LONDON CITY REPORT

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UK

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Background

London lies within a roughly circular basin covering an area of approximately 1,600 Km^2. It lies at a latitude of 52 degrees north and enjoys a temperate maritime climate. The most recent data available for this study are from 2001, both for health data (mortality and hospital admission statistics) and air pollution data sources, including measures of fine particles ($PM_{2.5}$).

Sources

Principal sources of air pollution were described in detail in the previous APHEIS city report (www.apheis.org). The most recent source data available for PM_{10} for London are from year 2001. However these are unavailable for the city of London as a whole because of large spatial variations.

Exposure data

There is an extensive network of air pollution monitoring sites though out London and the UK. The pollutants monitored vary from monitoring station to monitoring station. The location of a station, in relation to its immediate surroundings, is classified as urban background, roadside, suburban etc. A single central site, classified as urban background and monitoring PM_{10} and $PM_{2.5}$ has been used for this study (London Bloomsbury). Three Black Smoke (BS) monitoring sites have been used (London City, Ilford and Enfield). Data availability and completeness as well as station classification are all factors in the choice of monitoring stations. All pollution data are for year 2001.

Daily mean (SE) levels of PM_{10}, $PM_{2.5}$ and BS were 22 (8), 13 (6) and 9 (6) $\mu g/m^3$ respectively. The 5^{th} and 95^{th} percentile values of their respective distributions were: PM_{10}: 13 and 38; $PM_{2.5}$: 7 and 24; BS 3 and 21 $\mu g/m^3$. The numbers of days on which the air pollution levels exceeded guidelines are given in table 1.

Table 1 Number of days when air pollutants exceed limit levels

	Short-term		
Air Pollutant	**PM_{10}**	**BS**	**$PM_{2.5}$**
Number of days above:	20 $\mu g/m^3$	20 $\mu g/m^3$	14 $\mu g/m^3$
	185	21	96
Number of days above:	50 $\mu g/m^3$	50 $\mu g/m^3$	35 $\mu g/m^3$
	5	0	2

Figures 1-3 show the distributions of the 3 pollutants.

