network : ATMO Nord-Pas de-Calais (Figure 1).

Only 24-hour average values of the urban background stations were used for the HIA. For every day, 24-hour average value is validated only if less than 25 % of the hourly values are missing. When one or several daily data were missing from the stations, the method of average seasons, or of linear regression, were used instead depending on how long the data had been missing for.

Particles (PM₁₀) and fine particles (PM_{2.5}) are measured by analyses using TEOM (tapered element oscillating microbalance) quartz microbalances.

The PM₁₀ indicator corresponds to the arithmetic mean of data collected by 6 urban monitoring sites (Faidherbe, Fives, Tourcoing, Marcq en Baroeul, Lomme, Villeneuve d'Ascq).

The PM_{2.5} exposure indicator is the arithmetic mean of mean of data collected by two urban monitoring sites: one traffic station (Faidherbe) and one background station (Lomme). The estimated PM_{2.5} converted from the PM₁₀ come from each of these two stations.

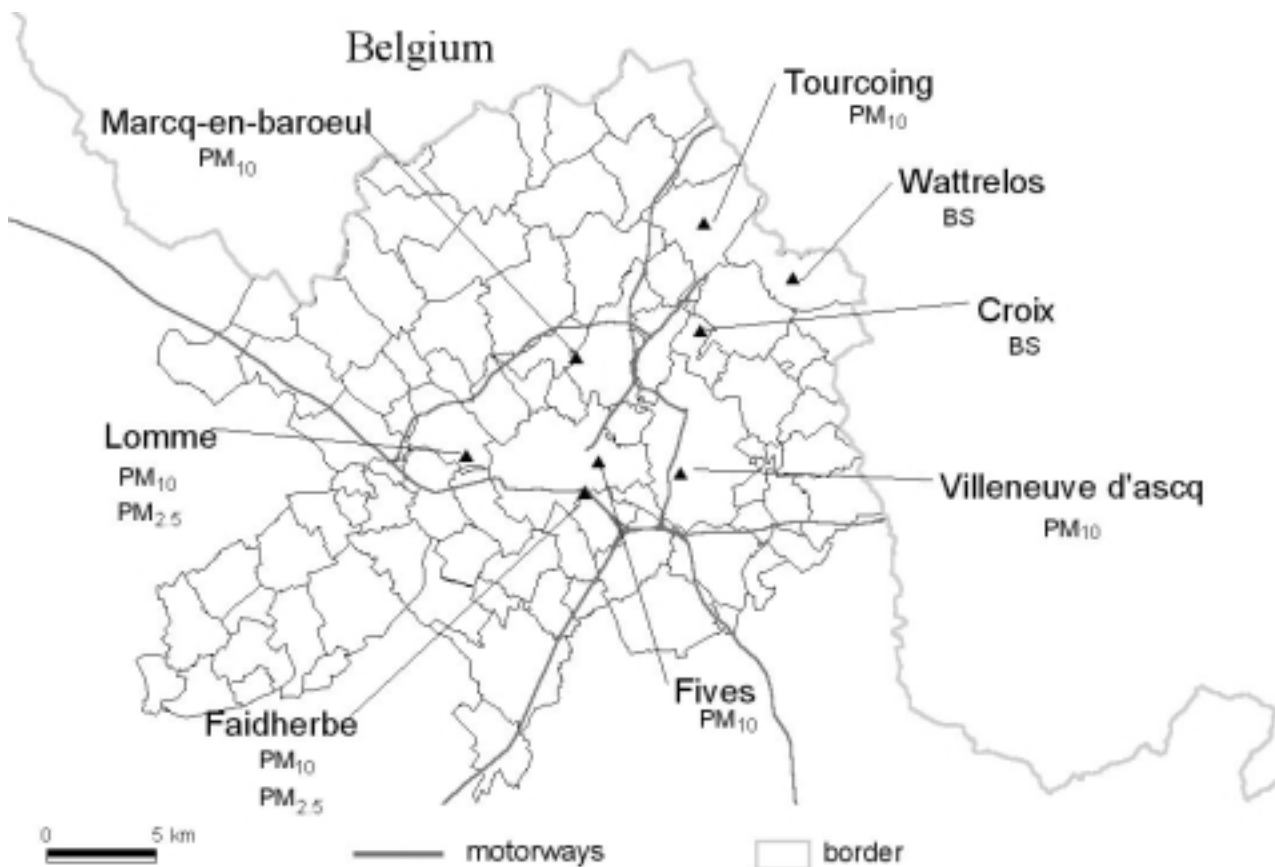
The BS are measured by the Ecole des Mines 'manual quality surveillance network since 1997 by reflectometry method. The exposure indicator for BS is the arithmetic mean issued of two urban monitoring sites (Croix et Wattrelos).

Exposure data for Apehis 3:

- Year of air pollution data was 2001

- Daily mean levels (SD) of BS were 10 (4) $\mu\text{g}/\text{m}^3$.
- Daily mean levels (SD) of PM_{10} were 26 (15) $\mu\text{g}/\text{m}^3$.
- Daily mean levels (SD) of direct $\text{PM}_{2.5}$ were 16 (11) $\mu\text{g}/\text{m}^3$.
- P5 and P95:
 - The levels of BS reached during the 365 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 6 $\mu\text{g}/\text{m}^3$ and 18 $\mu\text{g}/\text{m}^3$.
 - The levels of PM_{10} reached during the 365 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 12 $\mu\text{g}/\text{m}^3$ and 48 $\mu\text{g}/\text{m}^3$.
 - The levels of $\text{PM}_{2.5}$ reached during the 365 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 7 $\mu\text{g}/\text{m}^3$ and 31 $\mu\text{g}/\text{m}^3$.

