LJUBLJANA CITY REPORT

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CITY REPORT PLAN
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LJUBLJANA CITY REPORT

Summary of the main findings

The analysis estimated that reduction of the long-term PM pollution to the levels of PM2,5 of 15 µg/m^3 would reduce mortality in Ljubljana by 76 deaths in one year, which would save 952 years of expected life for starting year of simulation. If the daily means of PM10 would be kept under 20 µg/m^3 8 deaths and 50 hospital admissions could have been avoided in the year 2000.

Principal sources of air pollution were described in detail in the previous Apheis city report last year (www.apheis.org). There is no important new point source. Transportation is still the main source of air pollution in mostly because of public transport in the city. We do not expect any major changes refer to sources of pollution in incoming years.

Background

Air pollution levels generally continue to fall in Ljubljana. BS and PM10 were used to estimate the exposure for Ljubljana to air pollution in the past APHEIS study. The annual daily mean level of BS has been decreasing for at least 10 years, from 1999 to 2000 decreased for another 20 % and has probably reached the bottom level (15 µg/m3). The levels of PM10 are of much greater concern. The annual daily mean level of PM10 is not decreasing and was 35,7 µg/m3 in 1999.

The relevance of the APHEIS study is estimate the exposure inhabitants to air pollution. The main finding is that the air pollution continues to pose a significant threat to public health in the city.

The main source of PM10 pollution is still traffic in the city. On long run more than 300 lives per year could be spared, providing that long term PM10 average annual value would not exceeded 10 ug/m^3. So we should take more actions to reduce traffic pollution. It all depends on new traffic policy that should be implemented in next few years.

At local level a network of cycling paths should be more extensively planned. Ministry of Health decided to go for a big health promotion campaign, promoting physical activity with emphasize on physical transport. And information was also given to city council and on to services that usually do planning and development and to general public.

The Ljubljana metropolitan area had a population of 263 290 on 30th June 2000. The number of people over 65 years was 55 060 (20,9 %). It has a climate that is transition between continental and alpine, with prevailing weak local winds, influenced by urban heat island. Ljubljana is located in basin with regular temperature inversions. The meteorological conditions are extremely unfavourable and dramatically contribute to build up of pollution. The average wind speed is below 1 m/s and average yearly daily temperature is 10,9 °C.

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	70	30	/	/

There is no important new point source except central heating plant, which was in a past important source, but significantly lost it s importance due to the use of high quality coal and introduction of sophisticated cleaning system. Most of classical emission sources are already removed. Transportation is still the main source of air pollution in Ljubljana: mostly because of public transport in the city. We do not expect any major changes refer to sources of pollution in incoming years.

Exposure data

The pollution indicators are monitored by Agency for Environment. Only measurements from urban background stations that are geographically representative of the study area and not directly influenced by local sources of air pollution were selected: two stations for PM10 and three stations for BS. We plan to introduce monitoring of PM2,5 next year at least at the beginning of 2005.

PM 10 Monitoring cite	*Type*
Figovec	Urban background

BS Monitoring cite	*Type*
Agency for Environment	Urban background

We used 24 – hour average values. The daily mean value of one station is selected only if more than 80 % of hourly values are available.

Daily mean levels for year 2000 were:
- daily mean levels (SD) of BS were 15,3 $\mu g/m^3$
- daily mean levels (SD) of PM10 were 31,5 $\mu g/m^3$
- daily mean levels (SD) of PM2,5 were 22,1 $\mu g/m^3$.

Data for PM2,5 were converted from data for PM10 by conversion factor 0,7. For purpose of long-term health impact assessment we used conversion factor 1,3.

The levels of BS reached during 366 days with the lowest (5^{th} percentile) and the highest (95^{th} percentile) levels were respectively 3,0 $\mu g/m^3$ and 43,8 $\mu g/m^3$.

The levels of PM10 reached during the 346 days with the lowest (5^{th} percentile) the highest (95^{th} percentile) levels were respectively 4,1 $\mu g/m^3$ and 71,9 $\mu g/m^3$.

The levels of PM2,5 reached during the 346 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 2,9 µg/m^3 and 50,3 µg/m^3.

Meteorological data were provided by Agency for Environment too. The data includes, on a daily basis minimum, mean, maximum temperature and relative humidity from sampling station in Agency for Environment yard.

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

	Short term		**Long term**	
Air pollutant	**PM_{10} / BS**	**$PM_{2,5}$**	**PM_{10}**	**$PM_{2,5}$**
Number of days above	20 µg/m^3	14 µg/m^3	20 µg/m^3	15 µg/m^3
	228 / 68	**228**	**255**	**246**
Number of days above	50 µg/m^3	35 µg/m^3	40 µg/m^3	20 µg/m^3
	61 / 15	**61**	**157**	**216**

The levels of BS were much higher in the winter because of heating. Same parts of city still use for heating poor quality coal. The levels of PM10 and PM2,5 correlate and there is no difference in pollution levels between summer and winter.

