ROME CITY REPORT

Ursula Kirchmayer
Paola Michelozzi
Francesco Forastiere
Carlo Perucci

Department of Epidemiology
Local Health Authority RM/E

Rome

Italy

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Summary of the main findings

Air pollution levels and trends compared to EC limit values
In the city of Rome daily mean levels of particulate matter have shown few annual differences in recent years, and are still above the EC limit values foreseen for 2005/2010 (PM_{10} daily mean levels: 50.31µg/m^3 (1998) – 45.54µg/m^3 (1999) – 51.48µg/m^3 (2000) - 47.18 µg/m^3 (2001) – 48.12 µg/m^3 (2002)). The increase in the year 2000 was mainly due to the extraordinary event of the jubilee of the catholic church, which caused an increase of road traffic – the major source of air pollution in Rome.
The analysis estimated that the long-term reduction of $PM_{2.5}$ to 15 ug/m^3 would reduce mortality in Rome by 3362 deaths a year. A short term reduction of daily means of PM_{10} under 20 ug/m^3 could have avoided 335 deaths and 1015 hospital admissions in the year 2001.

Main causes of air pollution in the city, and actions implemented / planned to reduce it:
Air pollution in Rome originates primarily from motor vehicle traffic (60%) and secondarily from home heating devices (30%), which together account for more than 90% of gaseous pollutants and airborne particles.
In recent years, the city council has been adopting a series of measures to reduce traffic-borne air pollution. Concretely, initiatives have been launched to encourage citizens to use public transport rather than private cars or motorcycles and the fleet of public vehicles is being renewed in order to reduce pollution produced by public transport. Annual exhaust controls have been introduced for cars and will be introduced for motorcycles in 2005. Incentives for the use of methane gas for cars instead of fuel and for the demolition of old cars and motorcycles have been introduced.
In recent years, the municipality of Rome has placed limitations on private car use. Since the beginning of 2003, private cars without catalytic converters or those diesel operated (except eco-diesel) are not permitted on weekdays within the so called green area, which covers about two-third of the entire city. Since the beginning of 2004, on Wednesday afternoons only half of private cars are permitted to drive in this area, determined by their license plate number (even/odd).

Background

The metropolitan area of Rome has a population of 2,7 million inhabitants, 18% older than 65 years of age (2000, National Institute of Statistics) and covers an area of 1495 km^2. Most of the population (ca. 80%) lives in the city centre, which has been defined by the local authorities as the area of concern for air pollution control. The city centre (ca. 320 km^2) includes archaeological and historical sites, business areas, and residential neighbourhoods.
The climate in Rome is typically Mediterranean, with mild winters and relatively hot summers. The annual mean temperature is 15.8°C and mean annual precipitation is 745.0 mm. Given its location, the climate is influenced by the land-sea interaction and sea breezes are frequent. The scirocco, a meridional wind, sometimes brings heat waves during the summer.
For the third year of the APHEIS project, an HIA was performed on the health and air pollution data for the year 2001. Originally the year 2000 data were considered, as in other APHEIS cities. For the city of Rome, however, the year 2000 was extraordinary, because the entire city area was highly influenced by the jubilee of the catholic church. Throughout the

year, road traffic in the city of Rome was markedly increased. Consequently, air pollution levels were higher compared to the years before and after 2000: PM_{10} daily mean levels were 45,5µg/m^3, 47,2µg/m^3, and 48.12µg/m^3 in 1999, 2001, and 2002 respectively, and in 2000 the daily mean level was 51.5µg/m^3. Therefore, the decision was made to publish the HIA results from the 2001 data for the comparison with the other APHEIS cities, because they better represent the usual standard levels of air pollution in Rome.

The results of the APHEIS second year report show that referring to the 1998 data Rome was one of the cities with the highest PM_{10} levels. Consequently, the potential benefit of reducing PM_{10} levels assessed in terms of avoidable cases of mortality and hospital admissions was bigger compared to most of the other European cities.

In APHEIS 3 the HIA was updated for the year 2001. Beyond the short term estimates, long term exposure was also considered and years of life lost were computed. Through this extension the potential benefit of PM_{10}/PM2,5 reduction was estimated more accurately. Moreover, the compilation of the mini case study helped to identify gaps in the Rome collaborative network on air pollution and plan future activities.

The results of APHEIS 3 will be an important tool for the collaboration with the city council on the issue of air pollution and health.

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 (%)
2001	60	30	5	5

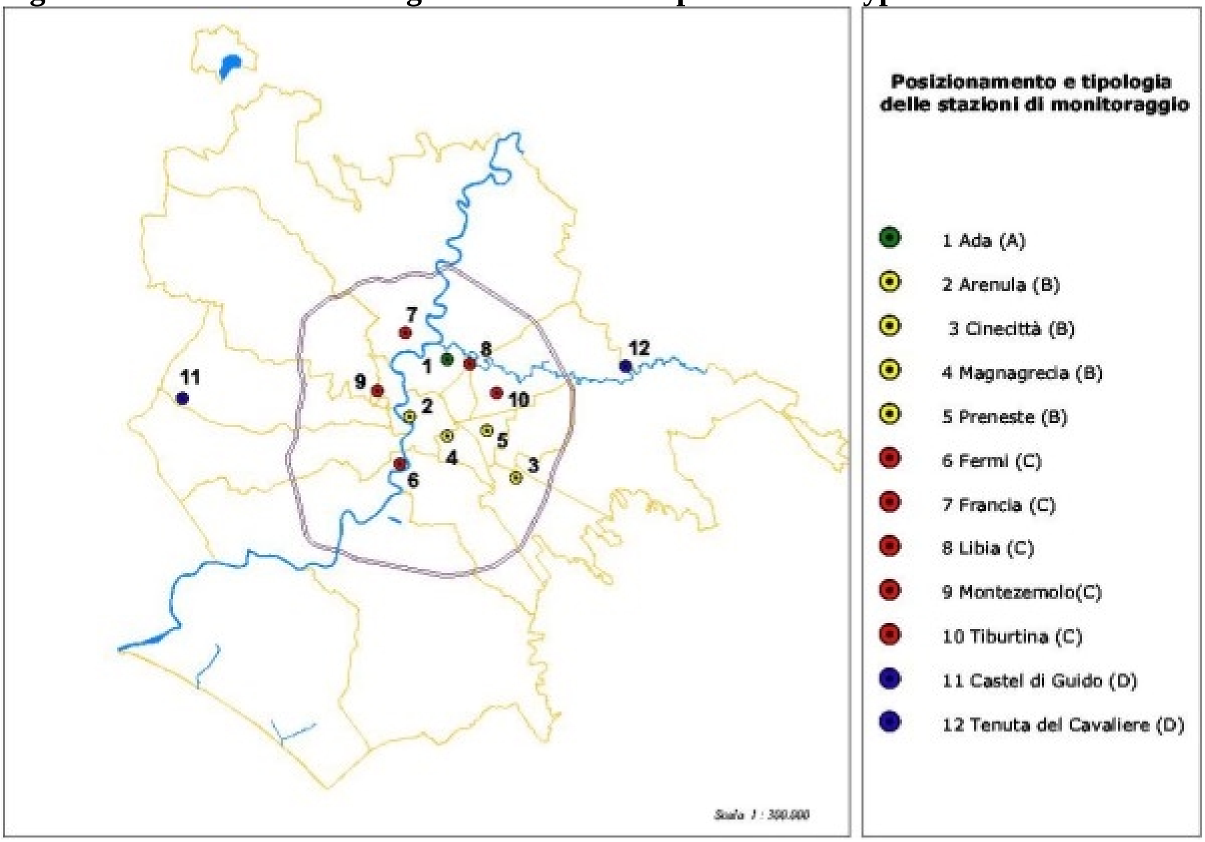
In recent years, regulatory measures have been implemented concerning the fixed PM_{10} sources (heating and industrial plants). Thus, the relative contribution of traffic to the overall pollution has increased, and recent initiatives therefore have focused on traffic borne pollution.