Figure 1. : Localisation of urban background stations in Lille Metropole



- We used a correction factor to convert TEOM measurements of PM_{10} into gravimetric measures :
 - For summer time period (april ,1th to Sept 30th) = 1.185
 - For winter time (Oct., 1th to Mar.,31th) = 1.271
- We used a conversion factor to derive $\text{PM}_{2.5}$ from PM_{10} : 0.66
- Number of days when air pollutants exceeded limit levels :

Table 2. Number of days when air pollutants exceeded limit levels (Year 2001)

Air pollutant	Short term*		
	PM ₁₀	BS	Real PM _{2.5}
Number of days above 20 µg/m ³	20 µg/m ³	20 µg/m ³	14 µg/m ³
	158	14	159
Number of days above 50 µg/m ³	50 µg/m ³	50 µg/m ³	35 µg/m ³
	12	0	15

* PM₁₀ and PM_{2.5} direct measurement by TEOM

Table 3. Number of days when air pollutants exceeded limit levels (Year 2001)

Air pollutant	Long term*		
	PM ₁₀	BS	Estimated PM _{2.5}
Number of days above 20 µg/m ³	20 µg/m ³	20 µg/m ³	14 µg/m ³
	221	14	206
Number of days above 50 µg/m ³	50 µg/m ³	50 µg/m ³	35 µg/m ³
	16	0	15

*PM₁₀ measures converted into gravimetric measurements, then PM_{2.5} derived using a 0.66 factor

Table 3a. Distribution of Black Smoke (BS) (Year 2001)

	BS		
	Year	Summer	Winter
Number	365	183	182
Minimum	2	4	2
Percentile 5	6	6	6
Percentile 25	8	8	8
Median	9	9	9
Percentile 75	10	10	12
Percentile 95	18	13	21
Percentile 98	22	14	23
Maximum	28	19	28
Daily mean	10	9	11
standard error	4	2	5
% missing values	0.00%	0.00%	0.00%

Table 3b. Distribution of TEOM PM10 data converted into gravimetric measures (Year 2001)

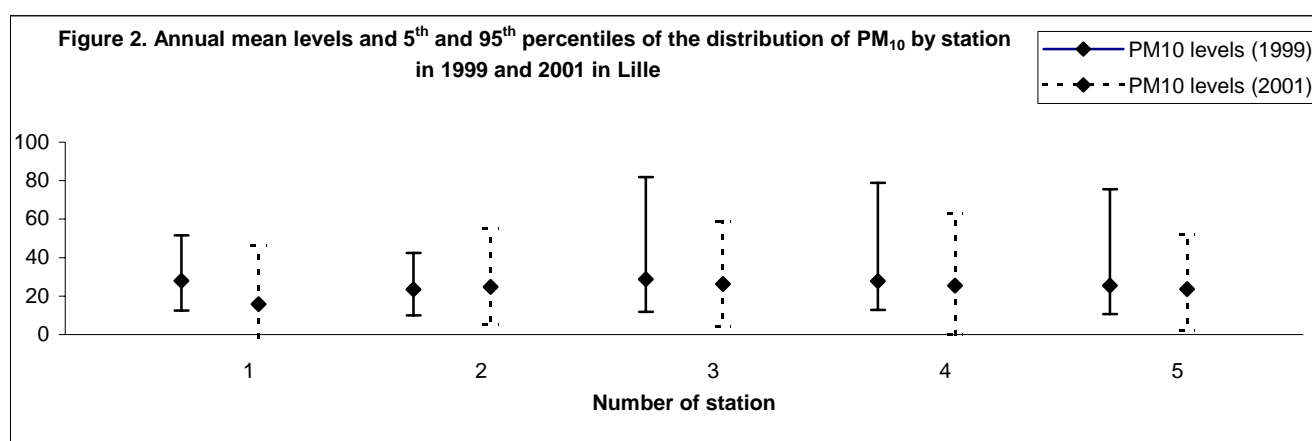
	TEOM extrapolated PM10 data		
	Year	Summer	Winter
Number	365	183	182
Minimum	9	10	9
Percentile 5	12	13	11
Percentile 25	17	17	17
Median	23	22	24
Percentile 75	31	28	34
Percentile 95	48	42	63
Percentile 98	67	46	73
Maximum	144	73	144
Daily mean	26	24	28
standard error	15	10	18
% missing values	0.00%	0.00%	0.00%

Table 3c. Distribution of TEOM direct PM_{2.5} measures (Year 2001)

	Real PM _{2.5}		
	Year	Summer	Winter
Number	358	182	176
Minimum	5	5	6
Percentile 5	7	7	7
Percentile 25	9	9	9
Median	13	12	14
Percentile 75	18	17	19
Percentile 95	31	25	39
Percentile 98	42	31	47
Maximum	111	43	111
Daily mean	16	14	17
standard error	11	6	14
% missing values	0	0	0

Table 3d. Distribution of TEOM direct PM₁₀ measures (Year 2001)

	TEOM PM ₁₀		
	Year	Summer	Winter
Number	365	183	182
Minimum	7	9	7
Percentile 5	10	11	9
Percentile 25	14	14	13
Median	19	18	19
Percentile 75	25	24	27
Percentile 95	39	35	50
Percentile 98	53	39	57
Maximum	114	62	114
Daily mean	21	20	22
standard error	12	8	14
% missing values	0.00%	0.00%	0.00%



1=Faidherbe, 2=Fives, 3=Lomme, 4=Tourcoing, 5= Marcq en Baroeul

We observed in the same five stations a moderate decrease of the annual mean level of PM₁₀ between 1999 and 2001 (figure 2).

Health data

- Mortality data quality assessment

The information department specialised in mortality data (Cepi DC) at the National Health and Medical Research Institute (INSERM) provided medical causes of death. The more recent available data were for year 1999. These data are submitted to a strict quality control procedures. No data were missing in basic cause death codification. This codification were performed for all the data according to the international classification of diseases (ICD9).

- Age-standardised total mortality rate (ICD9 = [000-999]) was 950 per 100 000 inhabitants, using the european population as a reference¹.

- Hospital admissions data quality assessment

The 2001 year data on hospitalisation admissions for respiratory and cardiovascular diseases was extracted by the hospital information technical agency (ATIH) from the Information Systems Medicalisation Programs (PMSI) of each of 6 hospitals and 6 private clinics that provide health care to the inhabitants of the studied urban area. This hospital admissions data was submitted to a internal PMSI quality control procedure. For year 2001, all admissions data was complete and no cause of admission was missing.

Table 4. Daily mean number and annual rate per 100 000 of deaths (1999) and hospital admissions(2001)

Health outcome	ICD9	ICD10	Daily mean number	Number of cases per 100 000
Short term HIA				
All causes mortality(excluding external causes)*	< 800	A00-R99	23	765.92
Cardiovascular mortality	390-459	I00-I99	7	138.10
Respiratory mortality	460-519	J00-J99	2	71.64
Cardiac mortality	390-429	I00-I52	5	164.82
Cardiac hospital admissions	390-429	I00-I52	30	987.3
Respiratory hospital admissions	460-519	J00-J99	32	1072.3
Long term HIA				
Total mortality	0-999	A00-Y98	25	822.45
Cardiopulmonary mortality	401-440	I10-I70		
	460-519	J00-J99	9	291.52
Lung cancer mortality	162	C33-C34	1	45.8

* For short and long term scenarios

¹ UNITED NATIONS. Population Division Department of Economic and Social Affairs. World Population Prospects: The 2000 Revision.

