HEALTH IMPACT ASSESSMENT OF AIR POLLUTION

ENHIS-1 PROJECT: WP5 HEALTH IMPACT ASSESSMENT

LOCAL CITY REPORT

Barcelona

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Summary of main findings for Barcelona

In 2002 the PM_{10} annual mean (SD) was 39,7 (14,3) µg/m^3, almost the same that 1999/30/EC Directive limit value established for 2005 (40 µg/m^3) and above that established for 2010 (20 µg/m^3). For the summer period of the same year, the mean (SD), P5 (5th percentile) and P95 of the maximum daily 8-hour moving average concentration of ozone (O_3) were 40,7(12,5), 18,0 and 60,5 µg/m^3.

Regarding children, infant mortality in Europe is quite low and consequently, the expected attributable number of deaths related to air pollution is also very low. All other things being equal, the reduction of the annual average levels of PM_{10} to 20 µg/m^3 would prevent 0,45 total post neonatal deaths. Reducing PM_{10} daily mean values to 20 µg/m^3 would prevent 10 hospital respiratory admissions.

2002 was the first year of obtaining PM10 values in Barcelona, and it is convenient to consider that PM_{10} available data begin at April, there correspond to 3 workable days per week, and it has a completeness between 16% and 38% all over the year.

As far as short-term effects of O_3 in summer are concerned, all other things being equal, each reduction by 10 µg/m^3 of the daily maximum 8-hour moving average concentrations would delay 22 deaths per year in the general population in the study area, 11 from cardiovascular diseases, and 9 from respiratory causes. In terms of hospital admissions, this would represent 1 respiratory admissions in the adult population (15 to 64 years) and 21 in the population over 64 years.

Summary of HIA of outdoor air pollution in Barcelona in ENHIS-1

Health outcome	Population	Pollutant	Period	Mean type	RR (for 10 µg.m^3 increase)	*References*	Number of attributable cases by scenario[1]	
Mortality							**Ozone: Reduction by 10 µg.m^3**	**PM10[4]: Reduction by 5 µg/m^3**
Total mortality excluding external causes (ICD9 < 800 - ICD10 A00-R99)	All ages	O_3 8h max	Summer[2]	Daily	1.0031 (1.0017-1.0052)	Gryparis et al 2004	22.08 (12.11-37.04)	
Cardiovascular mortality (ICD9 390-459 - ICD10 I00-I99)					1.0046 (1.0022-0.0073)		10.97 (5.25-17.41)	
Respiratory mortality (ICD9 460-519 - ICD10 J00-J99)					1.0113 (1.0074-1.0151)		8.86 (5.80-11.83)	
Total postneonatal mortality	1 month-1 year	Corrected PM_{10}[3]	Year	Annual	1.048 (1.022-1.075)	Lacasaña et al 2005		0.12 (0.05-0.18)
Postneonatal respiratory mortality (ICD9 460-519 - ICD10 J00-J99)					1.216 (1.102-1.342)			0.10 (0.05-0.15)
Postneonatal Sudden Infant Death Syndrom Mortality (ICD9 798.0 - ICD10 R95)					1.12 (1.07-1.17)	Woodruff 1997		0.03 (0.02-0.04)
Morbidity								
Emergency room visits for asthma (ICD-9 codes 493, ICD-10 codes J45, J46)	< 18 years	O_3 1h max	Year	Daily	1.0115 (1.0067-1.0163)	CARB 2004	not available	
Cough	< 18 years	Measured PM_{10}			1.0407 (1.0202-1.0511)	Ward and Ayres 2004		not available
Lower respiratory symptoms LRS	< 18 years	Measured PM_{10}			1.0407 (1.0202 -1.617)	Ward and Ayres 2004		not available
Hospital respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	< 15 years	Measured PM_{10}			1.010 (0.998-1.021)	Anderson et al 2004		2.48 (-0.50-5.20)
Hospital respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	15 - 64 years	**O_3 8h max**	Summer		1.001 (0.991-1.012)		1.36 (-12.24-16.33)	
Hospital respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	> 64 years				1.005 (0.998-1.012)		21.13 (-8.45-50.71)	

[1] For ozone: absolute reduction by 10 µg/m^3. For PM_{10} absolute reduction by 5 µg/m^3.