We do not expect any major changes in air pollutants levels in incoming years. Most of classical emission sources are already removed and not much improvement can be expected from this side. It all depends of new traffic policy.

Health data

National Institute of Public Health provides mortality and hospital admission data. For year 2000 standardised mortality rate using European population was 781.08 per 100 000 inhabitants. Total European population (both sexes combined): 727 304 (in thousands) for year 2000[1].

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

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

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	**6,86**	954,1
Cardiovascular mortality	390-459	I00-I99	**2,95**	409,8
Respiratory mortality	460-519	J00-J99	**0,49**	68,7
Cardiac hospital admissions	390-429	I00-I52	**6,29**	873,9
Respiratory hospital admissions	460-519	J00-J99	**4,93**	684,8
Long term HIA				
All causes mortality	0-999	A00-Y98	**7,36**	1022,4
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	**3,29**	456,9
Lung cancer mortality	162	C33-C34	**0,39**	54,3

* For short and long term scenarios

Slight decrease of number of births expected. Independent research institutions do predict a slight decrease, but it also depends on number of newly come immigrants.

Health impact assessment

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In the city of Ljubljana, these scenarios were built for three indicators of this particulate pollution: BS, PM10 and PM2,5. Different tools and different estimates were used for evaluating the short- and long-term impacts of this particulate pollution on health.

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

	Health indicator	ICD		Tool	RR (95% IC) For 10 $\mu g/m^3$ increase
Attributable cases		**ICD9**	**ICD10**		
		ST HIA for all cities report			
PM10	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.008)
	All ages, cardiovascular mortality	390-459	I00-I99		WHO, 2003: 1.009 (1.005 - 1.013)
	All ages, respiratory mortality	460-519	J00-J99		WHO, 2003: 1.013 (1.005 - 1.021)
	All ages, cardiac hospital admissions	390-429	I00-I52		Le Tertre et al. 2002: 1.006 (1.003 - 1.009)
	All ages, respiratory hospital admissions	460-519	J00-J99		Apheis 3: 1.0114 (1.0062 - 1.0167)
BS	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.009)
	All ages, cardiovascular mortality	390-459	I00-I99		WHO, 2003: 1.004 (1.002 - 1.007)
	All ages, respiratory mortality	460-519	J00-J99		WHO, 2003: 1.006 (0.998 - 1.015)
	All ages, cardiac hospital admissions	390-429	I00-I52		Le Tertre etal. 2002:1.011 (1.004 - 1.019)
	All ages, respiratory hospital admissions	460-519	J00-J99		Apheis 3: 1.0030 (0.9985 -1.0075)
PM10 Distributed lag (40 days)	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Zanobetti et al. 2002: 1.01227 (1.0081 - 1.0164)
	All ages, cardiovascular mortality	390-459	I00-I99		Zanobetti et al. 2003: 1.01969 (1.0139 - 1.0255)
	All ages, respiratory mortality	460-519	J00-J99		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 BS, short-term findings are expressed in terms of number of attributed deaths per year
- 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 BS/ PM_{10} on mortality and hospital admissions over one year:

<u>Short term HIA scenarios for BS</u>

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.

<u>Short term HIA scenarios for PM10</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 PM10</u>**

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 a local estimates in the combined (meta-analytic) one.

Long-term scenarios

Long-term HIA scenarios for PM10

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})