Health impact assessment

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In Lille, these scenarios were built for three indicators of this particulate pollution: BS, PM₁₀ and PM_{2.5}. The estimated health impacts of these indicators may overlap, and caution is recommended in the interpretation of findings : under no circumstances should we add findings of these indicators because they represent the same type of pollution.

Different tools and different estimates were used to evaluate the short- and long-term impacts of this particulate pollution on health (table 4).

Table 4. Summary SHORT-TERM Health impact assessment (HIA)

	Health indicator	ICD		Tool	RR (95% IC) For 10 µg/m ³ increase				
Attributable cases									
		ICD9	ICD10						
ST HIA for all cities report									
PM10	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.008)				
	All ages, cardiovascular mortality	390-459	I00-I99		WHO, 2003: 1.009 (1.005 - 1.013)				
	All ages, respiratory mortality	460-519	J00-J99		WHO, 2003: 1.013 (1.005 - 1.021)				
	All ages, cardiac hospital admissions	390-429	I00-I52		Le Tertre et al. 2002: 1.006 (1.003 -				
	All ages, respiratory hospital admissions	460-519	J00-J99		Apheis 3: 1.0114 (1.0062 - 1.0167)				
BS	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.009)				
	All ages, cardiovascular mortality	390-459	I00-I99		WHO, 2003: 1.004 (1.002 - 1.007)				
	All ages, respiratory mortality	460-519	J00-J99		WHO, 2003: 1.006 (0.998 - 1.015)				
	All ages, cardiac hospital admissions	390-429	I00-I52		Le Tertre et al. 2002: 1.011 (1.004 - 1.019)				
	All ages, respiratory hospital admissions	460-519	J00-J99		Apheis 3: 1.0030 (0.9985 - 1.0075)				
PM10 Distributed lag (40 days)	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Zanobetti et al. 2002: 1.01227 (1.0081 -				
	All ages, cardiovascular mortality	390-459	I00-I99		Zanobetti et al. 2002: 1.01969 (1.0139 -				
	All ages, respiratory mortality	460-519	J00-J99		Zanobetti et al. 2002: 1.02551 (1.0109 -				
1.0742)									
Complementary ST HIA for some cities reports									
PM10 with shrunken estimates	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Apheis 3: RRs and 95% CI of the shrunken estimate for each city				
					RR				
					Athens	1,012 (1,008-1,017)			
					Barcelona	1,009 (1,005-1,012)			
					Budapest	1,005 (0,999-1,011)			
					Cracow	1,004 (0,998-1,009)			
					London	1,007 (1,004-1,010)			
					Madrid	1,006 (1,002-1,010)			
					Paris	1,005 (1,001-1,009)			
					Rome	1,011(1,006-1,015)			
					Stockholm	1,006 (0,999-1,013)			
					Tel-Aviv	1,006 (1,002-1,011)			

Table 4 (cont), Summary LONG-TERM Health impact assessment (HIA)						
	Health indicator	ICD 9	ICD10	Tool	RR (95% IC) For 10 µg/m³ increase	Scenarios
Long term HIA for all-cities report						
Attributable cases						Annual mean
PM10	All causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Kunzli et al, 2000 1.043 (1.026 -1.061)	Reduction to 40 µg/m ³ Reduction to 20 µg/m ³ Reduction by 5 µg/m ³
PM2.5	All causes mortality Cardiopulmonary mortality LCA	0-999 401-440 and 460-519 162	A00-Y98 I10-I70 and J00-J99 C33-C34	French PSAS-9 Excel spreadsheet	CA III Pope, 2002 1.06 (1.02 - 1.11) 1.09 (1.03 - 1.16) 1.14 (1.04 - 1.23)	Reduction to 20 µg/m ³ Reduction to 15 µg/m ³ Reduction by 3.5 µg/m ³
YoLL						Annual mean
PM2.5	All causes mortality Cardiopulmonary mortality LCA	0-999 401-440 and 460-519 162	A00-Y98 I10-I70 and J00-J99 C33-C34	WHO AirQ software	CA III Pope, 2002 1.06 (1.02 - 1.11) 1.09 (1.03 - 1.16) 1.14 (1.04 - 1.23)	Reduction to 20 µg/m ³ Reduction to 15 µg/m ³ Reduction by 3.5 µg/m ³
Complementary LT HIA for some cities report						
Prospective scenarios on air pollution, prospective scenarios on birth numbers	Local choice	-	-	WHO AirQ software	-	-

Also, different approaches were used to describe the impacts:

For BS, short-term findings are expressed in terms of number of attributed deaths per year.

For PM₁₀, short and long-term findings are expressed in terms of number of attributed deaths per year.

For PM_{2.5} long-term findings are expressed in terms of :

- number of attributed deaths per year.
- number of expected years of life lost for starting year of simulation.

Short-term scenarios

We used the following scenarios to estimate the acute effects of short-term exposure to BS/PM₁₀ mortality and hospital admissions over one year.

Short term HIA scenarios for BS

We used two scenarios to estimate the acute health effects of BS on all causes (excluding external causes), cardiovascular and respiratory mortality over one year :

- reduction of BS levels to a 24-hour value of 20 µg/m³ on all days exceeding this value.
- reduction by 5 µg/m³ of all the 24-hour values of BS.

Short term HIA scenarios for PM₁₀

Short-term HIA of PM₁₀ on 0-1 days and cumulative HIA of PM₁₀ up to 40 days

We used three scenarios to estimate the acute health effects of PM₁₀ on 0-1 days and cumulative health effects of PM₁₀ up to 40 days on all causes (excluding external causes), cardiovascular and respiratory mortality over one year :

- reduction of PM₁₀ levels to a 24-hour value of 50 µg/m³ on all days exceeding this value (2005 and 2010 limit values for PM₁₀).
- reduction of PM₁₀ levels to a 24-hour value of 20 µg/m³ on all days exceeding this value (to allow for cities with low levels of PM₁₀).
- reduction by 5 µg/m³ of all the 24-hour values (to allow for cities with low levels of PM₁₀).

Long-term scenarios

Long-term HIA scenarios for PM₁₀

We used two scenarios to estimate the chronic effects of long-term exposure to PM₁₀ on all causes mortality (excluding external causes) over one year:

- reduction of the annual mean value of PM₁₀ to a level of 20 µg/m³ (2010 limit values for PM₁₀).
- reduction by 5 µg/m³ in the annual mean value of PM₁₀ (to allow for cities with low levels of PM₁₀).

