SEVILLE CITY REPORT

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Summary of the main findings

In 2000, daily mean levels (SD) of PM_{10} in Seville were 44.38 (11.88) µg/m^3. This value is very similar to the daily mean levels (SD) for the year before, 44.36 (10.72) µg/m^3. There was an increasing trend in daily mean levels of PM_{10} during the years before 1999 (38.57 µg/m^3 in 1996, 40.37 µg/m^3 in 1997 and 44.23 µg/m^3 in 1998). However, PM_{10} data for 2001 and 2002 show a slightly decreasing trend, with daily mean levels of PM_{10} around 39 µg/m^3.

Although annual mean of PM_{10} for 2000 was near the EC limit value for 2005 (40 µg/m^3), there were 110 days with 24-hour levels above the EC limit value for 2005 (50 µg/m^3).

The analysis estimated that reduction of the long-term PM pollution to the levels of $PM_{2.5}$ of 15 µg/m^3 would reduce mortality in Seville by 675 deaths in one year, which would save 45.19 years of expected life for starting year of simulation. If the daily means of PM_{10} would be kept under 20 µg/m^3, 82 deaths and 178 hospital admissions could have been avoided in the year 2000.

Transportation is the main source of air pollution but projects to increase public transportation (i.e. underground) are being currently implemented.

Background

In the previous HIA of Seville it was noted that PM_{10} levels in the city were above the limits set by the European Union for 2005 and 2010.

The previous HIA for the long term showed that over 494 attributable mortality cases could be avoided if annual mean levels of PM_{10} were reduced to 20 µg/m^3. This number represents 78.7 cases per 100 000 inhabitants, of which almost 11 cases are related to short-term mortality.

For this third HIA, we used exposure and mortality data for 2000 and hospital admissions data for 1999, since data for 2000 were incomplete. In the year 2000, the municipality of Seville had 700,715 people, 13.87% older than 65 years. It is 141 km^2 in size and is situated to the south-west of the Iberian Peninsula, about 80 km from the Atlantic ocean, and at 49 meters above sea.

Seville is the political and administrative centre and capital of Andalusia. For this reason, the city and its metropolitan area have an important radial system of communication infrastructures. The services sector represents almost 70% of the total economic activity in the city, followed by the construction sector. Industry is much less important in the city, being only 5% of the total economic activity.

Sources

Principal sources of air pollution were described in detail in the previous Apheis city report last year (www.apheis.org). This is an update of the main sources of air pollution:

Table 1. Main sources of air pollution

Source (year)	Road (%)	Heating (%)	Industry (%)	Other sources (specify)
2000	67.4	10.0	15.3	7.4

Transportation constitutes the main source of air pollution in Seville and its metropolitan area: 87.3% of CO, 48.3% of CO_2 and 67.4% of NOx emissions came from traffic sources.

Specific meteorological conditions like Saharian dust intrusions may have a punctual influence on maximum PM_{10} levels but not on annual mean. This source of air pollution represents less than 2% of PM_{10} annual mean.

In the year 2000, high ozone levels were the cause of all the negative environmental assessments. The reason for ozone peaks is the special weather conditions in the summer: strong sun radiation, calm wind situation, and transportation emissions, which lead to ozone levels above the maximum allowed concentrations.

Exposure data

The Surveillance System for Air Pollution has been gradually implemented in the city. It is run by the Regional Environment Department of the Andalusian Regional Government. The air quality control system of stations does not cover the whole municipality, but presents an acceptable distribution, covering the urban area of the city, where more than 80% of the population resides.

In the year 2000, Seville had 10 air pollution monitoring stations. The six stations used for this HIA are the same used for the previous, and all of them are background stations: Macarena, Torneo, Príncipes, Reina Mercedes, Enramadilla and Ranilla.

Automated method (beta-radiation attenuation, UNE-EN 12341-1999) was used for PM_{10} measurements. In order to compensate losses of volatile particulate matter, a local conversion factor of 1.13 was used.

$PM_{2.5}$ data have been calculated from PM_{10} data, using the APHEIS conversion factor of 0.7.

For 2000,

- Daily mean levels (SD) of PM_{10} were 44.38 (11.88) µg/m^3.
- Daily mean levels (SD) of $PM_{2.5}$ were 31.07 (8.32) µg/m^3.

- The levels of PM_{10} reached during the 36 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 27 µg/m^3 and 65.3 µg/m^3.

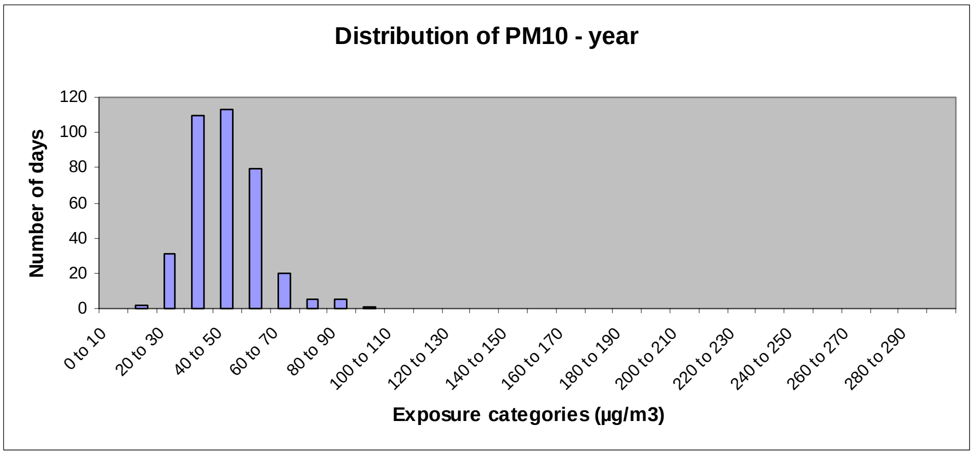
- The levels of $PM_{2.5}$ reached during the 36 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 18.8 µg/m^3 and 45.7 µg/m^3.