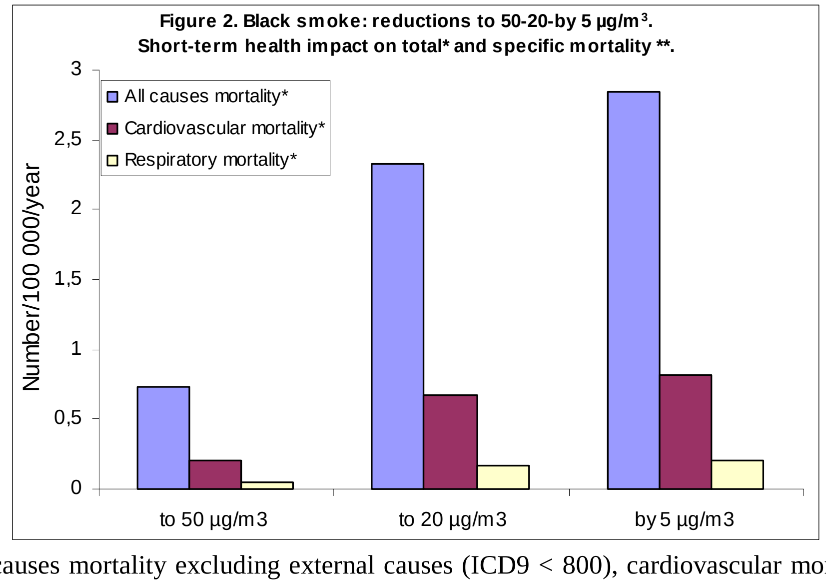
Long term HIA for PM2,5

We estimated chronic effects of PM2,5 in the Ljubljana 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 PM2,5 to a level of 20 µg/m^3 [2]
- reduction of the annual mean value of PM2,5 to a level of 15 µg/m^3 [2]
- reduction by 3,5 µg/m^3 in the annual mean value of PM2,5 (to allow for cities with low levels of PM2,5)

BS findings

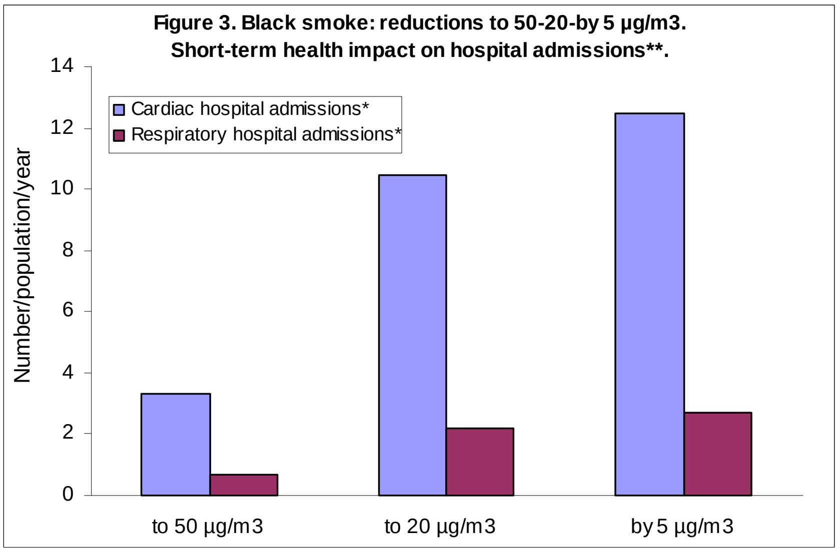
Add a graph for all causes mortality (excluding external causes), cardiovascular mortality and respiratory mortality.



* All causes mortality excluding external causes (ICD9 < 800), cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519).
** Black smoke data for 2000, mortality data for 2000.

Reduction of short term BS exposure by 5 µg/m^3 would be the most significant and would reduce total mortality by 3 persons, mortality due to cardiopulmonary diseases by approximately 1 person and mortality due to lung cancer by 0,2 person.

A graph for cardiac and respiratory hospital admissions.



* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519).
** Black smoke data for 2000, hospital admissions data for 2000.

Again, reduction of short term BS exposure by 5 µg/m^3 would be the most significant and would reduce cardiac hospital admissions by 13 persons and respiratory hospital admissions by 3 persons.