Long term HIA for PM_{2.5}

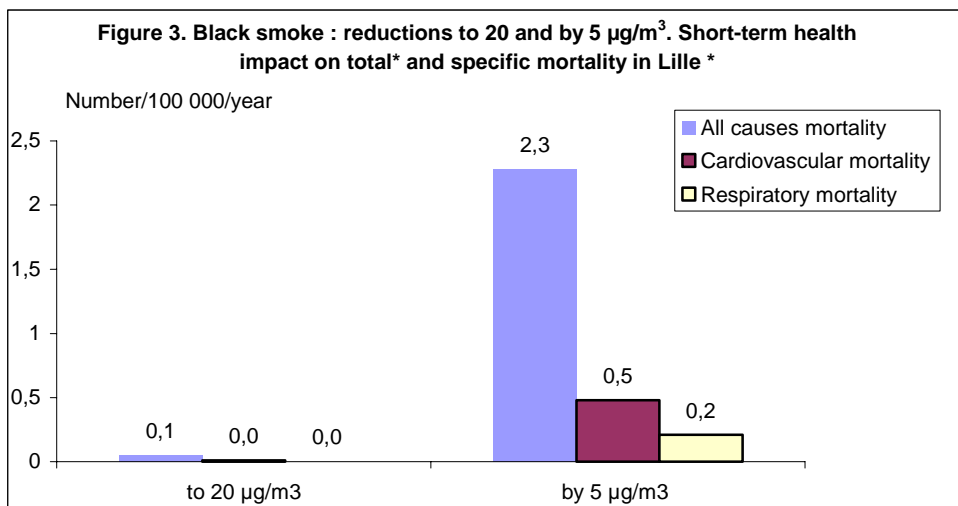
We estimated chronic effects of PM_{2.5} in the Lille in population over 30 years old as impacts on mortality due to all causes, due to cardiopulmonary and due to lung cancer deaths. The following two pollution scenarios were considered :

- reduction of the annual mean value of PM_{2.5} to a level of 15 µg/m³
- reduction by 3.5 µg/m³ in the annual mean value of PM_{2.5} (to allow for cities with low levels of PM_{2.5})

BS findings

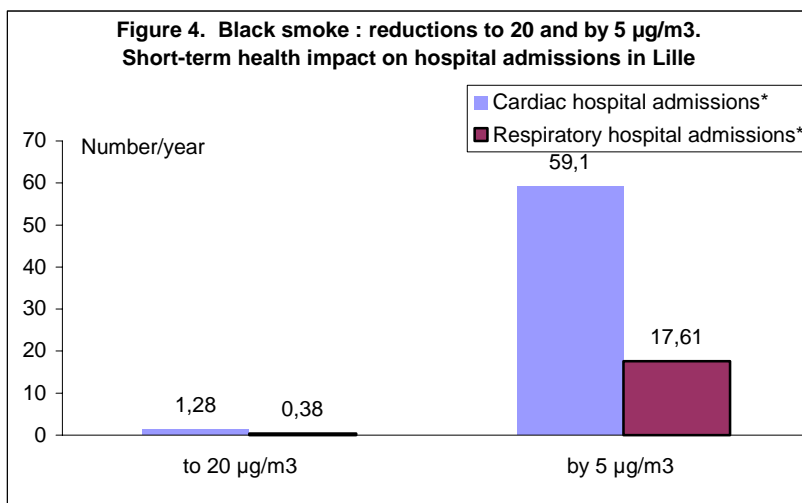
We analysed the acute health effects of BS on all causes (excluding external causes), cardiovascular and respiratory mortality over one year (figure 3).

The attributable benefit of reducing current daily BS levels by 5 µg/m³ in Lille would result in a decrease of 2.3, 0.5 and 0.2 deaths/ 100 000 inhabitants for the non-specific, cardiovascular and respiratory mortality, respectively. By comparison, a daily reduction of BS to 20 µg/m³ wouldn't induce in a significant reduction of the pollution related mortality.



* All causes mortality excluding external causes (ICD9 < 800), cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519) for 1999. Black smoke data for 2001.

The short-term health impact on hospital admissions after reductions of BS to 20 and by 5 µg/m³ was assessed (figure 4).



*Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519) data for 2001, Black smoke data for 2001

A reduction of the current daily BS levels by 5 $\mu\text{g}/\text{m}^3$ in Lille would result in an attributable benefit of 59 and 17 hospital admissions /100 000 inhabitants/year due to cardiac and respiratory hospital admissions respectively, while a daily reduction of BS to 20 $\mu\text{g}/\text{m}^3$ would not induce in a significant reduction of the number of pollution related hospital admissions.

PM₁₀ findings

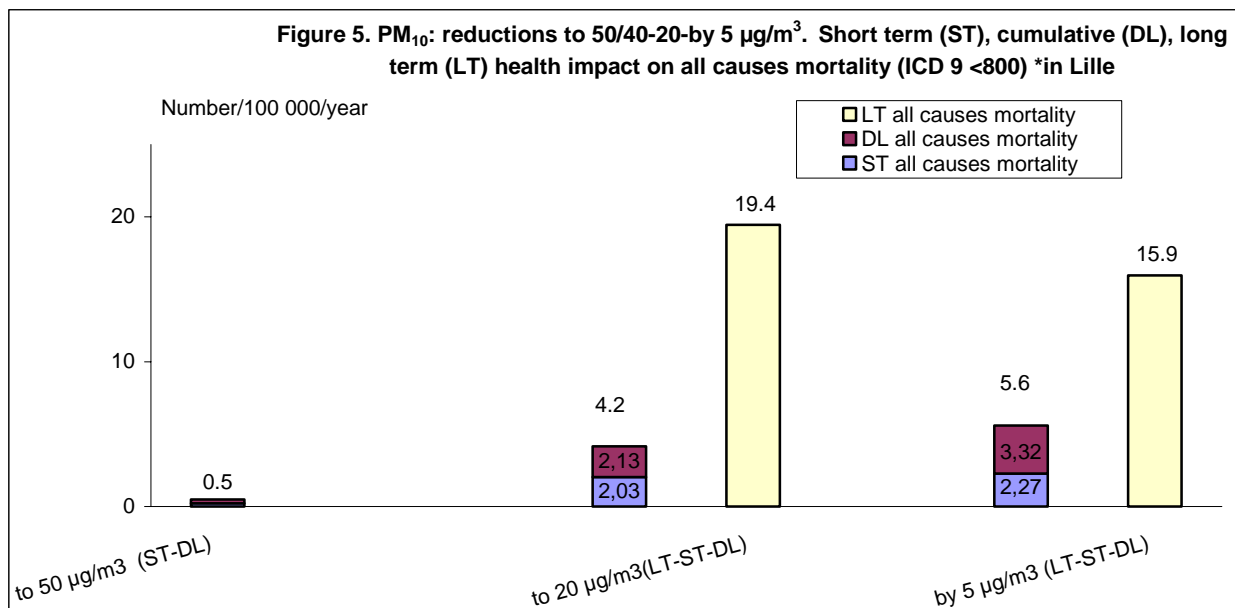
1. Short-term HIA of PM₁₀ on 0-1 days and cumulative HIA of PM₁₀ up to 40 days, and long term HIA of PM₁₀

1.1. Mortality findings

We assessed the health impact of PM₁₀ on non specific mortality for different lags: short-term-ST (0-1 day lag), cumulative effect-DL-distributed lag (up to 40 days lag) and long-term LT (years) (figure 5).