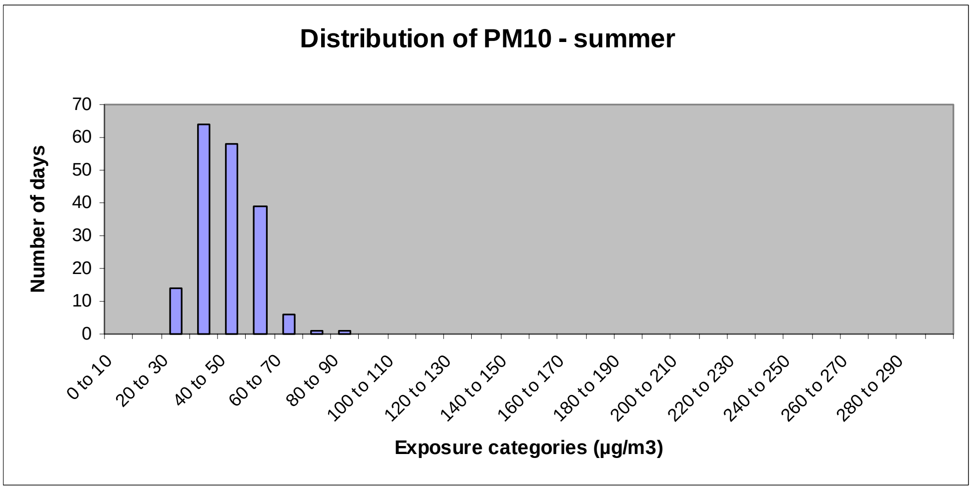
- Number of days above scenario levels were:

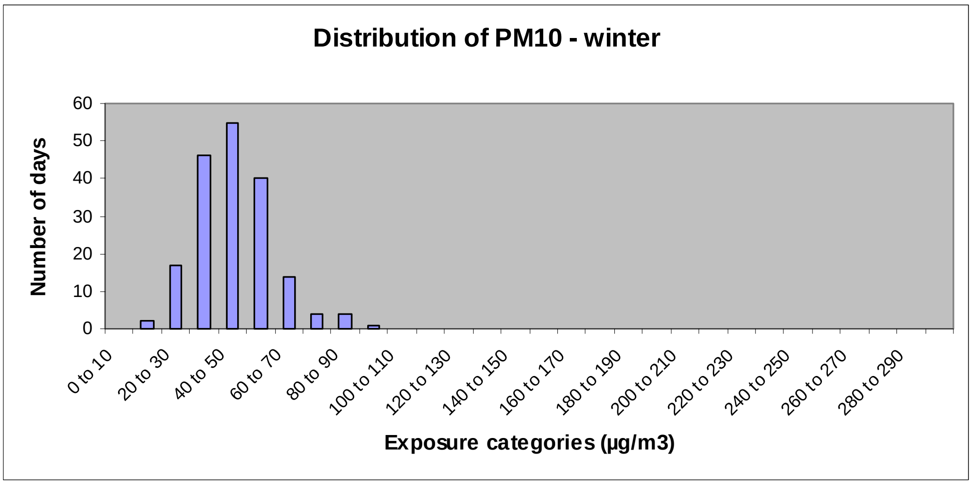
Table 2. Number of days when air pollutants exceeded limit levels

	Short term	
Air pollutant	**PM_{10}**	**$PM_{2.5}$**
Number of days above	20 µg/m^3	14 µg/m^3
	364	364
Number of days above	50 µg/m^3	35 µg/m^3
	110	110

The distribution of PM_{10} for year, for summer and for winter was:

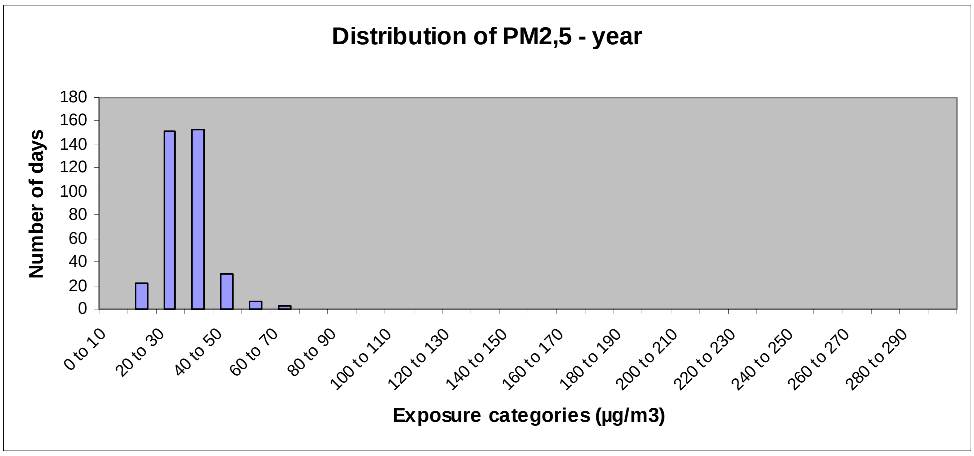


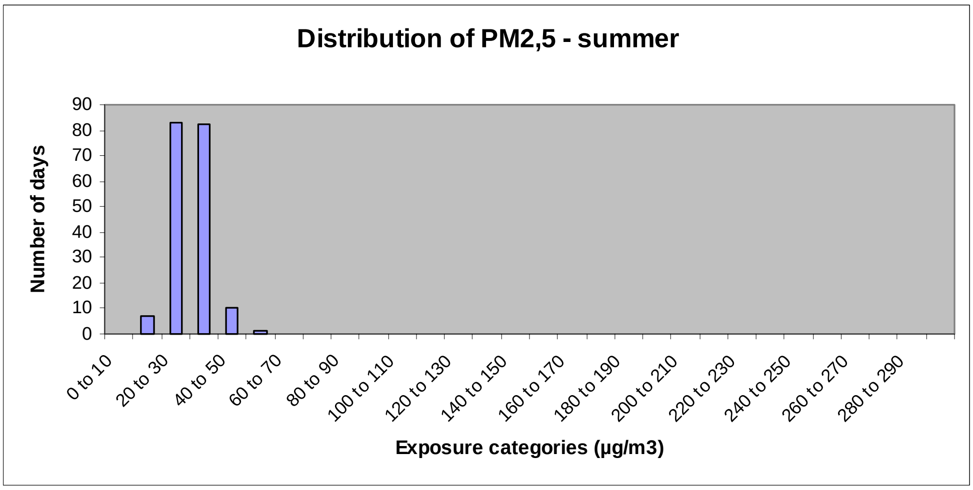


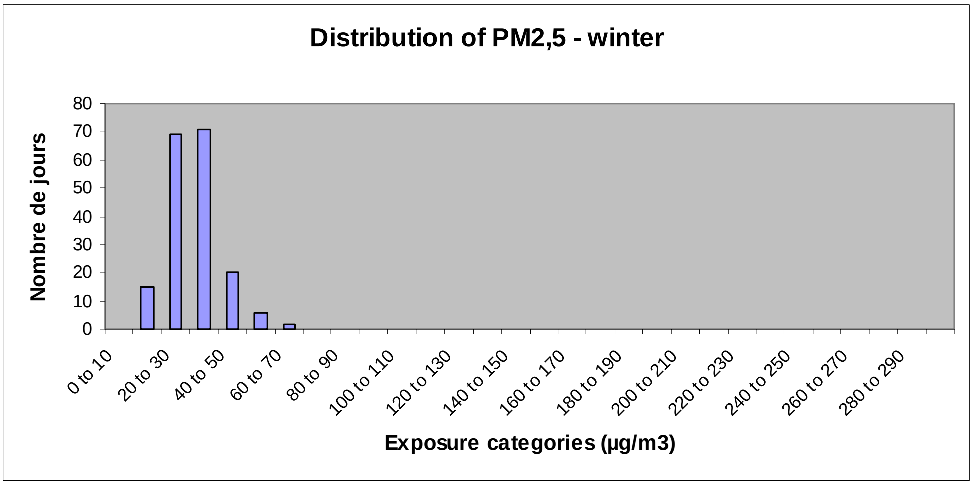


The main exposure category of PM_{10} in winter was 40 to 50 μg/m^3, while in summer was 30 to 40 μg/m^3. Highest levels of PM_{10} (>80 μg/m^3) were reached in winter.

The distribution of $PM_{2.5}$ for year, for summer and for winter is:



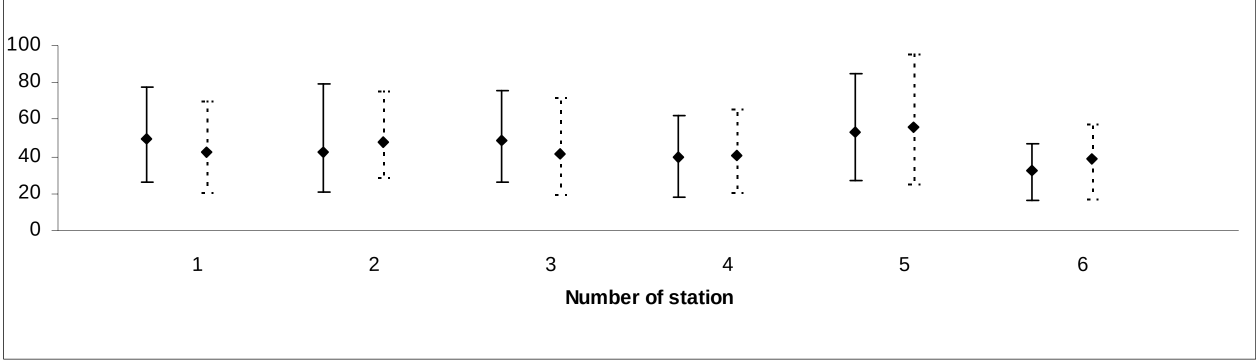




The main exposure category of $PM_{2.5}$ in summer was 20 to 30 µg/m^3, while in winter was 30 to 40 µg/m^3. Highest levels (>60 µg/m^3) were reached in winter.

Figure 1 shows comparative annual mean levels and percentiles of the distribution of PM_{10} by station in Apheis 2 (1999) and Apheis 3 (2000).

Figure 1. Annual mean levels and 5th and 95th percentiles of the distribution of PM_{10} by station in Apheis 2 and 3.



Annual mean levels were similar between the two years for each station, with a slight increase from 1999 to 2000 in stations 2 (Macarena), 5 (Ranilla) and 6 (Torneo), a slight decrease in stations 1 (Enramadilla) and 3 (Príncipes), and similar annual mean levels in station 4 (Reina Mercedes).

Health data

Mortality data for 2000 comes from the Regional Registry of Mortality, coded according to the International Classification of Diseases (ICD10). Hospital admissions data for 1999 on respiratory and cardiovascular causes come from the Andalusian Health Services Information Service, also coded using the International Classification of Diseases (ICD10).

The age-standardised mortality rate for Seville for 2000, using the European population as a reference, was 700 per 100 000 inhabitants.

Table 3. Daily mean number and annual rate per 100 000 of deaths (2000) and hospital admissions (1999)

Health outcome	ICD9	ICD10	Daily mean number (SD)	Number of cases per 100 000
Short term HIA				
All causes mortality (excluding external causes)*	< 800	A00-R99	15.43 (4.64)	805.75
Cardiovascular mortality	390-459	I00-I99	6.69 (2.75)	349.36
Respiratory mortality	460-519	J00-J99	1.52 (1.54)	79.49
Cardiac hospital admissions	390-429	I00-I52	13.54 (4.85)	704.08
Respiratory hospital admissions	460-519	J00-J99	10.6 (6.81)	551.20
Long term HIA				
All causes mortality	0-999	A00-Y98	16.18 (4.63)	844.99
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	7.92 (3.27)	413.58
Lung cancer mortality	162	C33-C34	0.84 (0.87)	43.96