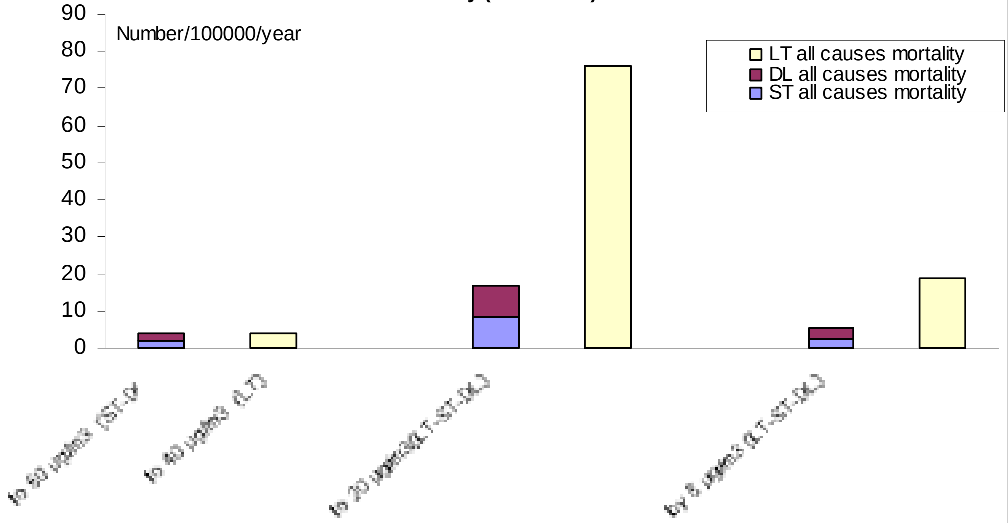
PM10 findings

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

1.1. Mortality findings

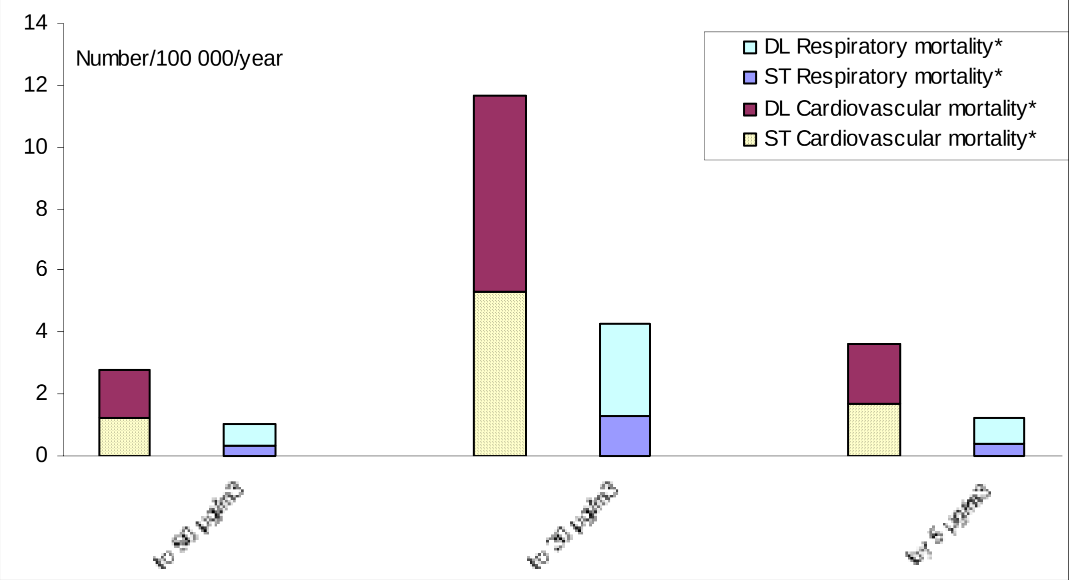
The following graphs show the health impact of PM10 on mortality for different lags: short-term-ST (0-1 day lag), cumulative effect –DL-distributed lag (up to 40 days lag) and long-term LT (years).

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/m³.
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.

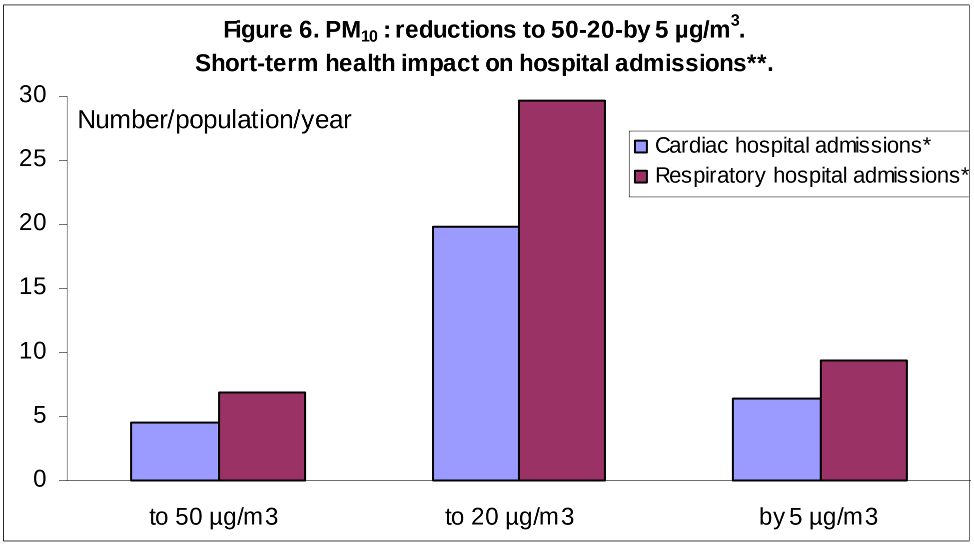
There is a difference in attributable cases between LT, ST and DL for PM_{10} on mortality. It seems that larger effect can be evenly ascribed to short and long term exposure. The effect is most pronounced in medium exposure. Thus it would most effective to reduce PM_{10} to 20 µg/m^3. Benefits of reducing are most clearly shown when studying long term (LT) health impact on all causes mortality: reduction to the levels of 20 µg/m^3 would reduce total mortality in Ljubljana by 76 deaths. The same reduction would reduce total mortality by 8 in case of short term health impacts and by 17 in case of cumulative health impacts.