The long term benefit on the non-specific mortality is of 19 and of 16 deaths/100 000 inhabitants/year, with a reduction of the daily PM₁₀ mean levels to 20 and by 5 $\mu\text{g}/\text{m}^3$, respectively.

The cumulative benefit after a 0-40 days and a short term (0-1day) lag would be of 4.1 and 5.6 deaths/100 000/year after a reduction of the daily PM₁₀ mean levels to 20 and by 5 $\mu\text{g}/\text{m}^3$, respectively.



* PM₁₀ data for 2001, mortality data for 1999

A reduction of the daily PM₁₀ mean levels above 50 µg/m³ to 50 µg/ µg/m³ wouldn't have any significant effect (0.5 deaths/100 000/year).

Whatever the scenario of pollution reduction considered, follow-up periods up to 40 days, or of longer term, produce larger estimates of all causes mortality than using a 0-1 day follow-up.

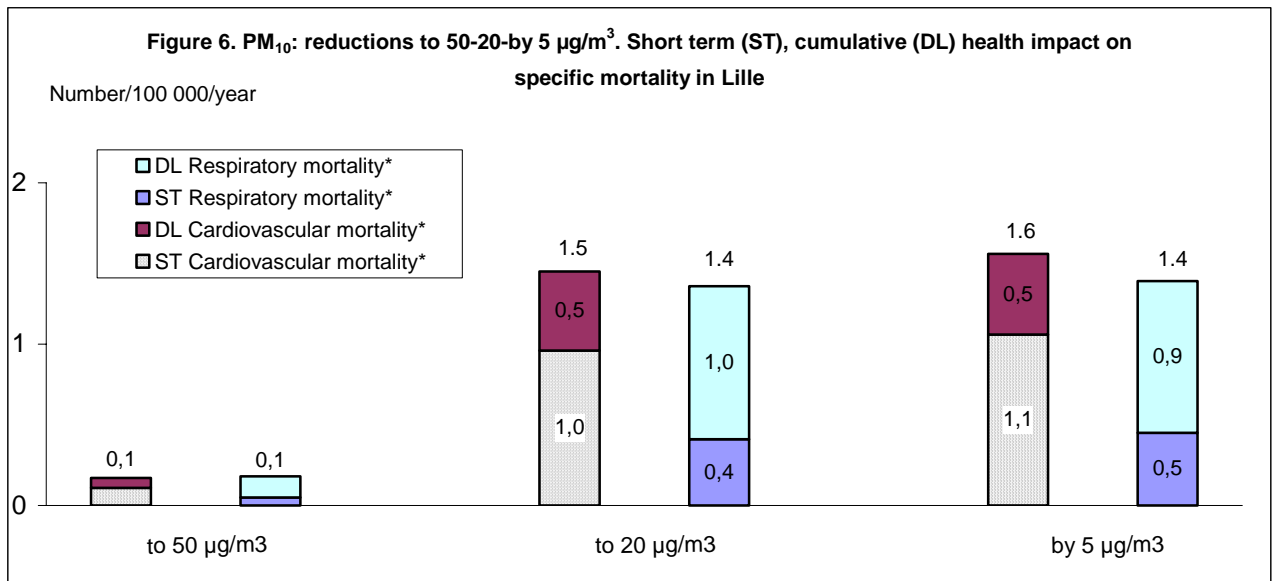
Then, we assessed the health impact of PM₁₀ on cardiovascular mortality and respiratory mortality for different lags: short-term-ST (0-1 day lag), cumulative effect –DL-distributed lag (up to 40 days lag) and long-term LT (years) (figure 6).

The cumulative benefit after both 0-40 days and short term (0-1 day) lags of follow-up would result in around 1.6 cardiovascular deaths/100 000/year with a reduction of the daily PM₁₀ mean levels to 20 µg/m³ as well as with a reduction by 5 µg/m³ .

In terms of respiratory deaths avoided, when using both 0-40 days and short term (0-1 day) lags follow up, the benefit would of 1.4 deaths/100 000/year with the a reduction of the PM₁₀ reduction to 20 µg/m³ as well as with a reduction by 5 µg/m³ .

As for the non-specific mortality, a reduction of the daily PM₁₀ mean levels above 50 µg/m³ to 50 µg/m³ wouldn't have any significant effect (0.1 deaths/100 000/year).

It's also worthless to note that, we generally observe a more important cumulative effect after a long term follow-up for the respiratory mortality than that for the cardiovascular mortality.

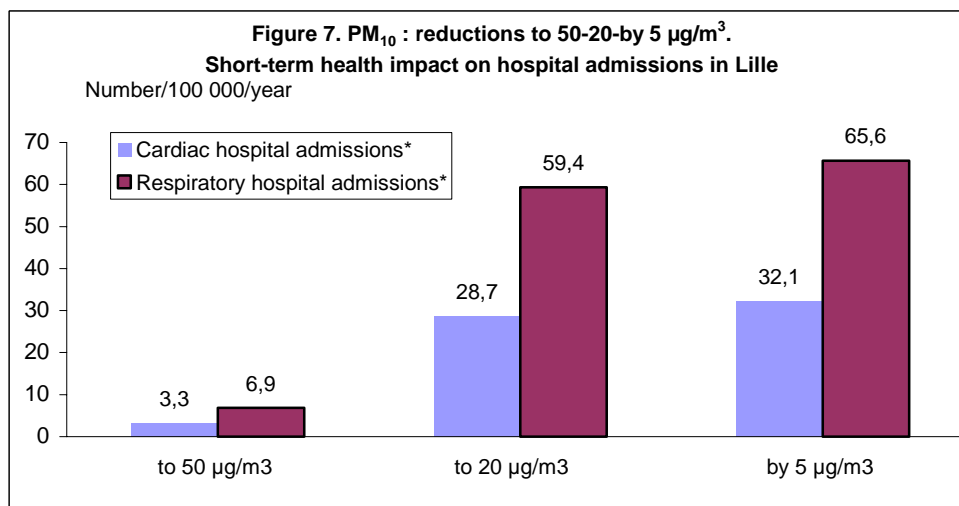


*Cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519), PM₁₀ data for 2001, mortality data for 1999

1.2. Hospital admissions findings

We estimated the acute effects of short-term exposure to PM₁₀ on cardiac and respiratory hospital admissions over one year (figure 7).