* For short and long term scenarios

Health impact assessment

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In the city of Seville, these scenarios were built for two indicators of this particulate pollution: PM_{10} 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			
	All ages, all causes mortality (excluding external causes)	< 800	A00-R99		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	French PSAS-9	Le Tertre et al. 2002: 1.006 (1.003 - 1.009)
PM10	All ages, respiratory hospital admissions	460-519	J00-J99	Excel spreadsheet	Apheis 3: 1.0114 (1.0062 - 1.0167)
	All ages, all causes mortality (excluding external causes)	< 800	A00-R99		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	French PSAS-9	Le Tertre etal. 2002:1.011 (1.004 - 1.019)
BS	All ages, respiratory hospital admissions	460-519	J00-J99	Excel spreadsheet	Apheis 3: 1.0030 (0.9985 -1.0075)
	All ages, all causes mortality (excluding external causes)	< 800	A00-R99		Zanobetti et al. 2002: 1.01227 (1.0081 - 1.0164)
PM10 Distributed lag	All ages, cardiovascular mortality	390-459	I00-I99	French PSAS-9	Zanobetti et al. 2003: 1.01969 (1.0139 - 1.0255)
(40 days)	All ages, respiratory mortality	460-519	J00-J99	Excel spreadsheet	Zanobetti et al. 2003: 1.04206 (1.0109 - 1.0742)
		Complementary ST HIA for some cities reports			
PM10 with shrunken stimates	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/m^3 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 PM_{10}, 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 PM_{10} on mortality and hospital admissions over one year:

- **Short-term HIA of PM_{10} on 0-1 days and cumulative HIA of PM_{10} up to 40 days**

We used three scenarios to estimate the acute health effects of PM_{10} on 0-1 days and cumulative health effects of PM_{10} up to 40 days on all causes (excluding external causes), cardiovascular and respiratory mortality over one year:

- reduction of PM_{10} levels to a 24-hour value of 50 µg/m^3 on all days exceeding this value (2005 and 2010 limit values for PM_{10})
- reduction of PM_{10} levels to a 24-hour value of 20 µg/m^3 on all days exceeding this value (to allow for cities with low levels of PM_{10})
- reduction by 5 µg/m^3 of all the 24-hour values (to allow for cities with low levels of PM_{10})

Long-term scenarios

Long-term HIA scenarios for PM_{10}

We used three scenarios to estimate the chronic effects of long-term exposure to PM_{10} on all causes mortality (excluding external causes) over one year:

- reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10})

Long term HIA for $PM_{2.5}$

We estimated chronic effects of $PM_{2.5}$ in the Seville city 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 three pollution scenarios were considered:
- reduction of the annual mean value of $PM_{2.5}$ to a level of 20 µg/m^3

- reduction of the annual mean value of $PM_{2.5}$ to a level of 15 µg/m^3
- reduction by 3.5 µg/m^3 in the annual mean value of $PM_{2.5}$ (to allow for cities with low levels of $PM_{2.5}$)

PM_{10} findings

1. Short-term HIA of PM_{10} on 0-1 days and cumulative HIA of PM_{10} up to 40 days, and long term HIA of PM_{10}

1.1. Mortality findings

The following graphs show the health impact of PM_{10} on 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).

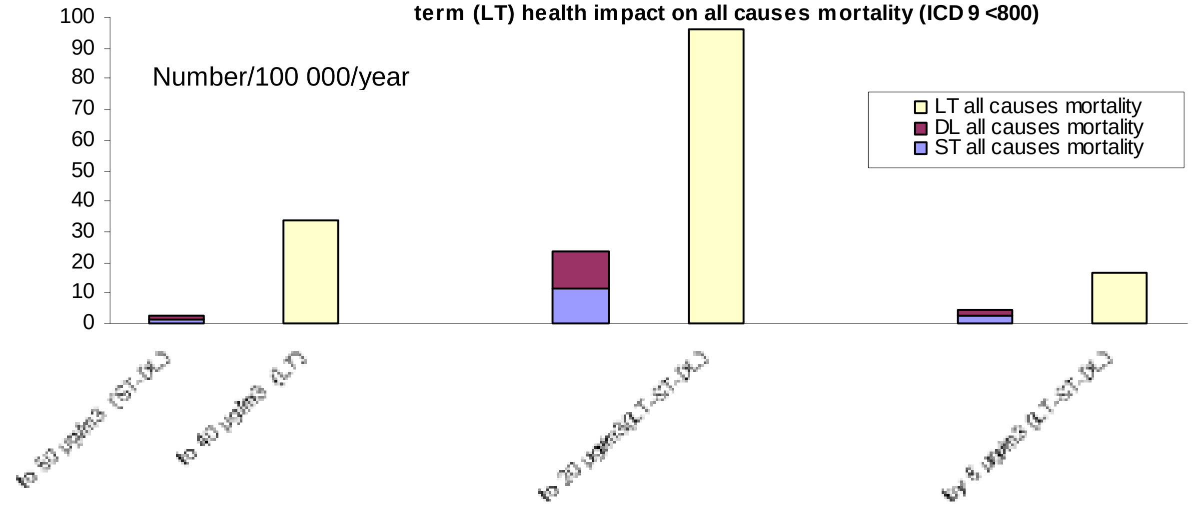


Figure 4. PM10: reductions to 50/40-20-by 5 µg/m³. Short term (ST), cumulative (DL), long term (LT) health impact on all causes mortality (ICD 9 <800)