Figure 1 Distribution of PM_{10}

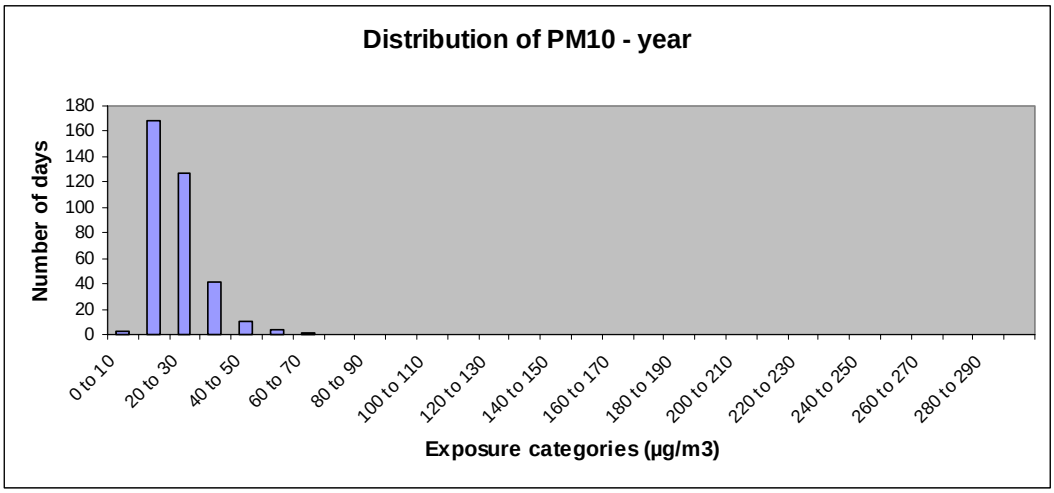


Figure 2 Distribution of BS

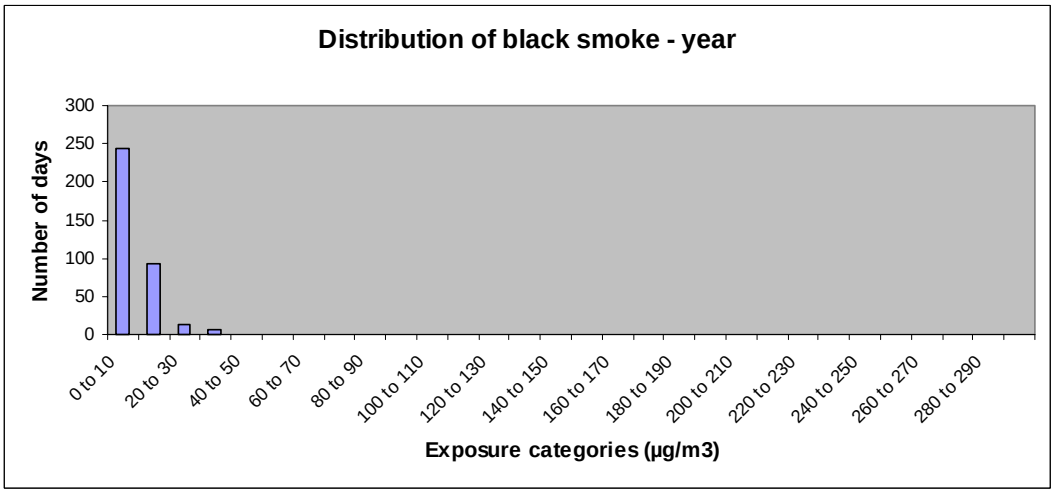
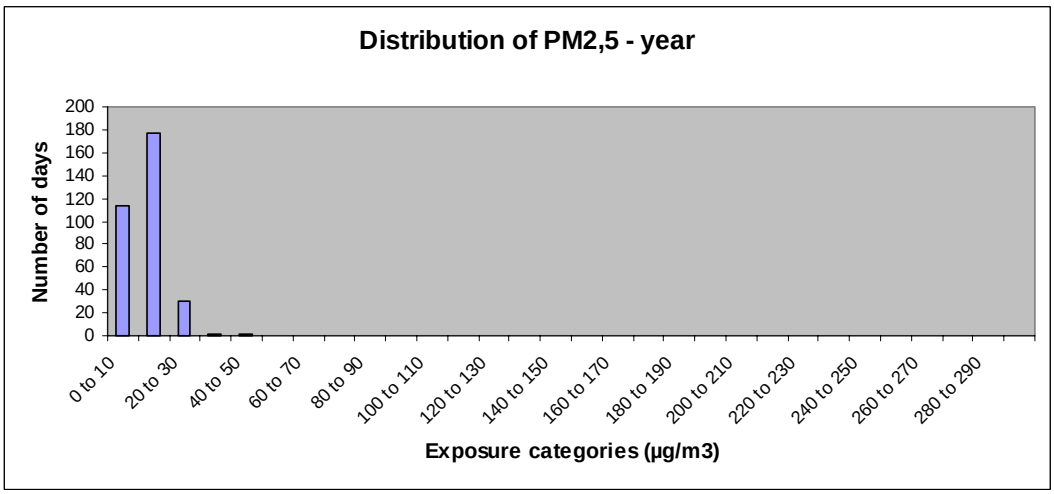


Figure 3 Distribution of $PM_{2.5}$



Health data

The Office for National Statistics and Department of Health provide information on mortality and hospital admissions in England and Wales. These data contain anonymous records giving cause of death or admission by ICD10 code together with age, location of residence and treatment. The age-standardised mortality rate (per 100 000 inhabitants) for London (both sexes combined) was 701 for year 2001.[1] Table 2 summarises the ICD code categories used together with mean number of events per day and the number of cases per 100,000 in the population.

Table 2. Daily mean number and annual rate per 100 000 of deaths and hospital admissions

Health outcome	ICD9	ICD10	Daily mean number (SD)	Number of cases per 100 000
Short term HIA scenarios				
All causes mortality (excluding external causes)*	< 800	A00-Q99	144.1	2.09
Cardiovascular mortality	390-459	I00-I99	57.9	0.84
Respiratory mortality	460-519	J00-J99	22.1	0.32
Cardiac mortality	390-429	I00-I52	37.7	0.55
Cardiac hospital admissions	390-429	I00-I52	100.2	1.45
Respiratory hospital admissions	460-519	J00-J99	133.9	1.94
Long term HIA scenarios				
Total mortality	0-999	A00-T98	147.8	2.14
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	74.6	1.08
Lung cancer mortality	162	C33-C34	8.6	0.12

* For short and long term scenarios

Health impact assessment

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In London, these scenarios were built for BS, PM_{10} and $PM_{2.5}$. The estimated health impacts of these indicators may overlap, and caution is recommended in the interpretation of findings. The health impact estimates for these pollutants should not be added since they can represent similar types of pollution and similar sources.

Different tools and different estimates were used to evaluate the short- and long-term impacts of this particulate pollution on health. (Table 3).