In terms of respiratory hospital admissions, the expected benefit of a reduction by 5 or to 20 µg/m³ levels of the daily PM₁₀ mean levels is roughly comparable. This reduction, of about 60 hospitalisations/100 000/year, is about twice that found with the cardiovascular hospital admissions : around 30 hospitalisations/100 000/year.



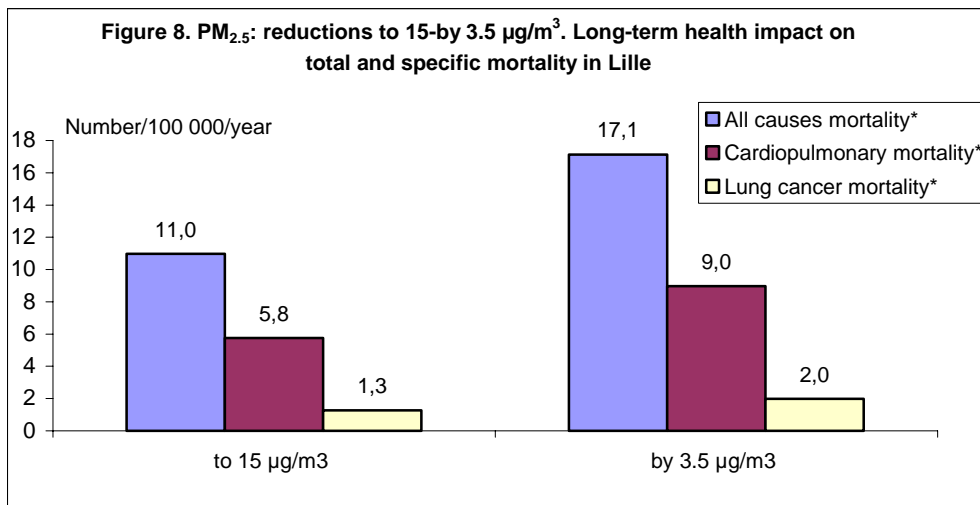
* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519), PM₁₀ data for 2001, hospital admissions data for 2001

PM_{2.5} findings

1. Number of attributed cases

We also used two scenarios to estimate the chronic effects of long-term exposure to PM_{2.5} on all causes, cardiopulmonary and lung cancer deaths expressed as per 100 000 inhabitants over one year (figure 8).

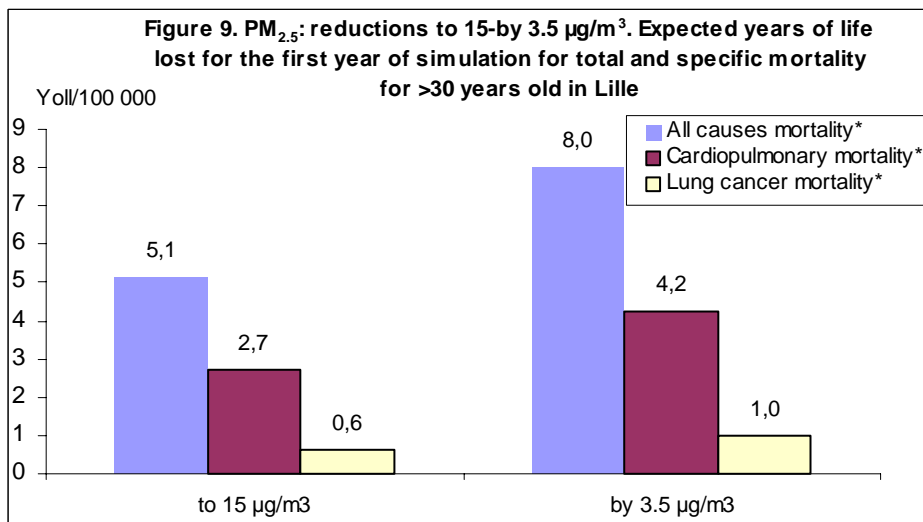
The attributable benefit of reducing current daily PM_{2.5} levels by 3.5 µg/m³ in Lille is a decrease of all causes deaths, cardiopulmonary and lung cancer deaths by 17.1, 9.0 and 2.0 per 1000 000 inhabitants per year, respectively. A daily reduction of PM_{2.5} above 15 µg/m³ to 15 µg/m³ would result in a less important benefit in terms of avoided deaths : 11, 5.8 and 1.3 per 1000 000 inhabitants per year, respectively for the three types of mortality.



* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162) for 1999, PM_{2.5} data for 2001.

2. Years of life lost

We estimated the years of life lost (YoLL) attributable to the chronic effects of PM_{2.5} in terms of non specific, cardiopulmonary and lung cancer deaths for 30 years of age or older in the population of Lille (figure 9).



* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162) for 1999, PM_{2.5} data for 2001.

In Lille for over 30 old people, reducing the annual PM_{2.5} average pollution level by 3.5 µg/m³, starting in 2001, could theoretically avoid about 8 years of life lost for 2001, per 100 000 inhabitants. For cardiopulmonary mortality, this number would be around 4 of expected life for starting of simulation /100 000 inhabitants and for lung cancer mortality around 1 Yoll /100 000 inhabitants.

In comparison, a reduction of the annual PM_{2.5} mean pollution level above 15µg/m³ to 15 µg/m³ would result in less important health impact.

We analysed these findings in terms of life expectancy (table 5).

Table 5. Life expectancy and its possible increase by reduction of air pollution by 3.5 µg/m³ in Lille

Age	Life expectancy	Expected gain in life expectancy		
		Mean	Low estimate	High estimate
At birth	76.72	0.22	0.06	0.38
30	47.61	0.22	0.06	0.39
65	17.53	0.16	0.04	0.27

In terms of life expectancy, all other things being equal, if annual mean PM_{2.5} levels (17.23 µg/m³) would be reduced by 3.5 µg/m³, the 47.6 years of life expectancy in a person of 30 years old would be increased by 0.22 years [0.06-0.39], or 2.6 months [0.7-4.7] due to reduced risk of death from all causes in the city of Lille.

Comments

Since 2000, the Lille-Metropole air quality network put into service two PM_{2.5} analysers. This new data allowed us to have a best knowledge on the impact of particulate matter on public health in Lille.

The annual mean level for BS and PM₁₀ are similar between 1999 (APHEIS 2) and 2001 (APHEIS 3), however, the number of days above 50 µg/m³ increase from 2 to 12 for the PM₁₀ between those two years.