* PM10 data for 2000, mortality data for 2000

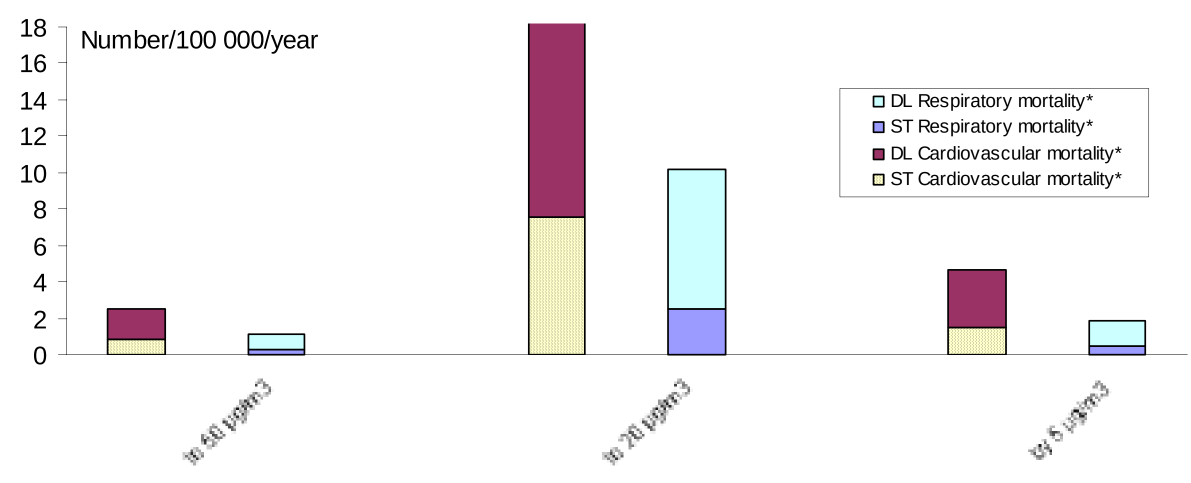


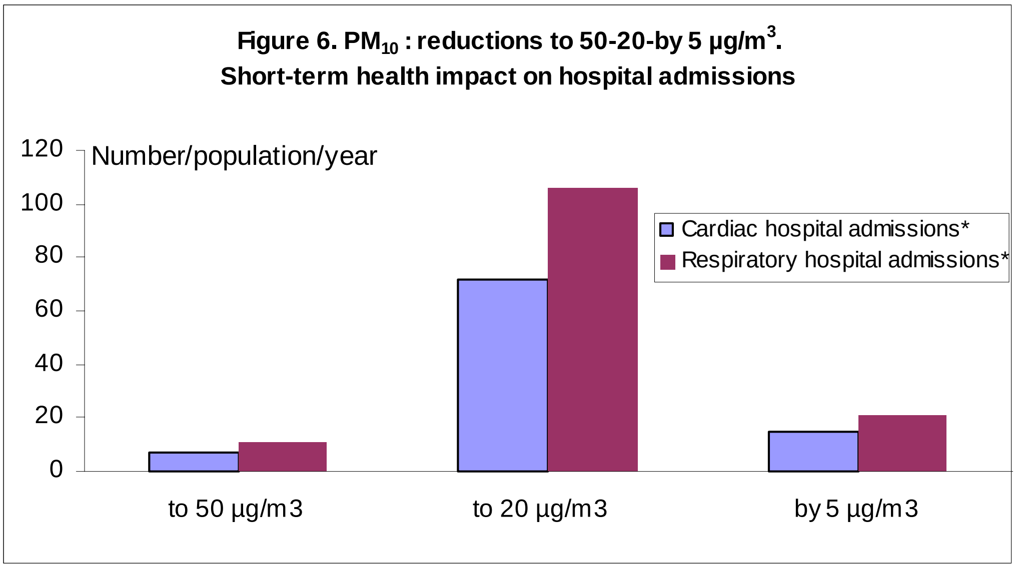
Figure 5. PM_{10}: reductions to 50-20-by 5 µg/m^3. Short term (ST), cumulative (DL) health impact on specific mortality

*Cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519).
** PM10 data for 2000, mortality data for 2000

The differences between short-term (ST) and cumulative (DL) estimates indicate that the effects of air pollution on mortality remain for several weeks and not only for two days. For total mortality, the number of attributable cases estimated up to 40 days lag (DL) was two times the number estimated for 0-1 day lag (ST). For cardiovascular and respiratory mortality, the cumulative effects was even more than twice that found using only two days of follow up.

1.2. Hospital admissions findings

We estimated the acute effects of short-term exposure to PM_{10} on cardiac and respiratory hospital admissions over one year.



* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519)
** PM10 data for 2000, hospital admissions data for 1999

According to these results, if daily PM_{10} levels were reduced to 50 µg/m^3 on all days exceeding this value (110 days in 2000), with other risks staying the same, about 7 and 11 hospital admissions for cardiac and respiratory diseases respectively could be avoided. These potential benefits would be much higher if PM_{10} levels were reduced to 20 µg/m^3 (72 and 106 hospital admissions for cardiac and respiratory diseases, respectively).

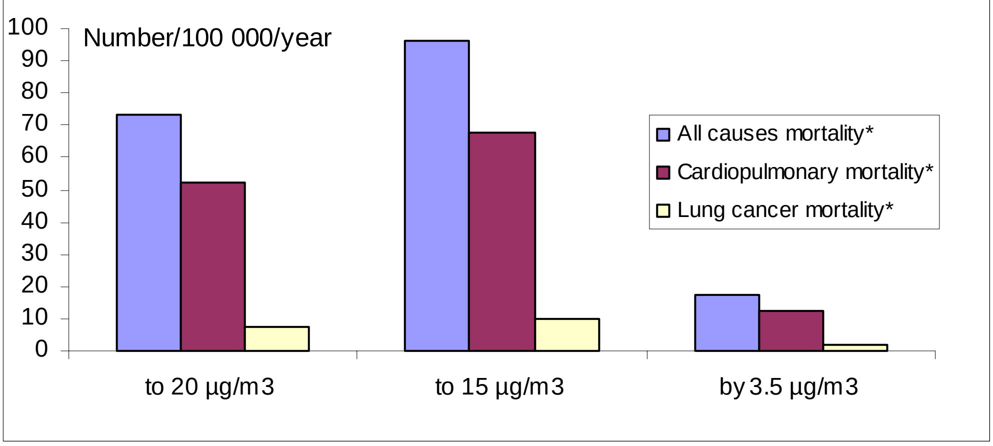
$PM_{2.5}$ findings

1. Number of attributed cases

We also used three scenarios to estimate the chronic effects of long-term exposure to $PM_{2.5}$ on mortality over one year.

The following graph presents the attributable number of all causes, cardiopulmonary and lung cancer deaths expressed as per 100 000 inhabitants.