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

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) All ages, cardiovascular mortality All ages, respiratory mortality All ages, cardiac hospital admissions All ages, respiratory hospital admissions	< 800 390-459 460-519 390-429 460-519	A00-R99 I00-I99 J00-J99 I00-I52 J00-J99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.008) WHO, 2003: 1.009 (1.005 - 1.013) WHO, 2003: 1.013 (1.005 - 1.021) Le Tertre et al. 2002: 1.006 (1.003 - 1.009) Apheis 3: 1.0114 (1.0062 - 1.0167)
BS	All ages, all causes mortality (excluding external causes) All ages, cardiovascular mortality All ages, respiratory mortality All ages, cardiac hospital admissions All ages, respiratory hospital admissions	< 800 390-459 460-519 390-429 460-519	A00-R99 I00-I99 J00-J99 I00-I52 J00-J99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.009) WHO, 2003: 1.004 (1.002 - 1.007) WHO, 2003: 1.006 (0.998 - 1.015) Le Tertre etal. 2002:1.011 (1.004 - 1.019) Apheis 3: 1.0030 (0.9985 -1.0075)
PM10 Distributed lag (40 days)	All ages, all causes mortality (excluding external causes) All ages, cardiovascular mortality All ages, respiratory mortality	< 800 390-459 460-519	A00-R99 I00-I99 J00-J99	French PSAS-9 Excel spreadsheet	Zanobetti et al. 2002: 1.01227 (1.0081 - 1.0164) Zanobetti et al. 2003: 1.01969 (1.0139 - 1.0255) 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 of the pollutants in both the short- and long-term scenarios. Short-term health effects of BS and PM_{10} are expressed in terms of number of attributed deaths per year. Long-term health effects for PM_{10} and $PM_{2.5}$ are also expressed in terms of number of attributed deaths per year. In addition for $PM_{2.5}$, long-term findings are expressed as the number of expected years of life lost due the deaths in one year

Short-term exposure

We used the following air pollution reduction scenarios to estimate the acute effects of short-term exposure to BS/ PM_{10} on mortality and hospital admissions over one year:

Short-term HIA scenarios for BS

We used three 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 50 µg/m^3 on all days exceeding this value
- reduction of BS levels to a 24-hour value of 20 µg/m^3 on all days exceeding this value
- reduction by 5 µg/m^3 of all the 24-hour values of BS.

Short-term HIA scenarios for PM_{10}

- **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})

- **Combined local and meta-analytic estimates for short-term HIA of PM_{10}**

We used the same scenarios than above and combined local and meta-analytic estimates to calculate the acute health effects of PM_{10} on all causes of death (excluding external causes) over one year. This sensitivity analysis was done to study the interest of including the weight of local estimates in the combined (meta-analytic) estimate.

Long-term exposure

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 $\mu g/m^3$ (2005 limit values for PM_{10})
- reduction of the annual mean value of PM_{10} to a level of 20 $\mu g/m^3$ (2010 limit values for PM_{10})
- reduction by 5 $\mu g/m^3$ 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 London 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 $\mu g/m^3$ [2]
- reduction of the annual mean value of $PM_{2.5}$ to a level of 15 $\mu g/m^3$ [2]
- reduction by 3.5 $\mu g/m^3$ in the annual mean value of $PM_{2.5}$ (to allow for cities with low levels of $PM_{2.5}$)

We also estimated the years of life lost attributable to the chronic effects of $PM_{2.5}$ using the data for 2001.

Results for BS

Figure 4 shows the expected reductions in the number of deaths (per 100 000/year) attributable to all-cause (excluding external causes), cardiovascular and respiratory diseases associated with a decrease in annual BS levels to 20 $\mu g/m^3$, and for a decrease of 5 $\mu g/m^3$. The number of days above the level of 50 $\mu g/m^3$ was 0. Figure 5 gives the results (no of attributable admissions per year in London) for hospital admissions for cardiac and respiratory causes under the same pollution reduction scenarios.

Data for all figures are contained in the Appendix

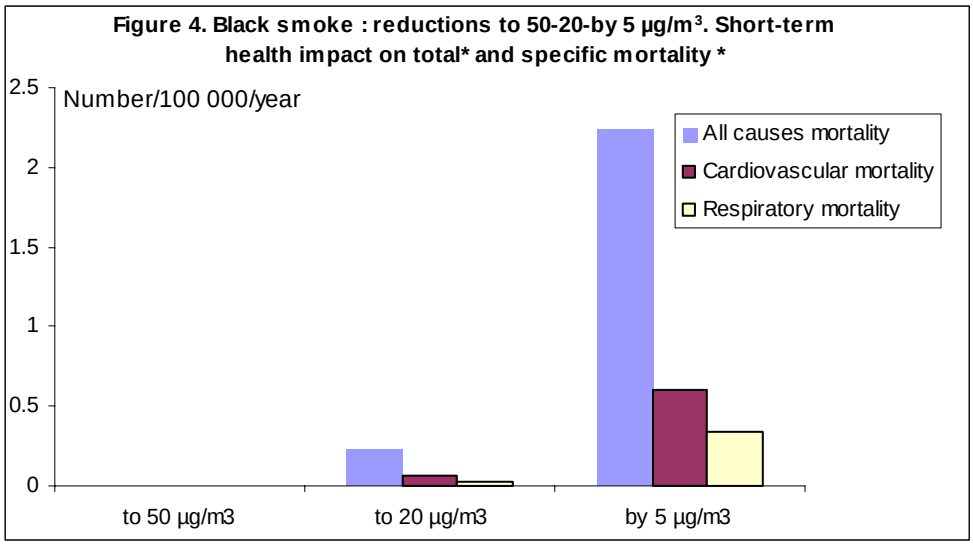
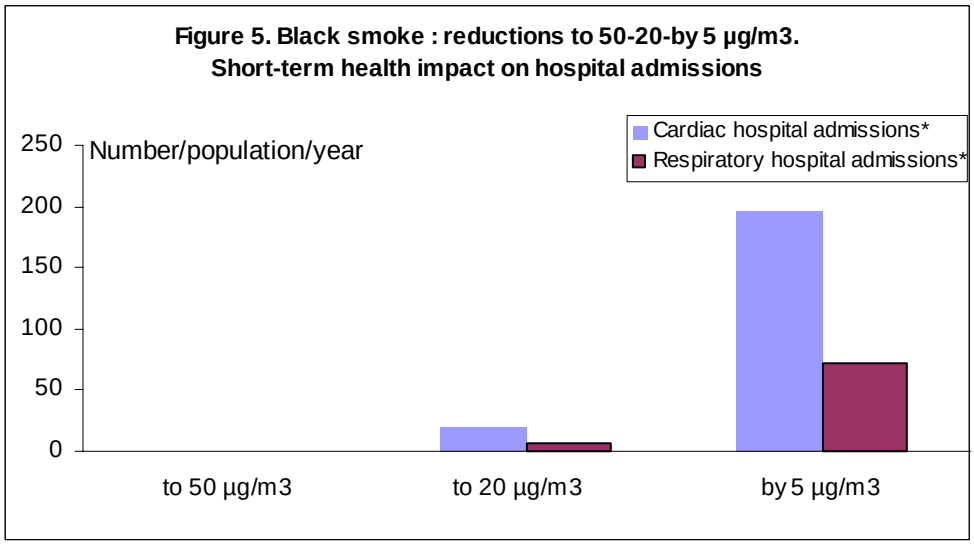