Nevertheless, our HIA shows that the potential benefits of reducing daily pollution levels on acute health effects (mortality and hospital admission) are important with a reduction by 5 µg/m³ in the levels of PM₁₀ and BS. This HIA confirms the importance for the acute health effects of short-term exposure to reduce the whole pollution levels even in cities, like Lille metropole, with low levels of air pollution. In the same way, if long-term exposure to outdoor concentrations of PM_{2.5} or PM₁₀ were reduced respectively by 3.5 µg/m³ or 5 µg/m³, the deaths that could be prevented annually were between 49 and 328 for PM_{2.5} and 106 and 246 for the PM₁₀.

We also observed a cumulative health effects of PM₁₀ up to 40 days on all causes mortality and respiratory mortality more important than health effects on 0-1 days.

This new HIA allowed us to estimate, for the first time in Lille metropole, the health effects of air pollution in terms of life expectancy. In 2001, a reduction by 3.5 µg/m³ in the levels of PM_{2.5} would be associated with an average 2.6 months increase life expectancy in a person of 30 years old.

The Nord-Pas-de-Calais PRQA (regional plan on air quality) was approved in April 2001. He recommended to conduct some studies to locally assess the health impact of pollution. In the region, 8 metropolitan areas (included Lille) of more than 100 000 inhabitants, covered by the new regional air quality network (ATMO Nord-Pas-de-Calais) are concerned. At the present time, this HIA is finished in one area and being realised in two others.

A collaborative project is in progress to model the health benefits of the Lille's PDU.

Appendix

A. Questionnaires on the exposure measurement methods and health data

Harmonised compilation of information indicating the exposure relevant area of the city, number of PM₁₀, PM_{2.5} or BS monitoring sites, and the type, sampling and measurement characteristics of stations selected for the HIA of APHEIS

1. City: _____ LILLE _____
2. Total area of agglomeration (km²): _____ 612 _____
3. Area (km²) covered by the air monitoring network in the city: _____ 612 _____
4. Number of population in this (exposure relevant) area: 1 091 496 (1999)
1 096 992 (2001)
5. Total number of PM₁₀ monitoring stations in this area: _____ 7 _____
6. Total number of BS monitoring stations in this area: _____ 3 _____
7. **Total number of PM_{2.5} monitoring stations in this area:** _____
8. Number of selected PM₁₀ monitoring stations for HIA: _____ 6 _____
9. Number of selected BS monitoring stations for HIA: _____ 2 _____
10. **Number of selected PM_{2.5} monitoring stations for HIA:** _____ 2 _____
11. Measurement interval (please cross)
Continuous (PM₁₀) ~~hourly~~— 24 hours (BS) ~~weekly~~— ~~2 weekly~~—
12. Quality assurance and control (please cross)
yes ~~no~~— ~~do not know~~
13. Data quality (please cross)
validated data ~~invalidated data~~—

14. Name, classification and sampling characteristics of the monitoring site (traffic, kerbside, building line, commercial, urban residential, sub-urban, rural, industrial, others)

<u>Name</u>	<u>PM₁₀/BS/PM_{2.5}</u>	<u>Classification</u>
<u>CROIX</u>	<u>BS</u>	<u>Urban residential</u>
<u>WATTRELOS</u>	<u>BS</u>	<u>Urban residential</u>
<u>MARCQ-EN-BAROEUL</u>	<u>PM₁₀</u>	<u>Urban residential</u>
<u>LILLE-RIVES</u>	<u>PM₁₀</u>	<u>Urban residential</u>
<u>TOURCOING</u>	<u>PM₁₀</u>	<u>Urban residential</u>
<u>LOMME</u>	<u>PM₁₀ and PM_{2.5}</u>	<u>Urban residential</u>
<u>VILLENEUVE D'ASCQ</u>	<u>PM₁₀</u>	<u>Urban residential</u>
<u>FAIDHERBE</u>	<u>PM₁₀ and PM_{2.5}</u>	<u>Proximity traffic</u>

15. Measurement method / Type of instrument

BS: Reflectometry

PM₁₀ manual: _____
 automated: TEOM
 probe temperature (in °C): 50°C
 optical: _____

PM_{2.5} manual: _____
 automated: TEOM
 probe temperature (in °C): 50°C
 optical: _____

16. Using PM₁₀ data for your city HIA calculation, did you used a conversion factor in order to compensate losses of volatile particulate matter?

YES ✓

yes if yes, a) which factor: Summer 1.185 Winter : 1.271

b) is it a default factor? **yes** — **no** ✓

or c) derived from own parallel measurements

Bibliographic ref Métrologie des particules JL Houdret and all ; Ecole des mines de Douai France Dec. 2002

(reference method vs. TEOM or beta attenuation) yes no

17. If your PM_{2.5} data have been calculated from your PM₁₀ data, what conversion

factor did you use?

=>We have direct PM_{2.5} measurements in 2 stations in Lille (Lomme and Faidherbe)

B. Tables

1. Tables for black smoke findings

Tables 1,2,3 present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for cardiac and respiratory hospital admissions.

Table 1. Deaths all causes (ICD9 < 800). (1999) Potential benefits of reducing daily BS levels (2001) above 20 to 20 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of BS

Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	Attributable cases per year					
		N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	14	0.54	0.36	0.81	0.05	0.03	0.07
By 5 $\mu\text{g}/\text{m}^3$	NA*	24.97	16.65	37.42	2.28	1.52	3.42

*NA: not applicable

Table 2. Cardiovascular deaths (ICD9 390-459)(1999) . Potential benefits of reducing daily BS levels (2001) above 20 to 20 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effect of BS

Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	Attributable cases per year					
		N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	14	0.11	0.06	0.20	0.01	0.01	0.02
By 5 $\mu\text{g}/\text{m}^3$	NA*	5.23	2.62	9.15	0.48	0.24	0.84

*NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (1999) Potential benefits of reducing daily BS levels (2001) above 20 to 20 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of BS

Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	Attributable cases per year					
		N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	14	0.05	0	0.13	0	0	0.01
By 5 $\mu\text{g}/\text{m}^3$	NA*	2.33	0	5.82	0.21	0	0.53

*NA: not applicable

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions(2001) . Potential benefits of reducing daily BS levels (2001) above 20 to 20 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number (95% confidence limits) attributable to the acute effects of BS

Attributable cases per year				
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths
		central	lower	upper
Hospital admissions for cardiac diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	14	1.28	0.58	2.10
By 5 $\mu\text{g}/\text{m}^3$	NA*	59.10	26.90	96.54
Hospital admissions for respiratory diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	14	0.38	0	0.94
By 5 $\mu\text{g}/\text{m}^3$	NA*	17.61	0	43.97

*NA: not applicable

1. Tables for PM₁₀ findings

3.1. Health effects of PM₁₀ on 0-1 days

Tables 1, 2, 3, present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for cardiac and respiratory hospital admissions.