Figure 7. $PM_{2.5}$: reductions to 20-15-by 3.5 µg/m^3. Long-term health impact on total and specific mortality



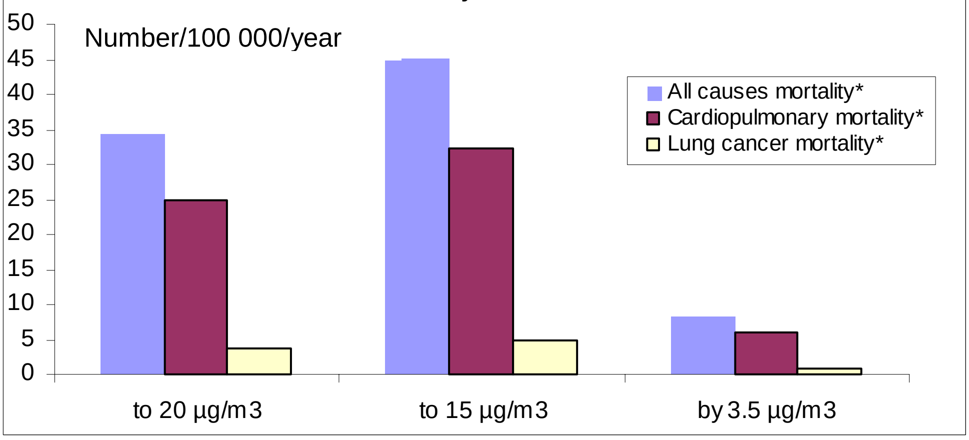
* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162).
** PM2.5 data for 2000, mortality data for 2000

The long-term health impact of $PM_{2.5}$ on total mortality indicates that 73 deaths per 100 000 inhabitants could be avoided if $PM_{2.5}$ annual mean was reduced to 20 µg/m^3, and this number would be higher (96 deaths) with a reduction to 15 µg/m^3. Lastly, the attributable benefit of reducing current annual mean $PM_{2.5}$ level by 3.5 µg/m^3 is a decrease in the number of long-term deaths by 18 per 100 000 inhabitants and year.

2. Years of life lost

We estimated the years of life lost attributable to the chronic effects of $PM_{2.5}$ using the data for 2000.
Figure 8 presents the years of life lost for all causes, cardiopulmonary and lung cancer deaths for 30 years of age or older in the population of Seville.

Figure 8. $PM_{2.5}$: reductions to 20-15-by 3.5 µg/m^3. Expected years of life lost for the first year of simulation for total and specific mortality for >30 years old



* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162).
** PM2.5 data for 2000, mortality data for 2000

For all causes of deaths, all other things being equal, reduction of $PM_{2.5}$ by 3.5 µg/m^3 in 2000 would save almost 9 years of expected life for starting year of simulation in people older than 30 years in the city of Seville. For cardiopulmonary mortality, this number would be around 6 and for lung cancer mortality, around 1 year.

The following table presents the findings in terms of life expectancy.

Table 5. Life expectancy and its possible increase by reduction of air pollution to 15 µg/m^3 in Seville

		Expected gain in life expectancy		
Age	Life expectancy	Mean	Low estimate	High estimate
At birth	77.66	1.17	0.31	2.04
30	48.47	1.19	0.31	2.06
65	17.16	0.89	0.23	1.56

In terms of life expectancy, all other things being equal, if annual mean $PM_{2.5}$ levels (35 µg/m^3) would be reduced to 15 µg/m^3, the 48 years of life expectancy in a person of 30 years old would be increased by 1.19 years, due to reduced risk of death from all causes in the city of Seville. In a person of 65 years old, the 17 years of life expectancy would be increased by 0.89 years.

Interpretation of findings

According to HIA results for short-term, if current levels of PM_{10} were reduced, and all days with levels above 50 µg/m^3 were reduced to 50 µg/m^3, with other risks staying the same, about 8 total deaths, 5 cardiovascular deaths, 2 respiratory deaths, 11 hospital admissions for respiratory diseases and 7 hospital admissions for cardiac diseases, would be avoided annually. In the same way, if daily levels of $PM_{2.5}$ were reduced by 3,5 µg/m^3, about 17 total deaths (of which 11 cases are cardiovascular deaths and 3 are respiratory deaths), 21 hospital admissions for respiratory diseases and 15 hospital admissions for cardiac diseases, would be avoided annually as well.

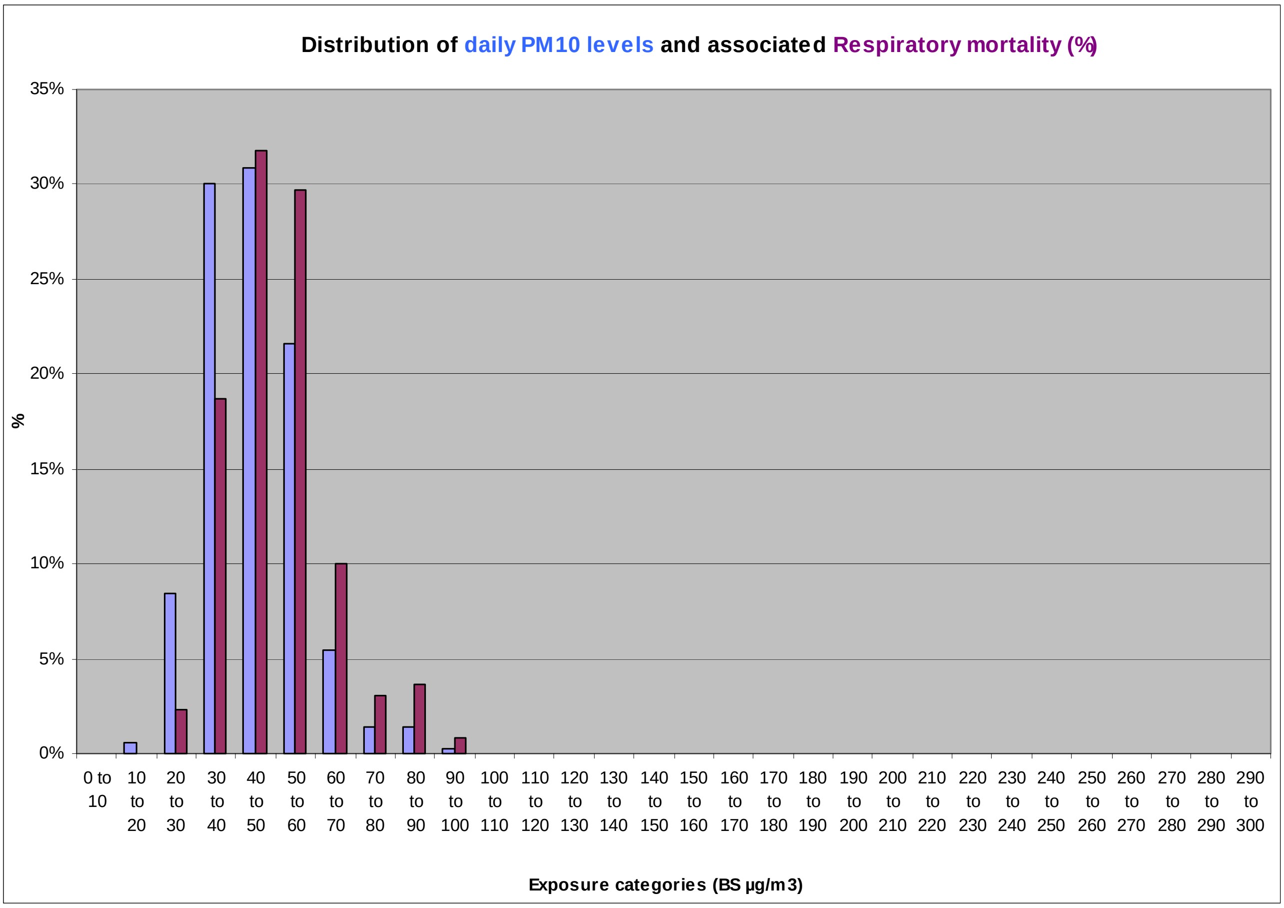
The expected benefits for reduced mortality in the long-term if, according to the European directive for 2010, annual mean levels of PM_{10} are reduced to 20 µg/m^3, are still greater. Over 673 attributable mortality cases could be avoided, which represents 96.1 cases per 100 000 inhabitants. In the same way, if annual mean levels of $PM_{2.5}$ are reduced to 15 µg/m^3, 675 mortality cases (of which 476 cases are cardiopulmonary deaths and 69 are lung cancer deaths) could be avoided.