It is important to note the contribution of natural sources to particulate matter, such as the dust carried into the city by southern winds, which cannot be abated.

Exposure data

Of the 12 fixed monitoring stations in the city of Rome, only two measured PM_{10} in 2001, numbers 4 and 6 in the figure. $PM_{2.5}$ was not measured.

Figure 1. The fixed monitoring station network – position and type of station



PM_{10} is measured using an automated β-gauge method. Compared to gravimetric methods, the automated method underestimates the PM concentration. Therefore, for the long-term health impact assessment, which uses relative risks based on gravimetric methods, a correction factor of 1.3 was applied to the original data (according to the recommendations by the EC working group on particulate matter with respect to EC directive 1999/30/EC). For short-term estimates the original, not the corrected data were used.
$PM_{2.5}$ data were computed from measured PM_{10} data using the European conversion factor 0.7.

- Air pollution data refer to the year 2001

- Daily mean level (SD) was 47.18 µg/m^3 (16.72) for PM_{10} and 33.03 µg/m^3 (11.70) for $PM_{2.5}$.

- The levels of PM_{10} / $PM_{2.5}$ reached during the 38 days with the lowest (5th percentile) and the highest (95th percentile) levels were 24.80 µg/m^3 and 76.68 µg/m^3 respectively for PM_{10} and 17.36 µg/m^3 and 53.67 µg/m^3 for $PM_{2.5}$.

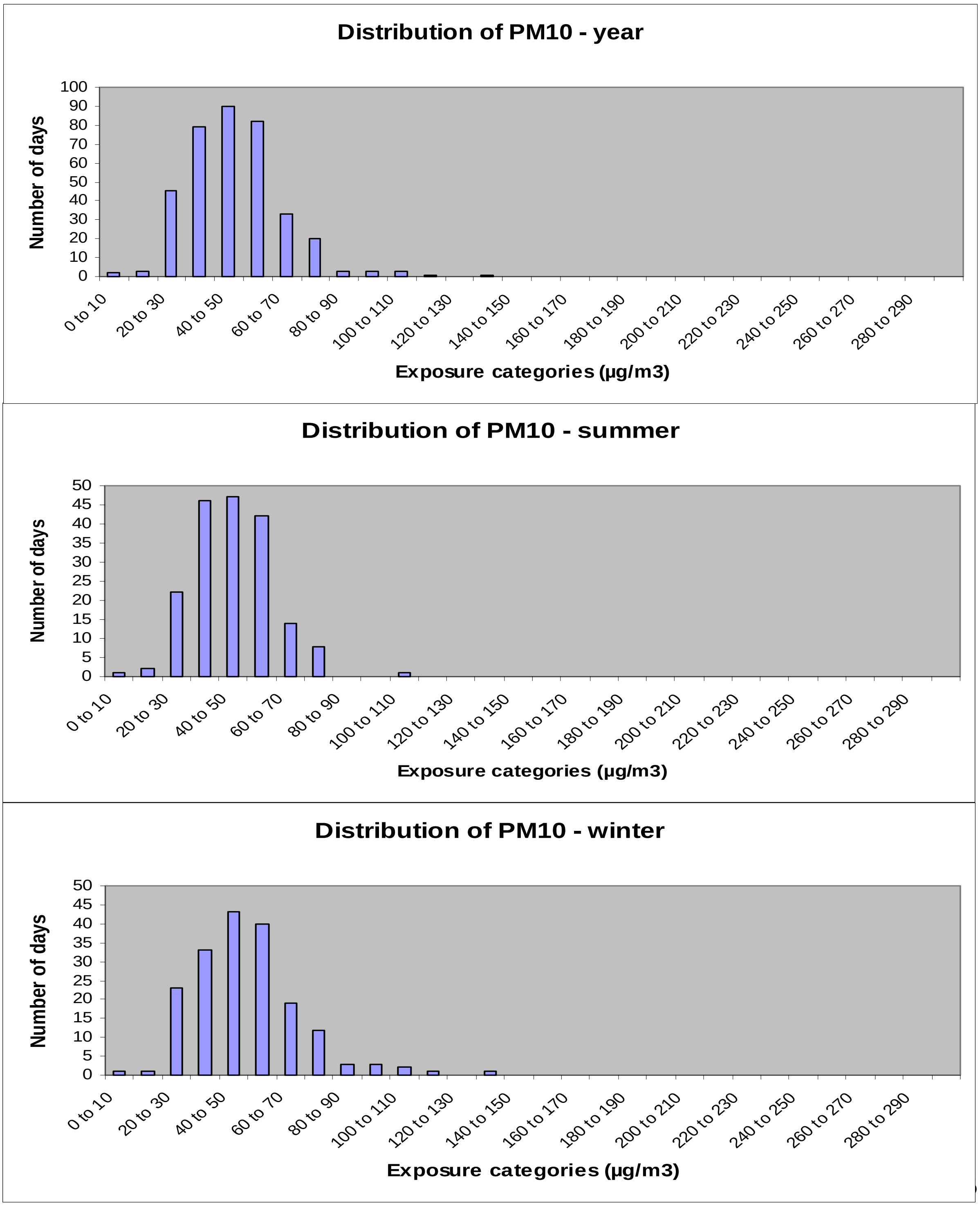
- Number of days when air pollutants exceeded limit levels:

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
	360	359
Number of days above	50 µg/m^3	35 µg/m^3
	146	146

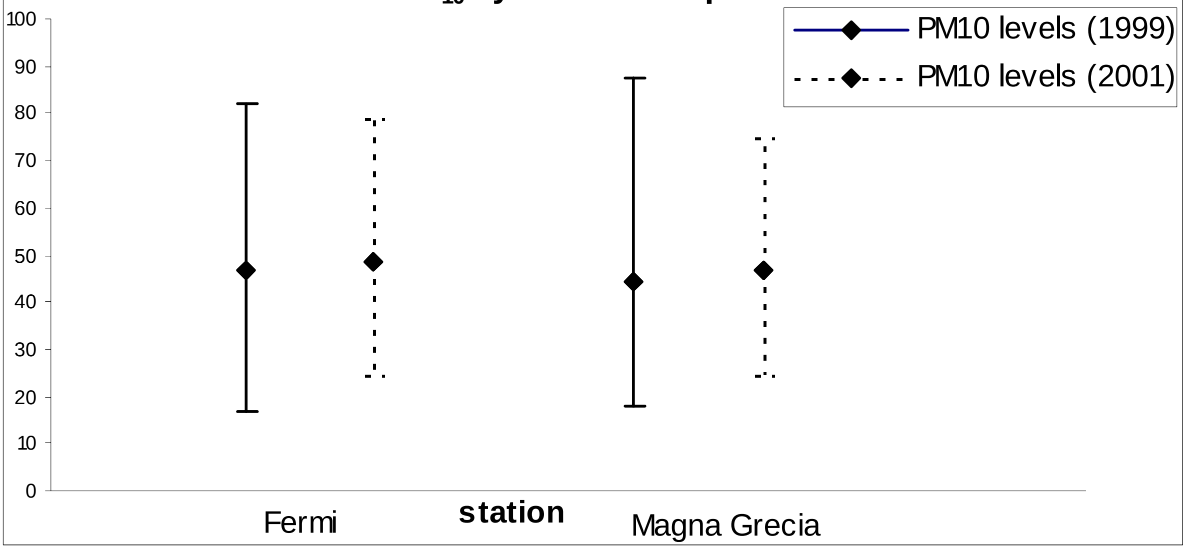
In 2001, most days showed values between 30 and 60 µg/m^3, the higher levels being more frequent in the winter months.

Figure 2. Distribution of PM_{10} in the year 2001 (year – summer – winter)



Comparing the measurements from the single monitoring stations from Apheis 2 and 3 (1999 and 2001), no important differences between the mean levels and the inter percentile range (5th-95th percentile) are observed.

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



Health data

Data on mortality were provided by the Mortality Information System of Rome (SIM). Individual information on sex, age, census tract of residence, date of death, place of death, and cause of death are available. This registry uses ICD-IX manual coding and is quality controlled. The percentage of missing data in main causes of death is less than 0.1. The incidence rate was calculated, excluding deaths occurring outside the municipality of Rome, and those of non-residents.
Data on hospital admissions were retrieved from the Regional Hospital Admission Information System, which uses ICD-IX coding and is quality controlled. 96% of both public and private hospitals in the Latium region are included, and less than 0.1 % of cause admission data are missing.
The system does not permit a straightforward classification of emergency and elective admissions, so we tried to remove conditions that were more likely to be unrelated to air pollution and/or elective procedures: day-hospital stay, rehabilitation, surgery, hospital transfers, traumas, births, psychiatric and dermatological conditions, which excluded about 775,000 admissions (56% of the total). Only primary diagnoses defined at discharge from the hospital were considered.

The age-standardised mortality rate for Rome for the year 2001, using the European population[1] as a reference, was 794 per 100.000 inhabitants.

Table 3. Daily mean number and annual rate per 100 000 of deaths and hospital admissions (2001)

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	56.48 (9.45)	779.81
Cardiovascular mortality	390-459	I00-I99	23.21 (5.74)	320.51
Respiratory mortality	460-519	J00-J99	3.07 (1.85)	42.37
Cardiac hospital admissions	390-429	I00-I52	81.76 (21.36)	1128.89
Respiratory hospital admissions	460-519	J00-J99	47.36 (13.19)	653.96
Long term HIA				
All causes mortality	0-999	A00-Y98	59.55 (9.68)	822.26
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	25.29 (6.06)	349.15
Lung cancer mortality	162	C33-C34	4.68 (2.16)	64.61

* For short and long term scenarios

It is difficult to estimate the expected changes in birth rates in Rome, because the composition of the adult population of child bearing age is influenced by immigration. Birth rates among Italian residents tend to decrease, while they are higher among resident immigrants.

Health impact assessment

1. HIA scenarios

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In the city of Rome, 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 these two values because they represent the same type of pollution.

Different tools and 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) 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:
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 due to the deaths in the starting year of simulation.

1.1. 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:

<u>Short term HIA scenarios for PM_{10}</u>

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

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})

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

The same scenarios as above were used to calculate the acute health effects of PM_{10} on all causes of death (excluding external causes) over one year using local and combined (meta-analytic) estimates. This sensitivity analysis was done to evaluate the impact of including the weight of local estimates in the combined (meta-analytic) one.