Table 1. Deaths all causes (ICD9 < 800)(1999). Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	158	22.11	14.72	29.53	2.03	1.35	2.71
50 $\mu\text{g}/\text{m}^3$	12	2.51	1.67	3.36	0.23	0.15	0.31
By 5 $\mu\text{g}/\text{m}^3$	NA*	24.80	16.54	33.05	2.27	1.52	3.03

*NA: not applicable

Table 2. Cardiovascular deaths (ICD9 390-459) (1999) . Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 µg/m ³	158	10.44	5.78	15.12	0.96	0.53	1.39
50 µg/m ³	12	1.20	0.66	1.74	0.11	0.06	0.16
By 5 µg/m ³	NA*	11.61	6.46	16.76	1.06	0.59	1.54

*NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (1999) . Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 µg/m ³	158	4.50	1.72	7.32	0.41	0.16	0.67
50 µg/m ³	12	0.52	0.20	0.86	0.05	0.02	0.08
By 5 µg/m ³	NA*	4.96	1.91	7.99	0.45	0.17	0.73

*NA: not applicable

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions(2001) . Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number (95% confidence limits) attributable to the acute effects of PM₁₀

Scenarios	Attributable cases per year			
	Number of days per year exceeding 20 and 50 µg/m ³	N° of deaths central	N° of deaths lower	N° of deaths upper
Hospital admissions for cardiac diseases (all ages)				
20 µg/m ³	158	28.66	14.29	43.09
50 µg/m ³	12	3.25	1.62	4.90
By 5 µg/m ³	NA*	32.13	16.08	48.16
Hospital admissions for respiratory diseases (all ages)				
20 µg/m ³	158	59.35	32.14	87.32
50 µg/m ³	12	6.88	3.71	10.16
By 5 µg/m ³	NA*	65.64	35.75	96.03

*NA: not applicable

3.2. Cumulative health effects of PM₁₀ up to 40 days

Tables 5, 6, 7 present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. Cumulative health effects of PM₁₀ up to 40 days and all causes of deaths (ICD 9 < 800) (1999) Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 µg/m ³	158	45.42	29.88	60.91	4.16	2.74	5.58
50 µg/m ³	12	5.28	3.46	7.10	0.48	0.32	0.65
By 5 µg/m ³	NA*	50.12	33.12	66.92	4.59	3.03	6.13

*NA: not applicable

Table 6. Cumulative health effects of PM₁₀ up to 40 days and cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths			N° of deaths per 100 000		
		central	lower	upper	central	lower	upper
20 µg/m ³	158	15.77	11.08	20.53	1.45	1.02	1.88
50 µg/m ³	12	1.88	1.32	2.46	0.17	0.12	0.23
By 5 µg/m ³	NA*	17.08	12.07	22.09	1.56	1.11	2.02

*NA: not applicable

Table 7. Cumulative health effects of PM₁₀ up to 40 days and respiratory deaths (ICD9 460-519) (1999) . Potential benefits of reducing daily PM₁₀ levels (2001) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths			N° of deaths per 100 000		
		central	lower	upper	central	lower	upper
20 µg/m ³	158	14.87	3.75	26.99	1.36	0.34	2.47
50 µg/m ³	12	1.93	0.48	3.58	0.18	0.04	0.33
By 5 µg/m ³	NA*	15.21	3.97	26.62	1.39	0.36	2.44

*NA: not applicable

3.4. Long term HIA for PM₁₀

Table 9 presents the attributable number of all causes of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 9. Deaths all causes (ICD9 < 800) (1999). Potential benefits of reducing annual mean values of PM₁₀ (2001) to levels of 20 and 40 µg/m³, and by 5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM₁₀

	Attributable cases per year					
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
20 µg/m ³	212.29	128.77	300.13	19.45	11.80	27.50
40 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 5 µg/m ³	174.11	105.71	245.93	15.95	9.69	22.53

4. Tables for PM_{2.5} findings

4.1. LT PM_{2.5}: Attributable Cases

Tables 1, 2, 3 present the attributable number of all causes, cardiopulmonary and lung cancer deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. Deaths all causes (ICD9 0-999) (1999) Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

	Attributable cases per year					
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	119.75	31.25	209.33	10.97	2.86	19.18
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3.5 µg/m ³	186.99	48.66	327.80	17.13	4.46	30.03

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (1999) Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

Attributable cases per year						
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	62.83	22.63	103.64	5.76	2.07	9.50
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3.5 µg/m ³	97.93	35.15	162.13	8.97	3.22	14.85

Table 3. Lung cancer deaths (ICD9 162) (1999) Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

Attributable cases per year						
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	13.95	4.72	23.37	1.28	0.43	2.14
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3.5 µg/m ³	21.69	7.30	36.53	1.99	0.67	3.35

4.2.LT PM_{2.5}: Years of Life Lost

Tables 1,2,3 present the years of life lost of all causes, cardiopulmonary and lung cancer deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. Deaths all causes >30 years, male and female, for one year (ICD9 0-999) (1999). Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

	Years of life lost					
	YoLL	YoLL	YoLL	YoLL	YoLL	YoLL
	central	lower	upper	per 100 000	per 100 000	per 100 000
15 µg/m ³	56.06	14.78	96.96	5.11	1.35	8.85
By 3.5 µg/m ³	87.67	23.17	151.24	8.00	2.11	13.8

Table 2. Cardiopulmonary deaths >30 years, male and female, for one year (ICD9 401-440 and 460-519) (1999). Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

	Years of life lost					
	YoLL	YoLL	YoLL	YoLL	YoLL	YoLL
	central	lower	upper	per 100 000	per 100 000	per 100 000
15 µg/m ³	29.73	10.83	48.39	2.71	0.99	4.42
By 3.5 µg/m ³	46.41	16.97	75.29	4.23	1.55	6.87

Table 3. Lung cancer deaths >30 years, male and female, for one year (ICD9 162)(1999). Potential benefits of reducing annual mean values of PM_{2.5} (2001) to levels of 15 and 20 µg/m³, and by 3.5 µg/m³. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

	Years of life lost					
	YoLL	YoLL	YoLL	YoLL	YoLL	YoLL
	central	lower	upper	per 100 000	per 100 000	per 100 000
15 µg/m ³	6.85	2.36	11.25	0.62	0.22	1.03
By 3.5 µg/m ³	10.66	3.69	17.44	0.97	0.34	1.59