Cumulative (DL) health impacts on all causes mortality and on specific mortalities are all approximately two times higher than short term (ST) assessments. Reduction of short term PM_{10} exposure to 20 µg/m^3 would reduce mortality due to cardiovascular diseases by 5 persons and mortality due to respiratory diseases by more than 1 person. In cumulative case reduction to 20 µg/m^3 would reduce mortality due to cardiovascular diseases by 12 persons and mortality due to respiratory diseases by more than 4 persons.

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.

Add one graph for cardiac and respiratory admissions. See next example.



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

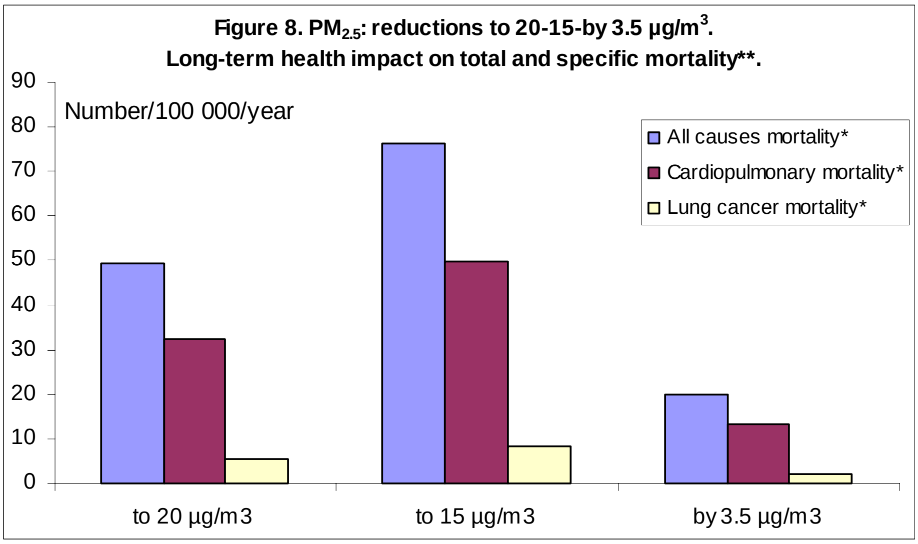
Reduction to 20 µg/m^3 would mean a significant reduction of hospital admissions in Ljubljana: by 20 patients in case of cardiac and by 30 patients in case of respiratory hospital admissions.

PM2,5 findings

1. Number of attributed cases

We also used three scenarios to estimate the chronic effects of long-term exposure to PM2,5 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.



* 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

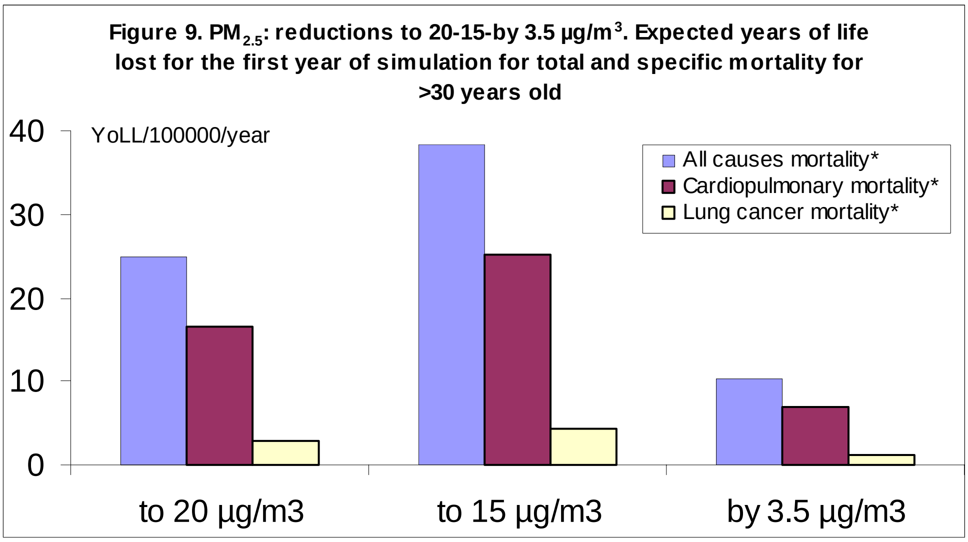
Reduction of long term $PM_{2,5}$ exposure to 20 µg/m^3 would reduce total mortality by 49 persons, mortality due to cardiopulmonary diseases by 32 persons and mortality due to lung cancer by 5 persons.