1.2. Long-term scenarios

<u>Long-term HIA scenarios for PM_{10}</u>

Three scenarios were used to estimate the chronic effects of long-term exposure to PM_{10} on all cause 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 $\mu g/m^3$ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10})

Long term HIA for $PM_{2.5}$

Chronic effects of $PM_{2.5}$ were estimated for the population over 30 years old as impacts mortality due to all causes, to cardiopulmonary and to lung cancer deaths.
For PM2.5, 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

The following three pollution scenarios were considered:

- reduction of the annual mean value of $PM_{2.5}$ to a level of 20 $\mu g/m^3$
- reduction of the annual mean value of $PM_{2.5}$ to a level of 15 $\mu g/m^3$
- 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 $PM_{2.5}$)

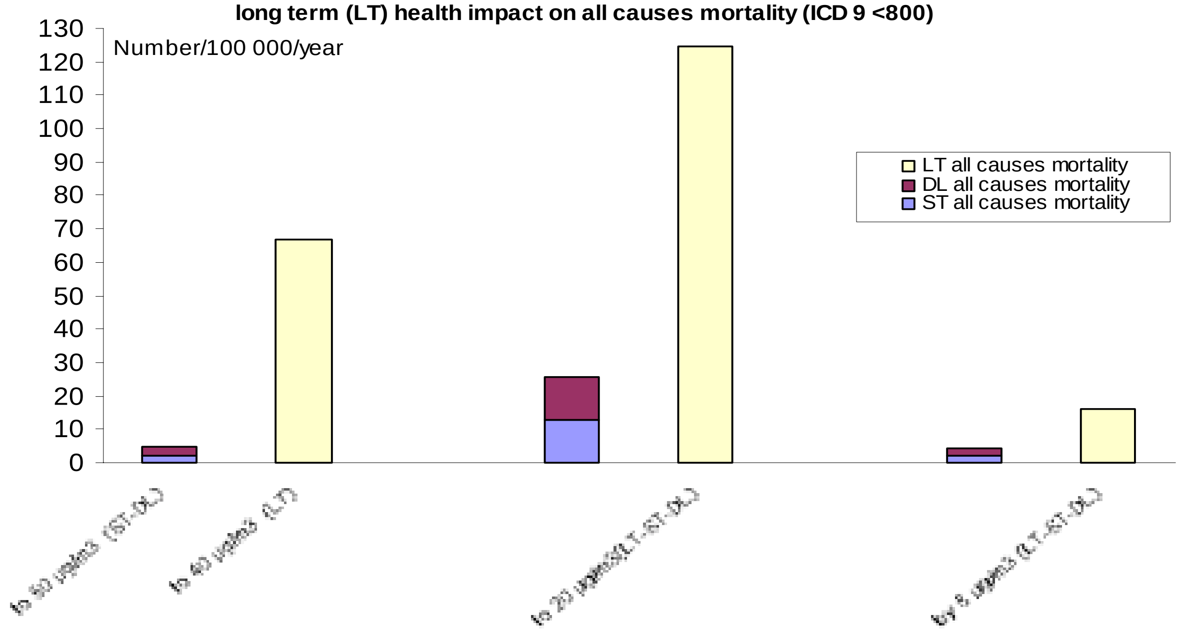
2. PM$_{10}$ findings

2.1. 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$_{10}$

2. 1.1. Mortality findings

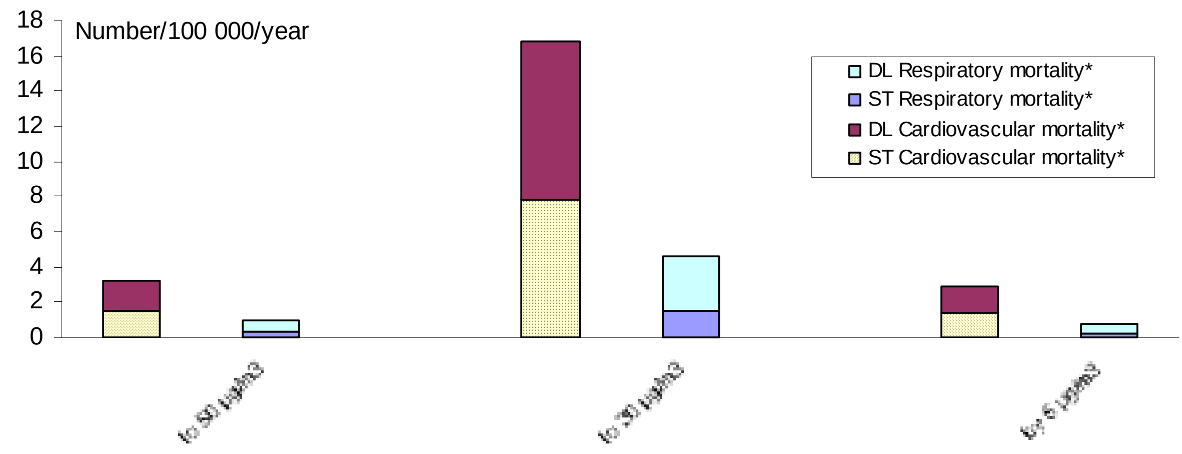
The following graphs show the health impact of PM$_{10}$ on mortality for different lags: short-term-ST (0-1 day lag), cumulative effect –DL-distributed lag (up to 40 days lag) and long-term LT (years).

Figure 4. PM10: reductions to 50/40-20-by 5 µg/m^3. Short term (ST), cumulative (DL), long term (LT) health impact on all causes mortality (ICD 9 <800)



* PM$_{10}$ data for 2001, mortality data for 2001

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).