[2] Definition of summer period : 01 April – 30 September

[3] PM_{10} reference papers for HIA on postneonatal mortality use gravimetric methods to measure PM_{10}.

[4] PM_{10} available data begin at 2002, April

Introduction

The city of Barcelona is located on the western shore of the Mediterranean Sea, bordered by the Collserola mountain range to the north, the river Besòs to the east and the river Llobregat to the west. It is 160 km from the Pyrenean border with France. It has a Mediterranean climate. The average of mean daily temperature for the year 2002 was 15,1 ºC, with 12,2 ºC and 19,5 ºC as the correspondent averages for daily minimum and maximum temperatures. For the same period, average of daily relative humidity was 72%, average rainfall was from 18 to 166 mm/month and main direction of the wind was SW. (1)

The situation of Barcelona between the sea and the Collserola mountain on two sides, and the two rivers on the other two sides produces a special micro-meteorological patterns in diffusion and stagnation of the atmospheric pollutants along the year.

Great part of the economic activity of Barcelona covers services sector, and in less proportion industry and construction. In 2002 and 2001 the population was 1.527.190 and 1.503.884 people, respectively. Annual rates have been calculated with population data of the 2001 because there is no available data of population distribution of year 2002. The population in Barcelona is aging and the proportion of the population older than 65 years has increased during the last years. 18% of the male population and 25% of the female population is older than 65 years. (2)

The main source of air pollution in Barcelona is traffic, and special micro-meteorological conditions play and important role. Air pollutants levels in Barcelona city are within that established by current regulations. Total suspended particulate matter (TSP), NO_2, lead and CO levels have not exceeded minimum levels admissible. Annual O_3 levels don't reached any day the information threshold. In 2002, began the PM_{10} measures, with 5 monitoring stations in the city.

Infantile mortality is very low, and has fallen during the current decade, as a function of the early neo-natal and the post-neonatal mortality, consequence of the more widespread use of methods of assisted reproduction. The causes responsible for most peri-natal and infantile deaths are conditions related directly with the pregnancy (placenta, amnios and umbilical cord), along with complications in the delivery, followed by congenital abnormalities. (3)

This work has been carried out within the framework of work package WP5 on health impact assessment of ENHIS-1 project (www.enhis.net).

Last Health Impact Assessment (HIA) of air pollution corresponded to black smoke exposure at year 2000, and was elaborated in the context of APHEIS network. The daily mean for total mortality (ICD<800) was 38,47 and Standard Deviation 8,34. Achieving a scenario with all days with BS mean levels under 20 ?g/m^3 could reduce the number of total deaths by 84 persons (5,5 deaths per 100.000 inhabitants), of cardiovascular deaths by 19 persons (1,3 deaths per 100.000 inhabitants) and respiratory deaths by 10 persons (0,7 deaths per 100.000 inhabitants). Additionally, cardiac and respiratory hospital admissions would be reduced by 219 and 78 persons respectively. (4)

Sources of air pollution

As it was already mentioned in the third year report of Apheis, traffic is the main source of air pollution in Barcelona (5). According to a study carried out in 1993, the emissions coming from cars are responsible of 35% of particles, whereas other potential sources of pollution such as industry or combustion contribute with only 1%.

On the other hand, it exists sometimes an important contribution of pollutants originated beyond the border, as O_3 coming probably from the south of France or particulate matter originated in North Africa.

Also, Barcelona acts sometimes as exporter of ozone precursors to the neighbour areas.

Exposure data

Pollution indicators are monitored by the *Direction for Environmental Surveillance* (Direcció de Vigilància Ambiental). Experts have selected measurements from monitoring stations more representative from Barcelona city.

PM_{10} has been monitored by 5 traffic stations with a gravimetric method of measurement. O_3 has been monitored by 3 traffic stations and one background station, both with UV absorption method of measurement.

PM_{10} monitoring stations in Barcelona are classified as "traffic", but there are also representative of the air at which are exposed city inhabitants. This is because Barcelona is very dense in population and with a traffic dense or very dense in the whole urban area.