Figure 4. Black smoke : reductions to 50-20-by 5 µg/m³. Short-term health impact on total* and specific mortality *
Number/100 000/year
2.5
2
1.5
1
0.5
0
All causes mortality
Cardiovascular mortality
Respiratory mortality
to 50 µg/m3
to 20 µg/m3
by 5 µg/m3

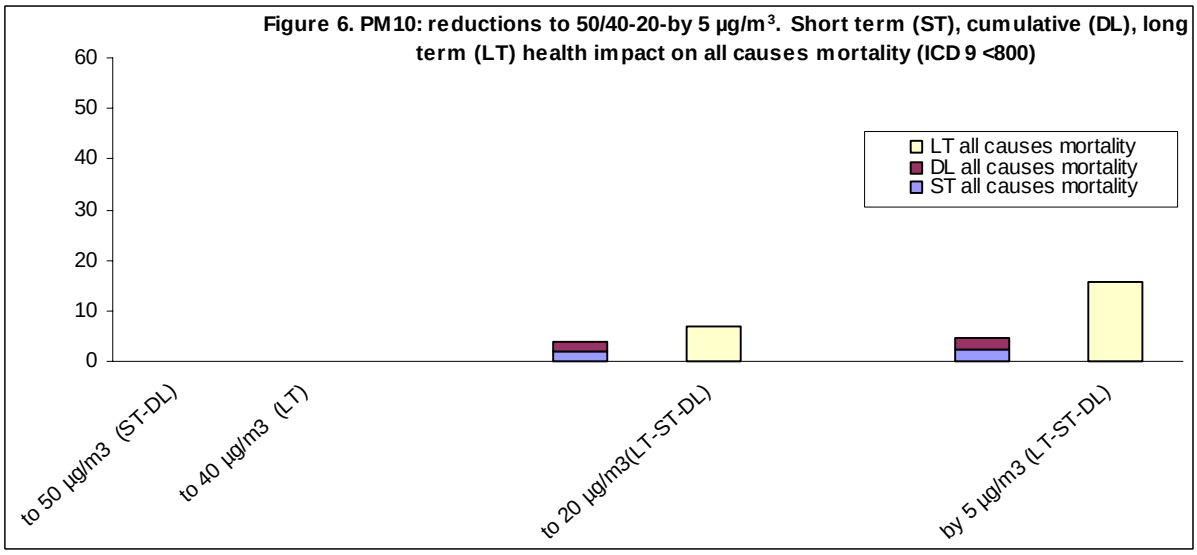
Figure 5. Short-term HIA of BS on 0-1 days for cardiac and respiratory hospital admissions



Results for PM_{10}

Figure 6 shows the expected reductions in the number of deaths attributable to all-cause (excluding external causes) associated with a decrease in annual PM_{10} levels to 20 µg/m^3, 40 µg/m^3 and for a decrease of 5 µg/m^3. The number of days above the level of 50 µg/m^3 was 0. These estimates are calculated for the short-term effect of PM_{10} on lag 0 and lag 1, for cumulative exposure up to 40 days and for the long-term health impact. Figure 7 illustrates the findings for cause-specific mortality.