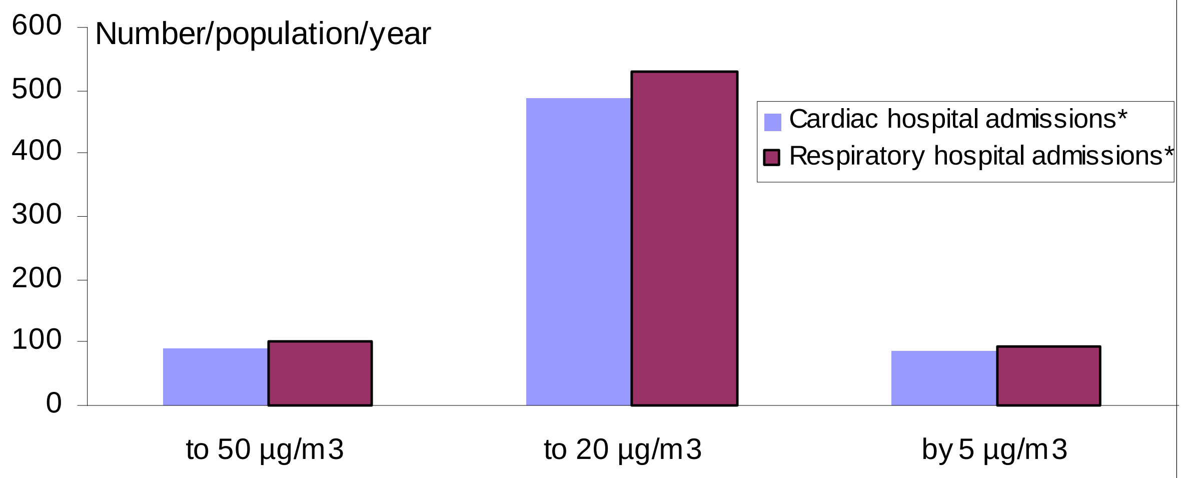
** PM$_{10}$ data for 2001, mortality data for 2001

Figures 4 and 5 both show that the estimates for the short-term (lag 0-1) effect of PM air pollution on mortality is only a small part of the effect estimated for cumulative and long-term exposure. The portion of the cumulative effect is bigger for respiratory diseases than for cardiovascular. Due to the fact that different PM_{10} data were used for ST/DL and LT estimates (original data for ST and DL, and data on which the EC correction factor of 1.3 was applied for LT) it is difficult to compare these numbers. Still it is evident that long-term exposure plays an important role which must be considered when talking about negative health effects of PM.

2.1.2. Hospital admissions findings

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

Figure 6. PM_{10} : reductions to 50-20-by 5 µg/m^3.
Short-term health impact on hospital admissions



* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519) for 2001
** PM_{10} data for 2001

Figure 6 shows that through a reduction of PM_{10} levels to the limit values foreseen for 2010 a considerable number of acute hospital admissions could be avoided in Rome.

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

We combined local and meta-analytic estimates (shrunken estimates-SE) to calculate the acute health effects of PM_{10} on all causes of death (excluding external causes) over one year.

The following figure compares the HIA of PM_{10} on 0-1 days and that of the combined estimate (SE).

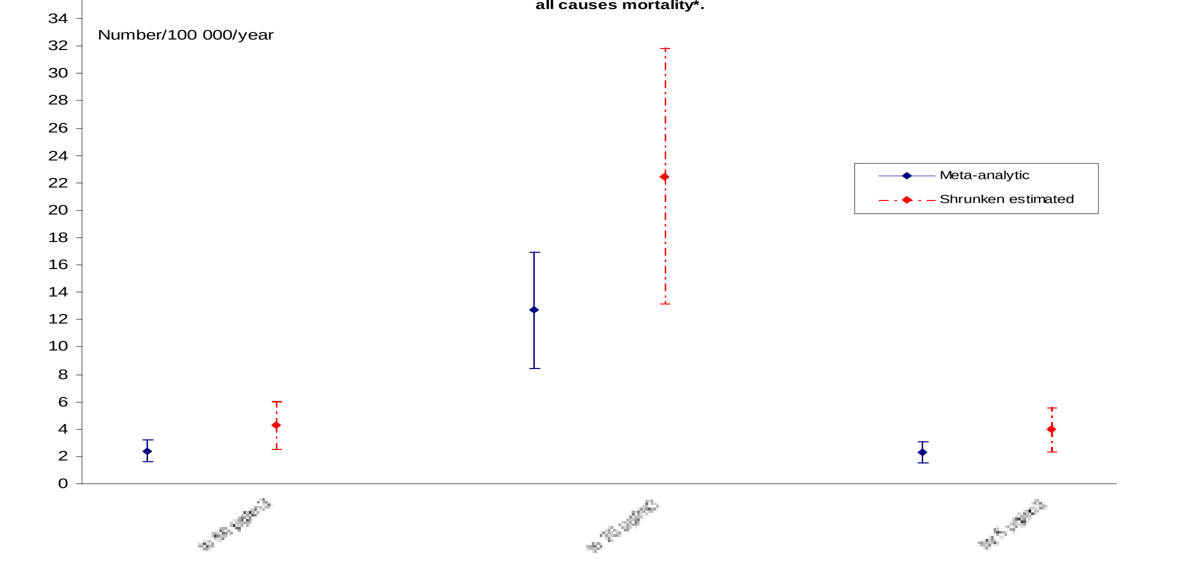


Figure 7. PM_{10}: reductions to 50-20-by 5 µg/m^3. Meta-analytic vs shrunken estimated health impact on all causes mortality*.

* All causes mortality excluding external causes (ICD9 < 800)
** PM_{10} data for 2001, mortality data for 2001

Figure 7 shows that the numerical values of PM_{10} attributable cases are higher when applying shrunken estimates (red bars) than when applying meta-analytic estimates (blue bars). Compared to the meta-analytic estimates, the shrunken estimates give more weight to the city specific data and consequently, values are higher, because Rome city data exceed Apheis city mean values.