Most studies of air pollution and daily mortality have related pollution levels to death in the day or two immediately following exposure. However, it is possible to miss some of the attributable deaths when limiting the study to one or two days after the exposure. The differences found between lags 0-1 and up to 40 days for PM_{10} show that the cumulative effect of air pollution on mortality is more than twice that found using only two days of follow up.

With regard to the years of life lost attributable to the chronic effects of $PM_{2.5}$, according to HIA results, a reduction of $PM_{2.5}$ levels by 3.5 µg/m^3 in 2000 would save 58 years of expected life for starting year of simulation in people older than 30 years in the city of Seville. In other words, the 48 years of life expectancy in a person of 30 years old living in Seville would be increased by 1.19 years, due to reduced risk of death from all causes.

Finally, the following figure shows the relative impact of PM_{10} peaks during a few days compared to daily exposure to lower levels of PM_{10} over long periods:

Short term distribution of PM_{10} levels and associated percentage of cases



Only 5% of the associated health impact is attributable to PM_{10} levels higher than 80 µg/m^3. However, more than 30% of the health impacts are attributable to PM_{10} levels between 40 and 50 µg/m^3. In conclusion, the relative impact of long periods levels around the PM_{10} annual mean are much higher than the relative impact of air pollution peaks.

General comments

Seville has persistently (compared to other cities) PM_{10} high values, which may be interpreted as that PM_{10} concentrations are relatively constant over the year. Taking into account that Seville and its metropolitan area add up to around 1,000,000 inhabitants and that it does not exist important contaminating industries around, it is clear that traffic is the main source of air pollution in the city. Although a new motorway was built around the city and it helped to redistribute traffic in the city, the main problem is the lack of the necessary public transportation system. Seville is the only large city in Spain with no underground: public transportation consist only in buses and taxis. Currently, the underground railway is under construction and this improvement of the public transportation system is expected to make PM_{10} levels decrease in the next years. In any case, it is absolutely necessary to inform population in order to obtain behaviour modifications in transportation or way of life.

Appendix

1. **Questionnaire for Seville on the exposure measurement methods**

Harmonised compilation of information indicating the exposure relevant area of Seville, number of PM_{10} monitoring sites, and the type, sampling and measurement characteristics of stations selected for the HIA of APHEIS

1.	City:	Seville
2.	Total area of agglomeration (km²):	141
3.	Area (km²) covered by the air monitoring network in the city:	90
4.	Number of population in this (exposure relevant) area:	550000
5.	Total number of PM_{10} monitoring stations in this area:	10
6.	Total number of BS monitoring stations in this area:	0
7.	Total number of $PM_{2.5}$ monitoring stations in this area:	0
8.	Number of selected PM_{10} monitoring stations for HIA:	6
9.	Number of selected BS monitoring stations for HIA:	0
10.	Number of selected $PM_{2.5}$ monitoring stations for HIA:	0

11. Measurement interval (please cross)

continuous x   hourly   24 hours   weekly   2 weekly

12. Quality assurance and control (please cross)

yes x no do not know

13. Data quality (please cross)

validated data x invalidated data

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

Name	PM_{10}/BS/ $PM_{2.5}$	Classification
Ranilla	PM_{10}	residential
Reina Mercedes	PM_{10}	residential
Príncipes	PM_{10}	others
Enramadilla	PM_{10}	residential
Macarena	PM_{10}	residential
Torneo	PM_{10}	residential

15. Measurement method / Type of instrument

BS: NO

PM_{10} manual: NO
automated: beta-radiation atenuation (UNE-EN 12341-1999) YES
probe temperature (in °C): unknown
optical: NO

PM2.5 manual: NO
automated: NO
probe temperature (in °C):
optical: NO

16. Using PM_{10} data for your city HIA calculation, did you used a conversion factor in order to compensate losses of volatile particulate matter?

no

yes x if yes, a) which factor: 1.13

b) is it a default factor? yes no x

or c) derived from own parallel measurements (reference method vs. TEOM or beta attenuation) yes x no