Data for all figures are contained in the Appendix



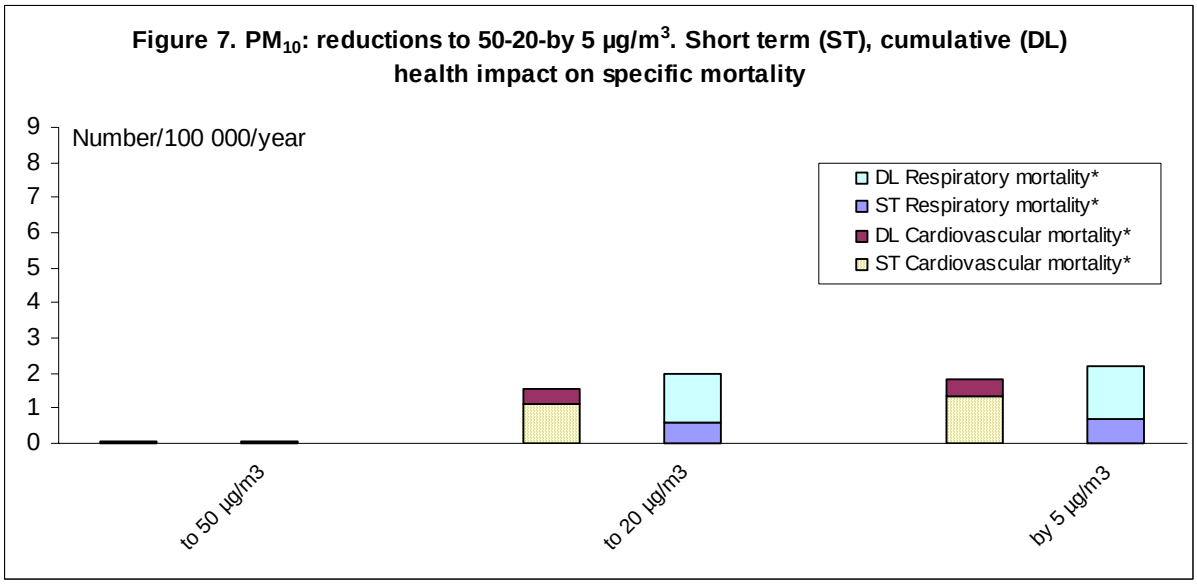


Figure 8 shows the expected reductions in the number of hospital admissions attributable to cardiac and respiratory diseases associated with a decrease in annual PM_{10} levels to 20 µg/m^3 and for a decrease of 5 µg/m^3. The number of days above 50 µg/m^3 was 0. These estimates are calculated for the short-term effect of PM_{10} on lag 0 and lag 1.

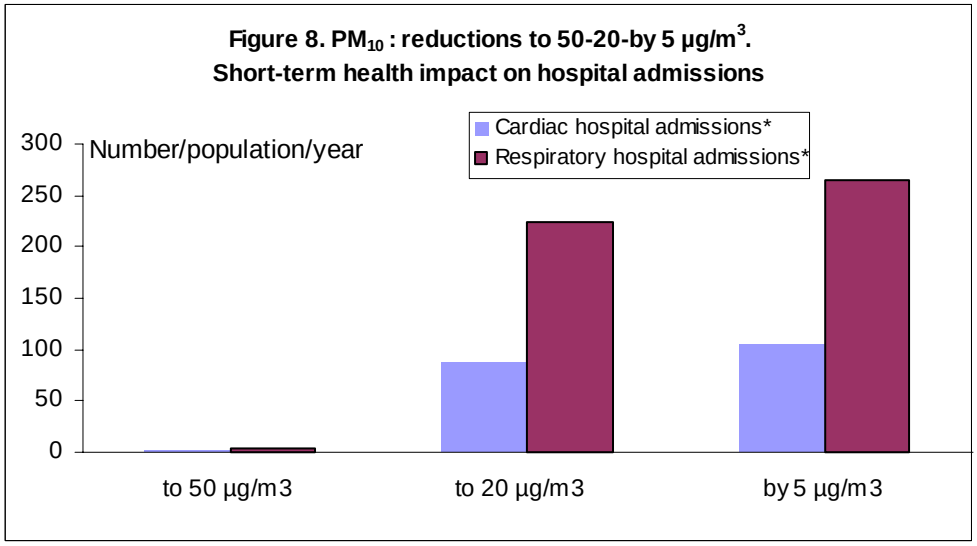
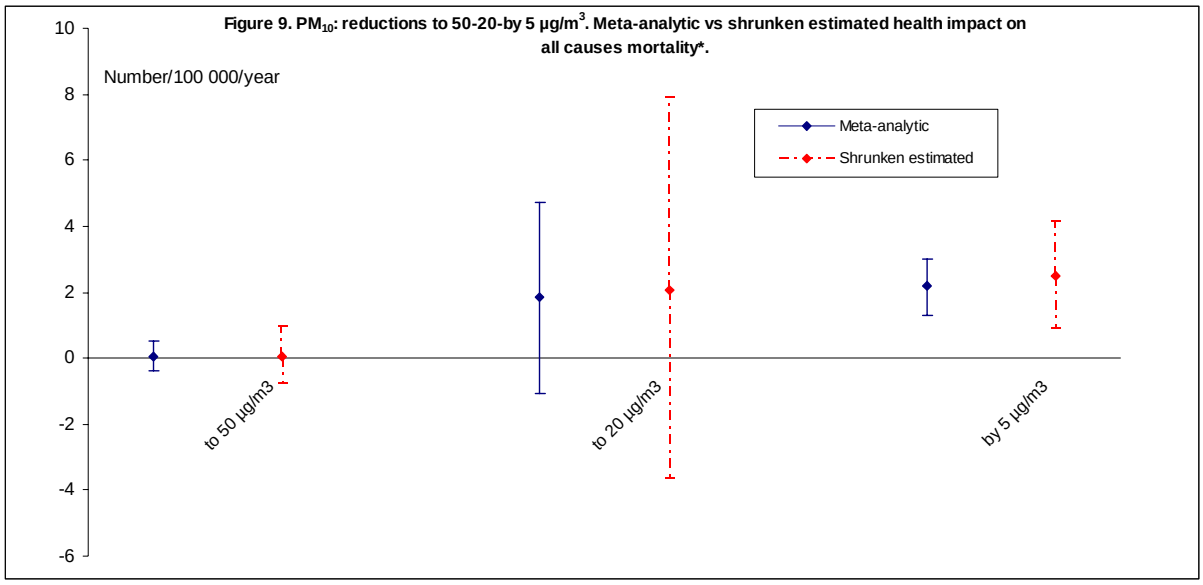