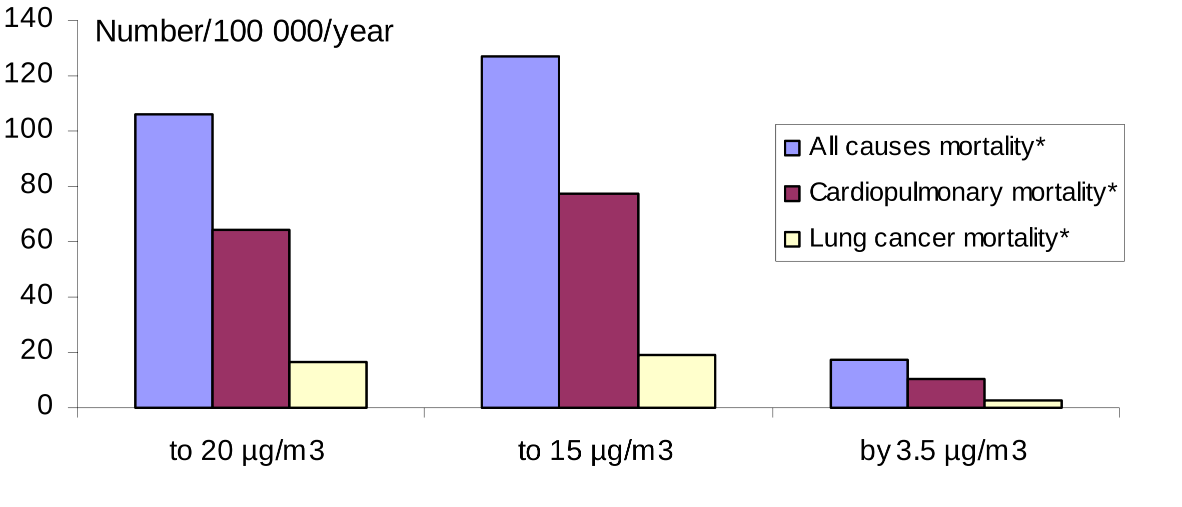
3. $PM_{2.5}$ findings

3.1. Number of attributed cases

Three scenarios were also used 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 per 100 000 inhabitants.

Figure 8. $PM_{2.5}$: reductions to 20-15-by 3.5 µg/m^3. Long-term health impact on total and specific mortality

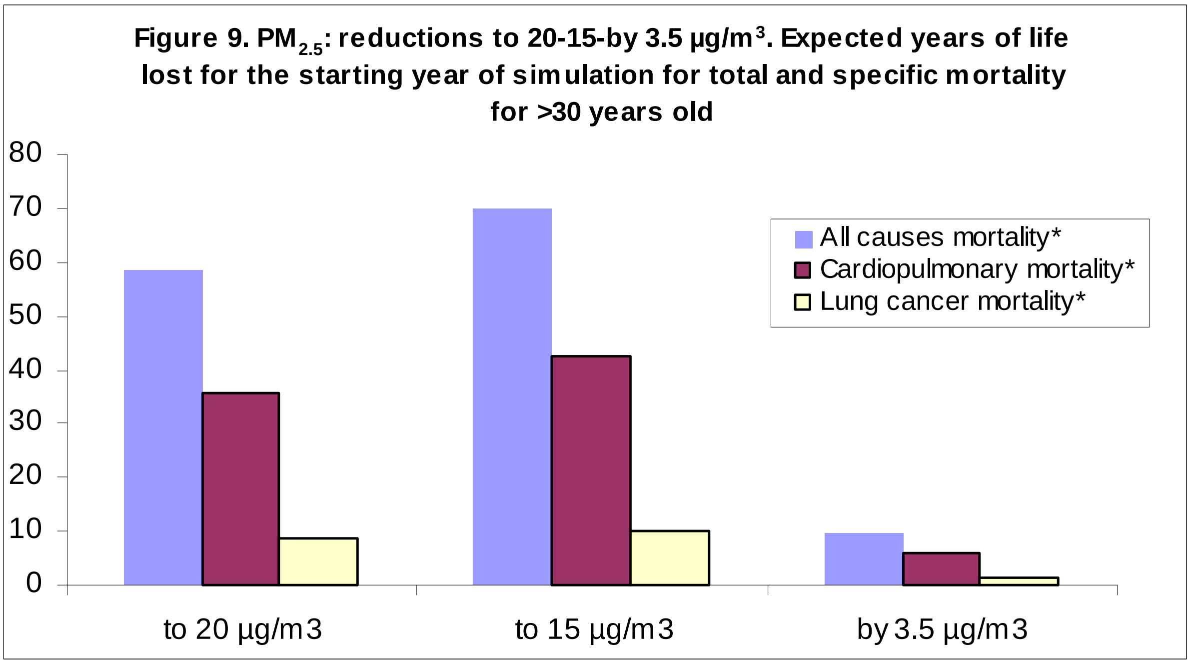


The estimated long-term benefits of reducing $PM_{2.5}$ in Rome show that there is great potential to reduce all cause and cardiopulmonary mortality even with small reductions of $PM_{2.5}$. A decrease of 3.5 µg/m^3 is estimated to save 17 lives per 100.000 residents, which equals 450 deaths in the city of Rome in one year.

3.2. Years of life lost

Years of life lost attributable to the chronic effects of $PM_{2.5}$ were estimated using the data for 2001.

Figure 9 presents the years of life lost for all causes, cardiopulmonary and lung cancer deaths for people 30 years of age or older in the population of Rome.



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

** $PM_{2.5}$ data for 2001, mortality data for 2001

For all causes of death, all other things being equal, a reduction of $PM_{2.5}$ by 3.5 µg/m^3 would save almost 10 years of expected life in 100.000 people older than 30 years in the city of Rome in the initial year of simulation, which equals 250 years of expected life in the entire over 30 population. For cardiopulmonary mortality, this number would be around 157 and for lung cancer mortality around 40.

The following figure 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 Rome

		Expected gain in life expectancy		
Age	Life expectancy	Mean	Low estimate	High estimate
At birth	79.50	1.60	0.42	2.81
30	50.48	1.63	0.42	2.85
65	18.38	1.31	0.34	2.32

In terms of life expectancy, all other things being equal, if annual mean $PM_{2.5}$ levels (47 µg/m^3) were reduced to 15 µg/m^3, the 50.48 years of life expectancy in a person 30 years old would increase by 1.63 years, due to reduced risk of death from all causes.

Interpretation of findings

Assessment of exposure to particulate matter in Rome in the year 2001 presented important limitations: PM_{10} data were available from only two monitoring stations, and $PM_{2.5}$ was not measured directly. Recent experimental $PM_{2.5}$ measurements have been compared with PM_{10} data and the ratio between PM_{10} and $PM_{2.5}$ has been estimated to be smaller than 0.7. Therefore, the converted $PM_{2.5}$ data used in this project probably overestimate the real $PM_{2.5}$ levels, and consequently, the assessment of the health impact attributed to $PM_{2.5}$ might be an overestimation too.
The fixed monitoring stations which were included in this study showed different characteristics than the stations used in most other Apheis cities, and were classified as traffic-related. Still it needs to be stressed that the monitoring stations are placed in highly urbanised areas and therefore represent the air breathed by most of the city population.