17. If your PM2.5 data have been calculated from your PM_{10} data, what conversion factor did you use? factor: 0.7

2. Tables for PM_{10} findings

2.1. Health effects of PM_{10} 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) (2000). Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m^3	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	364	81.93	54.51	109.45	11.69	7.78	15.62
50 µg/m^3	110	8.28	5.51	11.05	1.18	0.79	1.58
By 5 µg/m^3	NA*	16.52	11.02	22.02	2.36	1.57	3.14

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459) (2000). Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m^3	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	364	53.06	29.36	76.95	7.57	4.19	10.98

50 µg/m³	110	5.40	2.99	7.81	0.77	0.43	1.11
By 5 µg/m³	NA*	10.61	5.90	15.31	1.51	0.84	2.18

NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (2000). Potential benefits of reducing daily PM_{10} levels (2000) 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 PM_{10}

		Attributable cases per year					
Scenarios	**Number of days per year exceeding 20 and 50 µg/m³**	**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/m³	364	17.31	6.61	28.20	2.47	0.94	4.02
50 µg/m³	110	1.78	0.68	2.88	0.25	0.10	0.41
By 5 µg/m³	NA*	3.43	1.32	5.52	0.49	0.19	0.79

NA: not applicable

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (1999). Potential benefits of reducing daily PM_{10} levels (2000) 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 PM_{10}

		Attributable cases per year		
Scenarios	**Number of days per year exceeding 20 and 50 µg/m³**	**N° of deaths central**	**N° of deaths lower**	**N° of deaths upper**
Hospital admissions for cardiac diseases (all ages)				
20 µg/m³	364	71.89	35.84	108.16
50 µg/m³	110	7.26	3.63	10.91
By 5 µg/m³	NA*	14.50	7.25	21.73
Hospital admissions for respiratory diseases (all ages)				
20 µg/m³	364	106.12	57.41	156.30
50 µg/m³	110	10.86	5.89	15.95
By 5 µg/m³	NA*	21.09	11.48	30.85

NA: not applicable

2.2. Cumulative health effects of PM_{10} 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 PM_{10} up to 40 days and all causes of deaths (ICD 9 < 800) (2000).Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	**Number of days per year exceeding 20 and 50 µg/m^3**	**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	364	166.07	109.17	222.89	23.70	15.58	31.81
50 µg/m^3	110	17.03	11.22	22.80	2.43	1.60	3.25
By 5 µg/m^3	NA*	32.92	21.76	43.96	4.70	3.11	6.27

**NA: not applicable*

Table 6. Cumulative health effects of PM_{10} up to 40 days and cardiovascular deaths (ICD9 390-459) .2000). Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	**Number of days per year exceeding 20 and 50 µg/m^3**	**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	364	114.36	80.26	148.98	16.32	11.45	21.26
50 µg/m^3	110	11.94	8.41	15.49	1.70	1.20	2.21
By 5 µg/m^3	NA*	22.22	15.71	28.73	3.17	2.24	4.10

**NA: not applicable*

Table 7. Cumulative health effects of PM_{10} up to 40 days and respiratory deaths (ICD9 460-519) (2000). Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

	Attributable cases per year

Scenarios	Number of days per year exceeding 20 and 50 µg/m^3	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	364	53.85	13.52	98.16	7.69	1.93	14.01
50 µg/m^3	110	5.92	1.51	10.58	0.84	0.22	1.51
By 5 µg/m^3	NA*	9.84	2.57	17.23	1.40	0.37	2.46

**NA: not applicable*

2.3. **Long term HIA for PM_{10}**

Table 8 presents the attributable number of all causes of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 8. Deaths all causes (ICD9 < 800) (2000). Potential benefits of reducing annual mean values of PM_{10} (2000) to levels of 20 and 40 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}

	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	673.21	400.22	972.19	96.07	57.12	138.74
40 µg/m^3	236.24	142.82	335.17	33.71	20.38	47.83
By 5 µg/m^3	117.64	71.43	166.16	16.79	10.19	23.71

3. **Tables for $PM_{2.5}$ findings**

3.1. LT PM2.5: Attributable Cases

Tables 9, 10 and 11 present the attributable number of all causes, cardiopulmonary and lung cancer deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 9. Deaths all causes (ICD9 0-999) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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 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
15 µg/m^3	674.57	169.09	1228.49	96.27	24.13	175.32
20 µg/m^3	514.35	130.40	925.85	73.40	18.61	132.13
By 3,5 µg/m^3	123.38	32.10	216.28	17.61	4.58	30.87

Table 10. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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 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
15 µg/m^3	476.34	162.89	828.68	67.98	23.25	118.26
20 µg/m^3	365.74	126.93	626.64	52.20	18.11	89.43
By 3,5 µg/m^3	89.19	32.01	147.66	12.73	4.57	21.07

Table 11. Lung cancer deaths (ICD9 162) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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 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
15 µg/m^3	69.14	21.65	125.37	9.87	3.09	17.89
20 µg/m^3	53.56	17.14	94.91	7.64	2.45	13.54
By 3,5 µg/m^3	13.34	4.49	22.46	1.90	0.64	3.21

3.2. LT PM2.5: Years of Life Lost

Tables 12, 13 and 14 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 12. Deaths all causes >30 years, male and female, for one year (ICD9 0-999) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) 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 central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m³	318.00	86.93	530.63	45.19	12.35	75.41
20 µg/m³	241.82	65.44	407.55	34.36	9.30	57.92
By 3,5 µg/m³	58.26	15.40	100.50	8.28	2.19	14.28

Table 13. Cardiopulmonary deaths >30 years, male and female, for one year (ICD9 401-440 and 460-519) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) 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 central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m³	227.21	86.78	353.17	32.29	12.33	50.19
20 µg/m³	173.96	65.57	273.87	24.72	9.32	38.92
By 3,5 µg/m³	42.58	15.57	69.09	6.05	2.21	9.82

Table 14. Lung cancer deaths >30 years, male and female, for one year (ICD9 162) (2000). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2000) 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 central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m³	34.03	12.59	52.18	4.84	1.79	7.42
20 µg/m³	26.30	9.54	41.09	3.74	1.36	5.84
By 3,5 µg/m³	6.58	2.28	10.76	0.94	0.32	1.53