Indicators have been calculated following APHEIS protocol, that refers to data quality objectives. (6)

- PM_{10}: daily exposure indicator has been calculated as the arithmetic mean of the daily concentrations measured at monitoring stations.
- Ozone: The daily maximum 1-hour indicator has been calculated as the arithmetic mean of the 1-hour maximum of the stations. The daily maximum 8-hour moving average of each day have been calculated as the arithmetic mean of the maximum 8-hour moving averages of the stations for the summer period (1st April to 30th September).

The annual mean level (SD) of PM_{10} in Barcelona was 39,7 (14,3) µg/m^3, and P5 and P95 of the daily mean values were, respectively, 19,5 µg/m^3 and 65,1 µg/m^3. The mean (SD) , P5 and P95 of the daily maximum 8-hour moving average concentrations of O_3 were, respectively, 40,7(12,5), 18,0 and 60,5 µg/ m^3, and those of the daily maximum 1-hour concentrations 57,6 (24,0), 16,0 and 93,8 µg/m3 (Table 1 and figures 1 -3)

Figure 1 shows distribution of O_3 8h max in summer period of 2002. The most frequent daily means are between 30 and 50 ?g/m^3 with a symmetrical distribution. Maximum and minimum values are 73 and 8, respectively.

Figure 2 shows distribution of O_3 1h max for year 2002. The most frequent daily means are between 60 and 70 ?g/m^3 with an asymmetrical distribution. Maximum and minimum values are 118 and 4, respectively.

Figure 3 shows distribution of PM_{10} for year 2002. The most frequent daily means are between 30 and 40 ?g/m^3 with an asymmetrical distribution. Maximum and minimum values are 97 and 7, respectively.

PM_{10} data quality objectives are fulfilled from April until December of 2002. For this reason, we are preparing a report that includes Black Smoke data of 2002. In the future, we will do the same with PM_{10} data of 2003.

Table 1. Descriptive statistics for ozone and PM_{10} levels in Barcelona, 2002

	O3 8h - summer	O3 1h max - year	PM_{10} - year
Number	183	365	187
Minimum	8	4	7
Percentile 5	18	16	19
Percentile 25	32	39	30
Median	41	61	38
Percentile 75	49	74	47
Percentile 95	61	94	65
Percentile 98	65	102	75
Maximum	73	118	97
Daily mean	41	58	40
standard error	13	24	14
% missing values	0,00%	0,00%	48,77%