Reduction of long term $PM_{2,5}$ exposure to 15 µg/m^3 would reduce total mortality by 76 persons, mortality due to cardiopulmonary diseases by 50 persons and mortality due to lung cancer by 8 persons.

Reduction of long term $PM_{2,5}$ exposure by 3,5 µg/m^3 would reduce total mortality by 20 persons, mortality due to cardiopulmonary diseases by 13 persons and mortality due to lung cancer by 2 persons.

2. Years of life lost

We estimated the years of life lost attributable to the chronic effects of PM2,5 using the data for year 2000. Figure 9 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 Ljubljana.



* 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 around 27 years of expected life for starting year of simulation in people older than 30 years in the city of Ljubljana. For cardiopulmonary mortality, this number would be 18 and for lung cancer mortality around 3 years.

For all causes of deaths, all other things being equal, reduction of $PM_{2,5}$ to 15 µg/m^3 in 2000 would save almost 102 years of expected life for starting year of simulation in people older than 30 years in the city of Ljubljana. For cardiopulmonary mortality, this number would be almost 67 and for lung cancer mortality around 11 years.

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 Ljubljana.

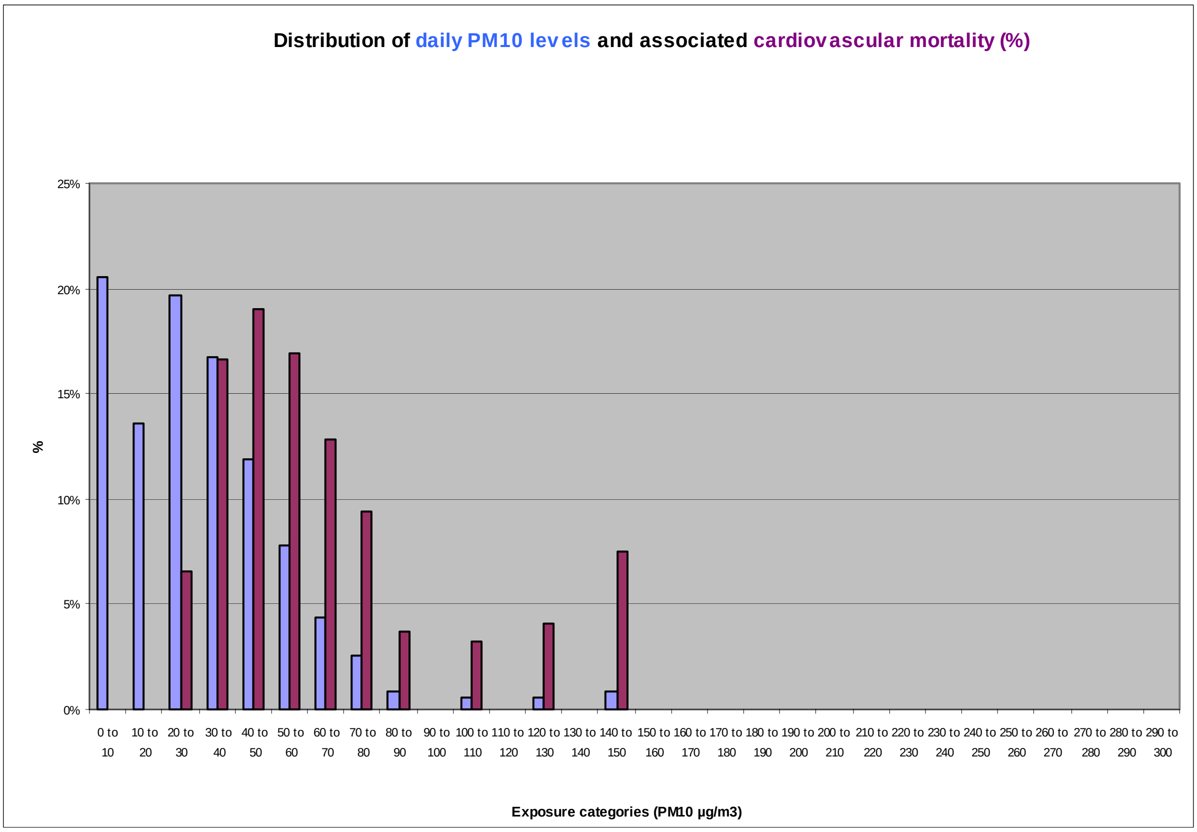
		Expected gain in life expectancy		
Age	Life expectancy	Mean	Low estimate	High estimate
At birth	76,34	0,62	0,16	1,08
30	47,41	0,63	0,17	1,10
65	16,94	0,46	0,12	0,80

In terms of life expectancy, all other things being equal, if annual mean $PM_{2,5}$ levels (22,1 µg/m^3) would be reduced to 15 µg/m^3, more than 47 years of life expectancy in a person of 30 years old would be increased by approximately one year, due to reduced risk of death from all causes in the city of Ljubljana. And approximately 17 years of life expectancy in a person of 65 years old would be increased by almost one year.