Figure 9 illustrates the estimated health benefits of reductions in PM_{10} pollution using meta-analytical and “shrunken” estimates of the health effects.

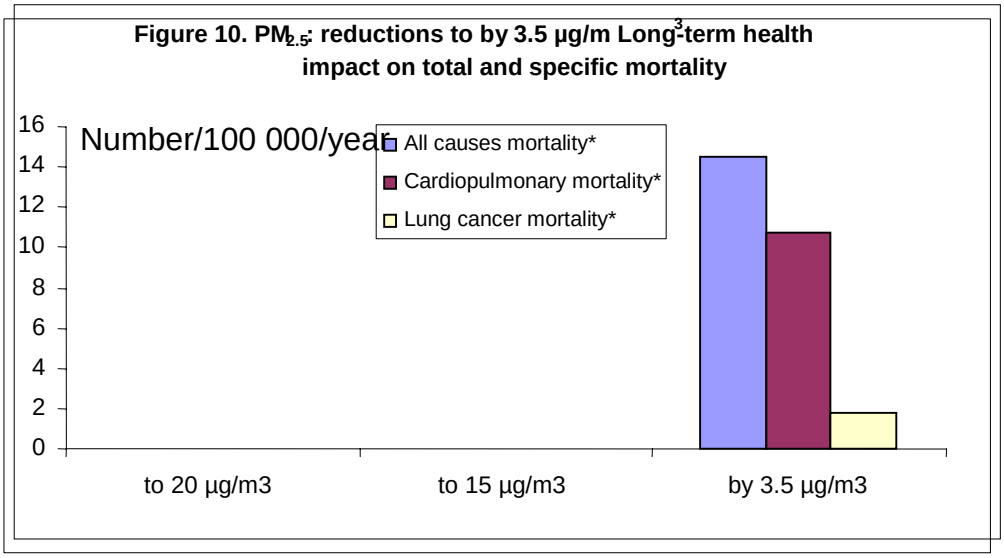


Results for $PM_{2.5}$

1. Number of attributed cases

We also used a scenario to estimate the chronic effects of long-term exposure to $PM_{2.5}$ on mortality over one year. Figure 10 presents estimates of the attributable number of deaths per 100 000 inhabitants due to all causes, cardiopulmonary and lung cancer.

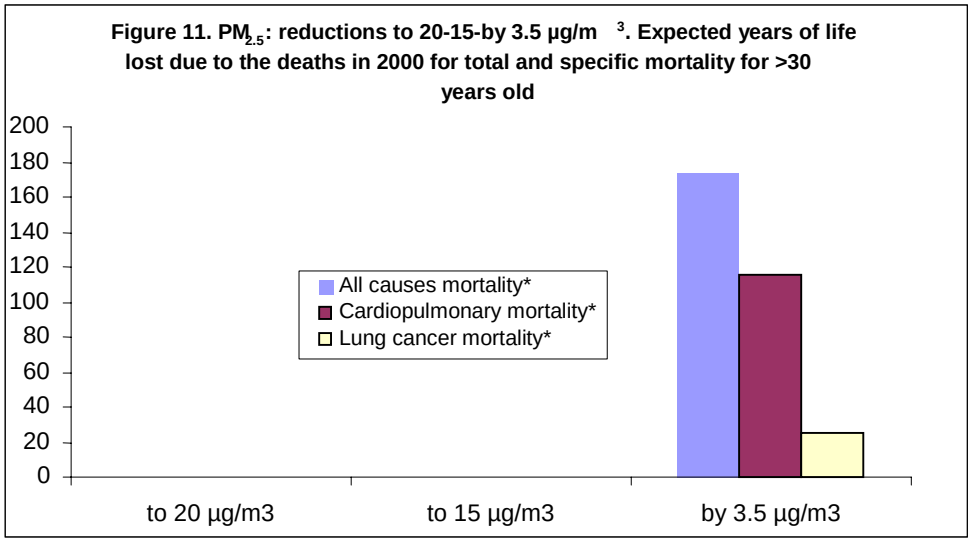
Data for all figures are contained in the Appendix