Fig 1. Distribution of daily O3 8h max in Barcelona area. Summer 2002

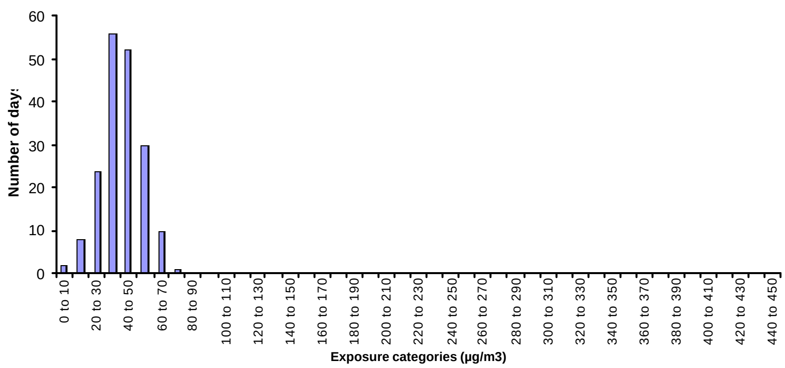


Fig 2. Distribution of daily O3 1h max in Barcelona area. Year 2002

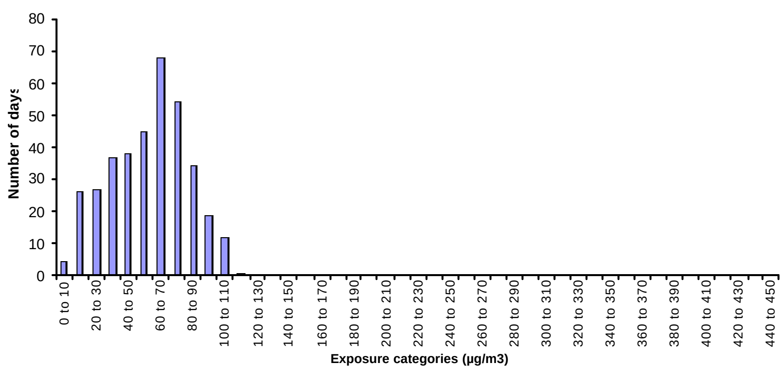
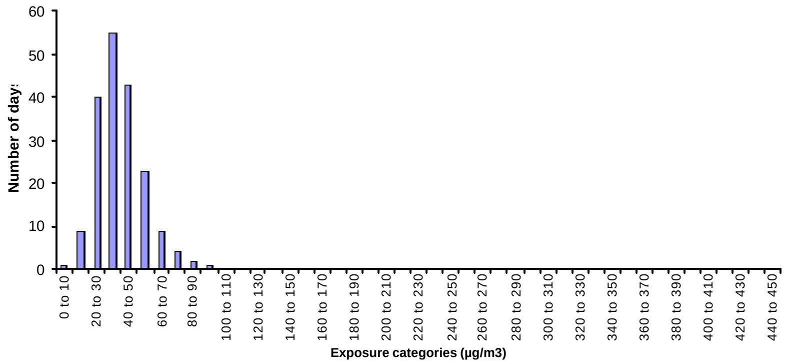


Fig 3. Distribution of daily PM 10 in Barcelona area. Year 2002



Health data

2002 Health data come from two different sources:

- Mortality data are provided by the *Public Health Observatory, Public Health Agency of Barcelona* (Observatori de Salut Pública, Agència de Salut Pública de Barcelona) and covers deaths on location (for the HIA only deaths of residents occurred in Barcelona have been selected). The register has a quality control program with a percentage of missing data in mortality cause equal than 0% and a completeness criteria above 70%.
- Hospital admissions data are provided by the *Health Department of the Regional Government* (Departament de Salut, Generalitat de Catalunya). For the HIA only emergency admissions of residents in public and private hospitals of Barcelona city have been selected. The register has a quality control program with a percentage of missing data in admission cause equal than 0,20% and a completeness criteria above 95%.

Mortality data are coded by the ICD10 and hospital admissions data are coded by the ICD9.

Cough, lower respiratory symptoms and emergency room visits for asthma are not registered as a matter of course in Barcelona, therefore they are not available.

Table 2 . Descriptive statistics for health outcomes in Barcelona, 2002

Health outcome	ICD9	ICD10	Annual deaths	Annual rate (per 100 000)	Daily mean (SD)	Daily rate (per 100 000)	Annual incidence rate (per 100 000)
POSTNEONATAL MORTALITY							
Total			10	78,85			
Respiratory *ICD9 460-519 ICD10 J00-J99*	460-519	J00-J99	2	15,77			
Sudden infant death syndrome *ICD9 798.0 – ICD10 R95*	798.0	R95	1	7,88			
GENERAL POPULATION MORTALITY							
Total mortality all causes *ICD9 <800 ICD10 A00-R99*	<800	A00-R99			39,29 (8,21)	2,61	
Cardiovascular mortality *ICD9 390-459 ICD10 I00-I99*	390-459	I00-I99			13,21 (4,44)	0,88	
Respiratory mortality *ICD9 460-519 ICD10 J00-J99*	460-519	J00-J99			4,43 (2,57)	0,29	
MORBIDITY							
Cough					not available		
Lower respiratory symptoms LRS					not available		
Emergency room visits for asthma - Age < 18 years *ICD9 493, ICD10 J45 J46*	493	J45-J46			not available	not available	
Hospital respiratory admissions - Age < 15 years *ICD9 460-519 ICD10 J00-J99*	460-519	J00-J99					580,55
Hospital respiratory admissions - Age 15 -64 years	460-519	J00-J99					270,87
Hospital respiratory admissions - Age > 64 years	460-519	J00-J99					2626,60

Health Impact Assessment

Methodology

Health impact of air pollution (AP) has been calculated as the annual number of health events attributable to AP in the target population. A causal relationship between AP and the effects is assumed, and therefore HIA can only be performed for those outcomes with sufficient evidence of causality. Once the effects with sufficient evidence of causal relationship with AP have been determined, the next step is to find the best exposure-response functions (ERFs) for each of the selected outcomes. Table 3 shows the result of a systematic review on these issues carried out by the Bilbao Apheis team (7) for WP5 of ENHIS-1. This table summarizes the health outcomes and ERFs deemed suitable for HIA according to the criteria established by WP5 with the advice of the air pollution experts of WP5[5].