Interpretation of findings

Relative importance of air pollution peaks during a few days compared to daily exposure to lower levels of air pollution over longer periods have much larger impact on mortality.

Short term distribution of PM10 levels and associated percentage of cases



General comments

Imposing a ban on traffic in city center, going for electrification of public transport are ideas already in place long time. The main obstacles to realize them is usually lack of money and unwillingness – even of responsible stakes to give up personal transport – cars.

The stakes are members of City council and public. Public Health Sector was asked to prepare a health assessment of present levels of air and water pollution. We were asked by city council to give an assessment of health effect of present levels of pollution. From this respect APHEIS program was extremely valuable, we were not the ones who had to find ways how to present results but were asked to do that. APHEIS program and part assessing the impact of consumption drinking water were presented at city council to all decision makers and their advisors. They were given a very comprehensive information, a full APHEIS report and separately parts about the city. Information so far was accepted and given to planning dept and urban development. Information was also presented at higher political level, at few ministries, health, transport and environment. There was a strong support from government level for necessary activities to take remedial actions. Ministry of transport put all the responsibility to local government, which is responsible for local transport and urban planning.

Ministry of Health decided to go for a big health promotion campaign, promoting physical activity with emphasize on physical transport – walking any cycling as a mode of public transport. At local level which is really the most important a network of cycling paths will be more extensively planned.

There is a kind of reluctance about imposing ban on traffic in city center. I did not get right answer why this is like that. The information was given on to services that usually do planning and development and to general public. While the information was presented to city council media was in place. The access to information is given to anybody. The quality of information was never questioned by anybody. Information about air pollution and health impact was fully accepted and considered scientific.

Conclusions

We intend to run on Apheis surveillance system and inform stakeholders and public about our findings. City air pollution policy should follow recommendations and findings. We would you like to develop Apheis communications tools if Apheis develop the appropriate templates. We would certainly well come HIA developments of water pollution and noise pollution programs and would you like to include them in the future besides air pollution.

Appendix

1. **Add the questionnaires for your city on the exposure measurement methods and health data**

2. **Tables for black smoke findings**

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

Table 1. Deaths all causes (ICD9 < 800) (2000). Potential benefits of reducing daily BS 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 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	68	6,14	4,08	9,27	2,33	1,55	3,52
50 µg/m^3	15	1,93	1,28	2,91	0,73	0,49	1,10
By 5 µg/m^3	NA*	7,48	4,97	11,21	2,84	1,89	4,24

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459) (2000). Potential benefits of reducing daily BS 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 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	68	1,75	0,87	3,08	0,67	0,33	1,17
50 µg/m^3	15	0,55	0,27	0,96	0,21	0,10	0,36
By 5 µg/m^3	NA*	2,15	1,07	3,75	0,82	0,41	1,43

NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (2000). Potential benefits of reducing daily BS 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 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	68	0,44	-0,15	1,13	0,17	-0,06	0,43
50 µg/m^3	15	0,14	-0,05	0,35	0,05	-0,02	0,13
By 5 µg/m^3	NA*	0,54	-0,18	1,34	0,20	-0,07	0,51

NA: not applicable

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (2000). Potential benefits of reducing daily BS 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 (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	68	10,44	3,75	18,33
50 µg/m^3	15	3,33	1,19	5,84
By 5 µg/m^3	NA*	12,48	4,55	21,51
Hospital admissions for respiratory diseases (all ages)				
20 µg/m^3	68	2,19	-1,08	5,52
50 µg/m^3	15	0,68	-0,34	1,72

By 5 µg/m³	NA*	2,69	-1,35	6,73

**NA: not applicable*

3. Tables for PM_{10} findings

3.1. 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/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	228	21,66	14,39	28,98	8,23	5,47	11,01
50 µg/m³	61	4,96	3,29	6,64	1,88	1,25	2,52
By 5 µg/m³	NA*	7,00	4,67	9,33	2,66	1,77	3,54