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 2001. Figure 11 presents the years of life lost for all causes, cardiopulmonary and lung

cancer deaths for 30 years of age or older. Data for all figures are contained in the Appendix



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

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

		Expected gain in life expectancy		
Age	Life expectancy	Mean	Low estimate	High estimate
At birth	75.1	0.2	0.06	0.039
30	50.4	0.2	0.06	0.040
65	18.7	0.2	0.05	0.31

APPENDIX 1

Short-term HIA for BS

Table 1. Deaths all causes (ICD9 < 800). Potential benefits of reducing daily BS levels 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 BS

		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	21	**14.85**	**9.90**	**22.29**	**0.22**	**0.14**	**0.32**
50 µg/m^3	0	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**154.14**	**102.81**	**231.03**	**2.23**	**1.49**	**3.35**

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459). Potential benefits of reducing daily BS levels 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 effect of BS

		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	21	**3.97**	**1.98**	**6.95**	**0.06**	**0.03**	**0.10**
50 µg/m^3	0	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**41.34**	**20.68**	**72.30**	**0.60**	**0.30**	**1.05**

**NA: not applicable*

Table 3. Respiratory deaths (ICD9 460-519). Potential benefits of reducing daily BS levels 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 BS

		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	21	**2.28**	**-0.76**	**5.70**	**0.03**	**-0.01**	**0.08**
50 µg/m^3	0	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**23.64**	**-7.90**	**58.97**	**0.34**	**-0.11**	**0.85**

**NA: not applicable*

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions. Potential benefits of reducing daily BS levels above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/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 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	21	**19.05**	**6.92**	**32.95**
50 µg/m^3	0	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**195.84**	**71.34**	**337.60**
Hospital admissions for respiratory diseases (all ages)				
20 µg/m^3	21	**6.87**	**-3.43**	**17.20**
50 µg/m^3	0	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**71.76**	**-35.92**	**179.20**

**NA: not applicable*

Short term HIA for PM_{10}

1.1. Cumulative health effects of PM_{10}, lag 0,1

Table 1. Deaths all causes (ICD9 < 800). Potential benefits of reducing daily PM_{10} levels 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	185	**126.49**	**84.28**	**168.75**	**1.83**	**1.22**	**2.45**
50 µg/m^3	5	**2.68**	**1.79**	**3.57**	**0.04**	**0.03**	**0.05**
By 5 µg/m^3	NA*	**152.10**	**101.45**	**202.70**	**2.20**	**1.47**	**2.94**

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459). Potential benefits of reducing daily PM_{10} levels 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	185	**76.25**	**42.32**	**110.26**	**1.11**	**0.61**	**1.60**
50 µg/m^3	5	**1.63**	**0.90**	**2.35**	**0.02**	**0.01**	**0.03**
By 5 µg/m^3	NA*	**91.14**	**50.68**	**131.51**	**1.32**	**0.73**	**1.91**

**NA: not applicable*

Table 3. Respiratory deaths (ICD9 460-519). Potential benefits of reducing daily PM_{10} levels 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	185	**42.05**	**16.14**	**68.08**	**0.61**	**0.23**	**0.99**
50 µg/m^3	5	**0.91**	**0.35**	**1.46**	**0.01**	**0.01**	**0.02**
By 5 µg/m^3	NA*	**49.86**	**19.21**	**80.38**	**0.72**	**0.28**	**1.16**

**NA: not applicable*

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions . Potential benefits of reducing daily PM_{10} levels above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. 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/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	185	**87.96**	**43.94**	**132.04**
50 µg/m^3	5	**1.86**	**0.93**	**2.79**
By 5 µg/m^3	NA*	**105.76**	**52.92**	**158.52**
Hospital admissions for respiratory diseases (all ages)				
20 µg/m^3	185	**223.40**	**121.32**	**327.74**
50 µg/m^3	5	**4.80**	**2.61**	**7.03**
By 5 µg/m^3	NA*	**265.72**	**144.70**	**388.75**