[5] Ferran Ballester: Valencian School of Health Studies, Valencia, Spain; Sylvie Cassadou: National Institute of Public Health Surveillance, InVS, Toulouse, France; Fintan Hurley: Institute of Occupational Medicine, Edinburgh, Scotland, UK; Nino Künzli: University of Southern California, Division of Occupational and Environmental Health, Los Angeles, CA, USA; Odile Meckel: Institute of Public Health NRW (LOEGD), Bielfeld, Germany; Hans-Guido Mücke: WHO Collaborating Center (Air)-Federal Environmental Agency, Berlin, Germany; Nikolaos Stilianakis: Institute for Environment and Sustainability, European Commission – JRC, Ispra, Italy.

Table 3. Health outcomes and Exposure-response functions (ERFs) selected for health impact assessment

	OUTCOME	POLLUTANT	ERFs	ORIGINAL SOURCE
CHILDREN – PARTICLES				
	Total postneonatal mortality (1 month-1 year)	PM_{10} Annual Mean	RR=1.048 (1.022-1.075) ?10µg/m^3	Lacasaña et al 2005
	Postneonatal respiratory mortality ICD9 460-519 ICD10 J00-J99	PM_{10} Annual Mean	RR=1.216 (1.102-1.342) ?10µg/m^3	Lacasaña et al 2005
	Postneonatal Sudden Infant Death Syndrome (SIDS) mortality (normal birth weight =2500g) ICD9 798.0 –ICD10 R95	PM_{10} Annual Mean	Adjusted Odds Ratio AOR=1.12 (1.07-1.17) ?10µg/m^3	Woodruff et al. 1997
	Cough	PM_{10} Daily Mean	OR=1.041 (1.020-1.062) ?10µg/m^3	Ward & Ayres 2004
	Lower respiratory symptoms LRS	PM_{10} Daily Mean	OR=1.041 (1.020-1.051) ?10µg/m^3	Ward & Ayres 2004
CHILDREN – OZONE				
	Emergency room visits for asthma <18 Y ICD9 493, ICD10 J45 J46	Ozone Maximum 1 h	RR=1.0116 (1.0067-1.0165) ?10µg/m^3	CARB 2004
ADULTS/GENERAL POPULATION				
	Total mortality all causes ICD9 <800 ICD10 A00-R99	Ozone Maximum 8 h Summer	RR= 1.0031 (1.0017-1.0052) ?10µg/m^3	Gryparis et al 2004 (APHEA 2)
	Respiratory mortality ICD9 460-519 ICD10 J00-J99	Ozone Maximum 8 h Summer	RR= 1.0113 (1.0074-1.0151) ?10µg/m^3	Gryparis et al 2004 (APHEA 2)
	Cardiovascular mortality ICD9 390-459 ICD10 I00-I99	Ozone Maximum 8 h Summer	RR= 1.0046 (1.0022-1.0073) ?10µg/m^3	Gryparis et al 2004 (APHEA 2)

To be coherent with mortality findings, it was decided, with the experts' advice, to include RRs of hospital admissions in the health impact assessment calculations, even if they were not statistically significant. More concretely, it was decided that if there was not any new RR published by the time of making the calculations, the RRs for respiratory hospital admissions from Anderson's meta-analysis could be used, although they were not statistically significant (see Table 2). The rationale for that is that if there is sufficient evidence to accept a causal relationship between air pollution and respiratory mortality -both in children-PM and adults-O_3- we should easily accept that there will also be an impact on hospital admissions.