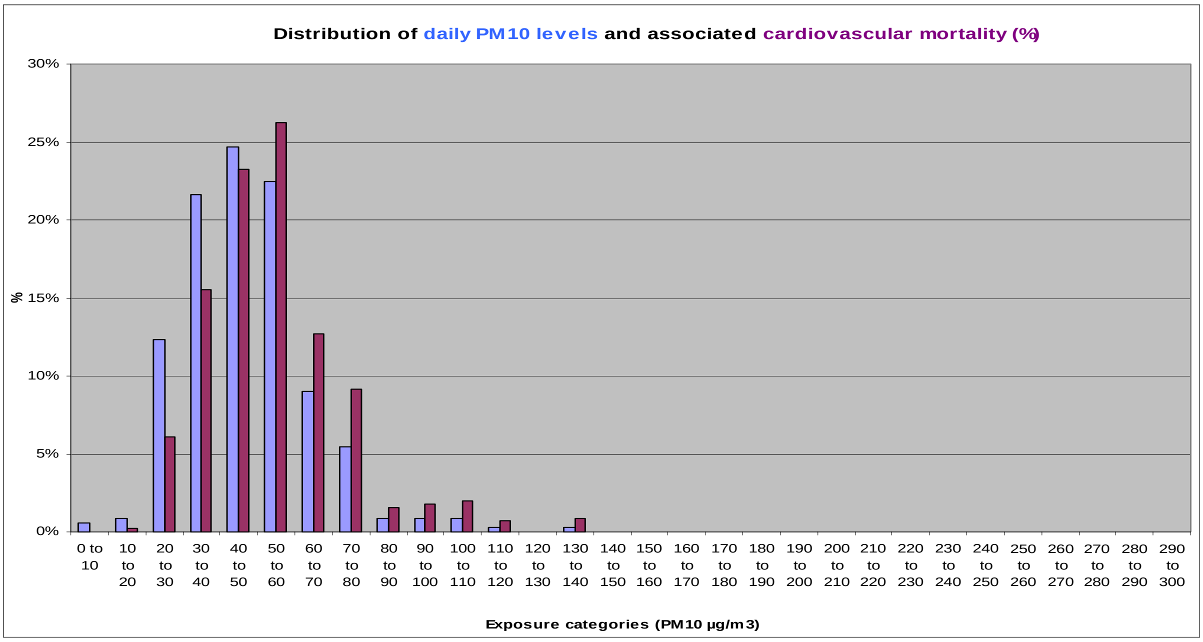
Health indicators (mortality and morbidity) were readily available and are very reliable.

The findings for short-term, distributed lag and long-term effects indicate that in Rome there is a considerable potential for health benefits through the abatement of air pollution. The contribution of short-term exposure (2.28 deaths/100.000 in 2001 for a reduction by $5\mu g/m^3$) turned out to be less important than the contribution of cumulative exposure (4.53 deaths/100.000 in 2001 for a reduction by $5\mu g/m^3$) and of long-term exposure (9.86 deaths/100.000 in 2001 for a reduction by $5\mu g/m^3$). The importance of the cumulative effect is higher for respiratory diseases than for cardiovascular diseases. These findings confirm former observations.

Due to the fact that $PM_{2.5}$ was not measured directly in Rome in 2001, the data used for health impact assessment were converted from the PM_{10} data. The findings for all cause mortality attributable to long-term $PM_{2.5}$ exposure are comparable to the PM_{10} results. For long-term $PM_{2.5}$ exposure years of life lost were computed. Examining the contribution of specific causes (cardiopulmonary causes and lung cancer) to all cause attributable cases and years of life lost, the numbers show that lung cancer plays a bigger role when the age at death is taken into account (YoLL). This makes clear how the YoLL approach gives more detailed information on the importance of certain health effects in a defined population.

Figure 10 shows that the higher the levels of PM_{10}, the higher the relative impact is on cardiovascular mortality. Above the category 40-50 $\mu g/m^3$ the mortality bars exceed the pollution bars, which means that while the number of days with levels above this category accounts for about 40% of the days, the number of cases attributable to higher levels is more than 55% of the overall cases. Single peaks of air pollution (> 95^{th} percentile) contribute to less than 10% of the attributable cases.

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



General comments

The Department of Epidemiology routinely performs analysis of air pollution data and has been involved in a number of studies and projects dealing with air pollution and health. The Apheis project has offered a new approach and has added new information, thus giving an important input to future work. The findings of the 3rd year will facilitate a broad dissemination of information to different target groups. Specifically, the report is a useful tool for the collaboration of the Department of Epidemiology with the Department for traffic and local transportation and the Department for social affairs and health.

Conclusions

The work performed for the Apheis project has established a basis for future HIAs, updating the estimates not only for particulate matter, but for other air pollutants as well. For example, in Rome there is much interest in assessing the health impact of ozone, especially during the summer season and in the context of studies which evaluate the role of climatic conditions, namely heat waves.
With regards to the Apheis 3 communication work package, it would be useful to develop a detailed communication strategy, which might improve risk communication.

Appendix

1. Questionnaires for Rome on the exposure measurement methods and health data

1.1 Characteristics of air pollution data sources

Harmonised compilation of information indicating the exposure relevant area of the city, number of PM10, PM2.5 or BS monitoring sites, and the type, sampling and measurement characteristics of stations selected for the HIA of APHEIS

1.	City:	Rome
2.	Total area of agglomeration (km²):	1495
3.	Area (km²) covered by the air monitoring network in the city:	320
4.	Number of population in this (exposure relevant) area:	2,2 Million
5.	Total number of PM10 monitoring stations in this area:	4
6.	Total number of BS monitoring stations in this area:	0
7.	Total number of PM2.5 monitoring stations in this area:	0
8.	Number of selected PM10 monitoring stations for HIA: 2 out of the 4 existing stations had problems and consequently there were too many missing data to consider the station for the HIA	2
9.	Number of selected BS monitoring stations for HIA:	0
10.	Number of selected PM2.5 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	PM10/BS/PM2.5	Classification
Fermi	PM10	traffic
Magna Grecia	PM10	traffic

15. Measurement method / Type of instrument

PM10 manual:____
automated: X beta Gauge
probe temperature (in °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?

no X
yes if yes, a) which factor: ________________________________
b) is it a default factor? yes no
c) derived from own parallel measurements (reference method vs. TEOM or beta attenuation)
yes no

17. If your PM2.5 data have been calculated from your PM10 data, what conversion factor did you use? factor:_0.7______________________________

1.2 Characteristics of health data sources

Table 1. - Characteristics of the information sources for mortality data.