**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/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	228	13,98	7,71	20,33	5,31	2,93	7,72
50 µg/m³	61	3,23	1,78	4,71	1,23	0,68	1,79
By 5 µg/m³	NA*	4,47	2,49	6,45	1,70	0,94	2,45

**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 $\mu g/m^3$	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
20 $\mu g/m^3$	228	3,39	1,29	5,56	1,29	0,49	2,11
50 $\mu g/m^3$	61	0,80	0,30	1,31	0,30	0,11	0,50
By 5 $\mu g/m^3$	NA*	1,07	0,41	1,73	0,41	0,16	0,66

**NA: not applicable*

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (2000). Potential benefits of reducing daily PM_{10} levels (2000) above 20 to 20 $\mu g/m^3$, above 50 to 50 $\mu g/m^3$ and all days by 5 $\mu g/m^3$. 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 $\mu g/m^3$	N° of deaths central	N° of deaths lower	N° of deaths upper
Hospital admissions for cardiac diseases (all ages)				
20 $\mu g/m^3$	228	19,84	9,87	29,91
50 $\mu g/m^3$	61	4,54	2,26	6,86
By 5 $\mu g/m^3$	NA*	6,41	3,21	9,61
Hospital admissions for respiratory diseases (all ages)				
20 $\mu g/m^3$	228	29,6	15,97	43,8
50 $\mu g/m^3$	61	6,91	3,72	10,23
By 5 $\mu g/m^3$	NA*	9,40	5,12	13,75

**NA: not applicable*

3.2. 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	228	44,4	29,1	59,8	16,9	11,07	22,7
50 µg/m^3	61	10,39	6,80	14,01	3,95	2,58	5,32
By 5 µg/m^3	NA*	14,06	9,29	18,78	5,34	3,53	7,13

**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	228	30,8	21,5	40,2	11,68	8,17	15,28
50 µg/m^3	61	7,37	5,14	9,66	2,80	1,95	3,67
By 5 µg/m^3	NA*	9,49	6,71	12,27	3,60	2,55	4,66

**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	228	11,18	2,74	20,94	4,25	1,04	7,95
50 µg/m^3	61	2,88	0,70	5,45	1,06	0,27	2,07
By 5 µg/m^3	NA*	3,19	0,83	5,59	1,21	0,32	2,12

**NA: not applicable*

3.4. **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) (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	200,8	120,3	287,6	76,3	45,7	109,2
40 µg/m^3	9,81	5,98	13,81	3,73	2,27	5,25
By 5 µg/m^3	49,5	30,0	69,9	18,8	11,4	26,5

4. **Tables for PM2,5 findings**

4.1. LT PM2,5: 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) (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 PM2,5.

	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	201,2	51,2	360,9	76,4	19,4	137,1
20 µg/m^3	129,6	33,3	229,9	49,2	12,7	87,3
By 3,5 µg/m^3	53,0	13,8	92,9	20,1	5,24	35,3

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (2000). Potential benefits of reducing annual mean values of PM2,5 (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM2,5.

	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/m³	130,8	45,6	223,2	49,7	17,3	84,8
20 µg/m³	84,9	30,0	142,7	32,2	11,4	45,2
By 3,5 µg/m³	35,0	12,6	57,9	13,3	4,77	22,0

Table 3. Lung cancer deaths (ICD9 162) (2000). Potential benefits of reducing annual mean values of PM2,5 (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM2,5.

	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/m³	21,5	6,93	37,9	8,18	2,63	14,40
20 µg/m³	14,09	4,64	24,3	5,35	1,76	9,22
By 3,5 µg/m³	5,86	1,97	9,88	2,23	0,75	3,75

4.2. LT PM2,5: 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) (2000). Potential benefits of reducing annual mean values of PM2,5 (2000) 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 PM2,5.

	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	101,71	27,46	171,81	38,43	10,38	64,92
20 µg/m^3	65,77	17,58	112,23	24,85	6,64	42,41
By 3,5 µg/m^3	27,30	7,22	47,08	10,32	2,73	17,79

Table 2. 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 PM2,5 (2000) 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 PM2,5.

	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	66,69	25,06	105,31	25,20	9,47	39,79
20 µg/m^3	43,42	16,10	69,47	16,41	6,08	26,25
By 3,5 µg/m^3	18,15	6,64	29,45	6,86	2,51	11,13

Table 3. Lung cancer deaths >30 years, male and female, for one year (ICD9 162) (2000). Potential benefits of reducing annual mean values of PM2,5 (2000) 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 PM2,5.

	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	11,33	4,09	17,79	4,28	1,55	6,72
20 µg/m^3	7,45	2,63	11,92	2,81	1,00	4,50
By 3,5 µg/m^3	3,15	1,09	5,14	1,19	0,41	1,94