**NA: not applicable*

1.2. Cumulative health effects of PM_{10} up to 40 days

We used the same scenarios above to estimate the acute cumulative health effects of PM_{10} up to 40 days on mortality over one year. Tables 5, 6, 7 present the attributable number of all causes, cardiac 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).Potential benefits of reducing daily PM_{10} levels 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	185	**258.78**	**170.63**	**346.28**	**3.75**	**2.47**	**5.02**
50 µg/m^3	5	**5.57**	**3.68**	**7.45**	**0.08**	**0.05**	**0.11**
By 5 µg/m^3	NA*	**307.26**	**203.05**	**410.27**	**4.45**	**2.94**	**5.95**

**NA: not applicable*

Table 6. Cumulative health effects of PM_{10} up to 40 days and cardiac deaths (ICD9 390-429).Potential benefits of reducing daily PM_{10} levels 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	185	**108.70**	**76.61**	**141.00**	**1.58**	**1.11**	**2.04**
50 µg/m^3	5	**2.39**	**1.69**	**3.09**	**0.03**	**0.02**	**0.04**
By 5 µg/m^3	NA*	**127.16**	**89.90**	**164.45**	**1.84**	**1.30**	**2.38**

**NA: not applicable*

Table 7. Cumulative health effects of PM_{10} up to 40 days and respiratory deaths (ICD9 460-519). Potential benefits of reducing daily PM_{10} levels 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	185	**136.32**	**35.02**	**242.71**	**1.98**	**0.51**	**3.52**
50 µg/m^3	5	**3.17**	**0.82**	**5.57**	**0.05**	**0.01**	**0.08**
By 5 µg/m^3	NA*	**152.57**	**39.84**	**267.09**	**2.21**	**0.58**	**3.87**

**NA: not applicable*

1.3. Combined local and meta-analytic estimates for the health effects of PM_{10}

We used the same scenarios above and combined local and meta-analytic estimates to calculate the acute health effects of PM_{10} on all causes of death over one year. Table 8 present the attributable number of all causes of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 8. Combined local and meta-analytic estimates for the health effects of PM_{10} and all causes of deaths (ICD9 < 800). Potential benefits of reducing daily PM_{10} levels 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	185	**143.65**	**77.39**	**210.23**	**2.08**	**1.12**	**3.05**
50 µg/m^3	5	**3.02**	**1.63**	**4.42**	**0.04**	**0.02**	**0.06**
By 5 µg/m^3	NA*	**173.25**	**93.49**	**253.14**	**2.51**	**1.35**	**3.67**

**NA: not applicable*

Long-term HIA for PM_{10}

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

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

Table 1. Deaths all causes (ICD9 < 800). Potential benefits of reducing annual mean values of PM_{10} 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					
Scenarios	Number of days per year exceeding 20 and 40 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	185	**465.14**	**283.08**	**655.40**	**6.74**	**4.10**	**9.50**

40 µg/m^3	16	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 5 µg/m^3	NA*	**1068.60**	**648.81**	**1509.37**	**15.49**	**9.40**	**21.87**

**NA: not applicable*

Long-term HIA for $PM_{2.5}$

1.1. Attributable cases for direct $PM_{2.5}$ measurements

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

- for a reduction of the annual mean value of $PM_{2.5}$ to a level of 15 $\mu g/m^3$ [2]
- for a reduction of the annual mean value of $PM_{2.5}$ to a level of 20 $\mu g/m^3$ [3]
- for a reduction by 3.5 $\mu g/m^3$ in the annual mean value of $PM_{2.5}$ (to allow for cities with low levels of $PM_{2.5}$)

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). Potential benefits of reducing annual mean values of $PM_{2,5}$ to levels of 15 and 20 $\mu g/m^3$, and by 3,5 $\mu g/m^3$. 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					
Scenarios	**Number of days per year exceeding 15 and 20 $\mu g/m^3$**	**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**
15 $\mu g/m^3$	77	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
20 $\mu g/m^3$	34	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 3,5 $\mu g/m^3$	NA*	**997.67**	**259.60**	**1748.95**	**14.46**	**3.76**	**25.35**

**NA: not applicable*

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519).Potential benefits of reducing annual mean values of $PM_{2,5}$ to levels of 15 and 20 $\mu g/m^3$, and by 3,5 $\mu g/m^3$. 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					
Scenarios	**Number of days per year exceeding 15 and 20 $\mu g/m^3$**	**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**
15 $\mu g/m^3$	77	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
20 $\mu g/m^3$	34	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 3,5 $\mu g/m^3$	NA*	**743.70**	**266.93**	**1231.23**	**10.78**	**3.87**	**17.84**

**NA: not applicable*

[2] CAFE Working Group on Particulate Matter. Second Position Paper on Particulate Mater –draft for discussion- August 20th, 2003.

Table 3. Lung cancer deaths (ICD9 162). Potential benefits of reducing annual mean values of $PM_{2,5}$ 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					
Scenarios	**Number of days per year exceeding 20 and 15 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**
15 µg/m^3	77	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
20 µg/m^3	34	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
By 3,5 µg/m^3	NA*	**120.88**	**40.66**	**203.56**	**1.75**	**0.59**	**2.95**

**NA: not applicable*