CITY	Type of source	Year	Source	Quality control programme	% Missing data in basic cause death	Codification		
						ICD	Manual	Automatic
Roma	Register	2001	Mortality Information System (SIM)	Yes	<0,1%	ICD 9	100%	

Table 2.- Characteristics of the information source for hospital admission data on cardiac and respiratory diseases.

CITY	Type of source	Year	Source	ICD	Quality control	Completeness (%)	% Missing data cause admission	Type of H. admissions	
								Total	Emergency
Roma	Register	2001	Hospital Information System (SIO)	9	Yes	96	0,1	X	

*Only public hospitals included

2. Tables for PM_{10} findings

2.1 Health effects of PM_{10} on 0-1 days

Tables 1, 2, and 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) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	335.17	222.84	448.11	12.68	8.43	16.95
50 µg/m^3	146	62.88	41.85	83.99	2.38	1.58	3.18
By 5 µg/m^3	NA*	60.21	40.16	80.25	2.28	1.52	3.04

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	205.78	113.70	298.86	7.78	4.30	11.31
50 µg/m^3	146	38.89	21.53	56.37	1.47	0.81	2.13
By 5 µg/m^3	NA*	36.63	20.37	52.85	1.39	0.77	2.00

**NA: not applicable*

Table 3. Respiratory deaths (ICD9 460-519) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	39.11	14.88	63.87	1.48	0.56	2.42
50 µg/m^3	146	7.46	2.85	12.14	0.28	0.11	0.46
By 5 µg/m^3	NA*	6.88	2.65	11.08	0.26	0.10	0.42

**NA: not applicable*

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	485.19	241.61	730.76
50 µg/m^3	146	91.03	45.40	136.89
By 5 µg/m^3	NA*	87.17	43.62	130.65
Hospital admissions for respiratory diseases (all ages)				
20 µg/m^3	360	530.17	286.30	782.31
50 µg/m^3	146	100.80	54.58	148.34
By 5 µg/m^3	NA*	93.67	51.01	137.03

**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) (2001).Potential benefits of reducing daily PM_{10} levels (2001) 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	360	679.73	446.18	913.68	25.71	16.88	34.56
50 µg/m^3	146	129.51	85.19	173.72	4.90	3.22	6.57
By 5 µg/m^3	NA*	119.77	79.15	159.92	4.53	2.99	6.05

**NA: not applicable*

Table 6. Cumulative health effects of PM_{10} up to 40 days and cardiovascular deaths (ICD9 390-459) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	443.93	310.91	579.54	16.79	11.76	21.92
50 µg/m^3	146	86.13	60.50	112.12	3.26	2.29	4.24
By 5 µg/m^3	NA*	76.44	54.04	98.86	2.89	2.04	3.74

**NA: not applicable*

Table 7. Cumulative health effects of PM_{10} up to 40 days and respiratory deaths (ICD9 460-519) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	121.96	30.28	225.14	4.61	1.15	8.52
50 µg/m^3	146	24.97	6.30	45.36	0.94	0.24	1.72
By 5 µg/m^3	NA*	19.60	5.12	34.32	0.74	0.19	1.30

**NA: not applicable*

2.3. Combined local and meta-analytic estimates for the health effects of 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. Combined local and meta-analytic estimates for the health effects of PM_{10} and all causes of deaths (ICD9 < 800) (2001). Potential benefits of reducing daily PM_{10} levels (2001) 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	360	593.99	347.64	843.30	22.47	13.15	31.90
50 µg/m^3	146	112.74	66.13	159.70	4.26	2.50	6.04
By 5 µg/m^3	NA*	105.17	61.99	148.25	3.98	2.34	5.61

**NA: not applicable*

2.4 Long term HIA for PM_{10}

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) (2001). Potential benefits of reducing annual mean values of PM_{10} (2001) 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	3292.90	1939.00	4803.83	124.56	73.35	181.72
40 µg/m^3	1771.16	1060.83	2537.71	67.00	40.13	96.00
By 5 µg/m^3	429.43	260.73	606.55	16.24	9.86	22.94

3. Tables for $PM_{2.5}$ findings

3.1. 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) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) 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	3362.19	827.81	6237.79	127.18	31.31	235.96
20 µg/m^3	2801.18	697.62	5135.50	105.96	26.39	194.26
By 3,5 µg/m^3	452.84	117.83	793.84	17.13	4.46	30.03

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) 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	2037.88	680.78	3632.96	77.09	25.75	137.43
20 µg/m^3	1709.46	579.68	3000.07	64.66	21.93	113.49
By 3,5 µg/m^3	284.02	101.94	470.22	10.74	3.86	17.79

Table 3. Lung cancer deaths (ICD9 162) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) 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	509.27	153.98	958.28	19.26	5.82	36.25
20 µg/m^3	430.84	133.21	791.61	16.30	5.04	29.94
By 3,5 µg/m^3	74.11	24.92	124.79	2.80	0.94	4.72

3.2. 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) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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/m^3	1860.92	516.86	3057.70	70.06	19.46	115.11
20 µg/m^3	1548.96	425.92	2570.11	58.31	16.03	96.76
By 3,5 µg/m^3	249.36	65.91	430.19	9.39	2.48	16.20

Table 2. Cardiopulmonary deaths >30 years, male and female, for one year (ICD9 401-440 and 460-519) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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/m^3	1135.29	442.60	1730.12	42.74	16.66	65.13
20 µg/m^3	951.31	366.11	1467.84	35.81	13.78	55.26
By 3,5 µg/m^3	157.28	57.50	255.19	5.92	2.16	9.61

Table 3. Lung cancer deaths >30 years, male and female, for one year (ICD9 162) (2001). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2001) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. 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/m^3	271.66	103.64	404.77	10.23	3.90	15.24
20 µg/m^3	229.68	85.95	348.40	8.65	3.24	13.12
By 3,5 µg/m^3	39.39	13.63	64.40	1.48	0.51	2.42