Table 4. Complementary Exposure-response functions (ERFs) for health impact assessment on respiratory hospital admissions for children (particles) and adults (ozone)

	OUTCOME	POLLUTANT	RR	SOURCE
CHILDREN - PARTICLES				
	Respiratory hospital admissions 0-14 Y ICD9 460-519 ICD10 J00-J99	*PM_{10}* Daily Mean	*RR= 1.010 (0.998-1.021) ?10µg/m³*	*Anderson 2004*
ADULTS/GENERAL POPULATION				
	Hospital respiratory admissions 15-64 Y ICD9 460-519 ICD10 J00-J99	*Ozone Maximum 8 h*	*RR=1.001 (0.991-1.012) ?10µg/m³*	*Anderson et al 2004*
	Hospital respiratory admissions >64 Y ICD9 460-519 ICD10 J00-J99	*Ozone Maximum 8 h*	*RR=1.005 (0.998-1.012) ?10µg/m³*	*Anderson et al 2004*

Finally, HIA needs defining the evaluation scenarios, i.e. the hypothetical scenario with which we want to compare the current air pollution situation. We calculate the impact on health of the (current) air pollution levels in the city that are above the pollution level of the evaluation scenario. In other words, the attributable number of health events (deaths, hospital admissions…) calculated for each scenario represents the number of events that would be prevented if, all other things being equal, air pollution levels were reduced to the evaluation scenario level. These evaluation scenarios are based on the objectives and limits established in 1999/30/CE, and 2002/3/CE Directives.

HIA scenarios

1 - HIA scenarios for PM_{10}

1.1.- Scenarios for HIA on **short-term** effects of PM_{10} and **cough, lower respiratory symptoms** in people under 18 year (<18), and **hospital respiratory admissions** in people under 15 year (< 15)

1.1.1 Reduction of PM_{10} levels to a 24-hour value of **50 µg/m^3** in all days exceeding this value (Limit of 1999/30/CE Directive)

1.1.2. Reduction of PM_{10} levels to a 24-hour value of **20 µg/m^3** in all days exceeding this value

1.1.3 Reduction **by 5 µg/m^3** of all the 24-hour values

1.2.- Scenarios for HIA on **long-term** effects of PM_{10} and **postneonatal mortality** (total, respiratory and sudden infant death syndrome-SIDS)

1.2.1 Reduction of the annual mean value of PM_{10} to a level of **40 µg/m^3** (Limit of 1999/30/CE Directive for 2005)

1.2.2 Reduction of the annual mean value of PM_{10} to a level of **20 µg/m^3** (Limit of 1999/30/CE Directive for 2010)

1.2.3 Reduction **by 5 µg/m^3** of the annual mean value of PM_{10}

2.- HIA scenarios on short-term effects of Ozone

1.2.1 Daily maximum 1-hour concentration and **emergency room visits for asthma** in people under 18 year (< 18)

1.2.1.1 Reduction of O_3 daily maximum 1-hour concentrations to a level of **180 µg/m^3** in all days exceeding this value (Information threshold of 2002/3/CE Directive)

1.2.1.2 Reduction **by 10 µg/m^3** of the daily maximum 1-hour concentrations

1.2.2 Daily maximum 8-hour moving average concentration and **mortality** in general population

1.2.2.1 Reduction of O_3 daily maximum 8-hour moving average concentrations to **120 µg/m³** in all days exceeding this value (Limit for health protection of 2002/3/CE Directive)

1.2.2.2 Reduction **by 10 µg/m³** in the daily maximum 8-hour moving average concentrations.

Findings

The annual number of postneonatal deaths attributable to PM_{10} levels higher than 20 ?g/m³ was 0,45 (95%CI: 0,20-0,71), which is equivalent to an annual rate of 3,55 deaths per 100 000 (95%CI: 1,58-5,60).

Table 5. Potential benefits of reducing PM_{10} levels. Absolute numbers and rates (per 100 000 children) (95% confidence limits) attributable to the health effects of PM_{10}.

	PM_{10} reduction	**Number of attributable cases per year**	**Annual rates (per 100.000)**
POSTNEONATAL MORTALITY	**Annual mean levels**		
Total	by 5 µg/m³	0,12 (0,05-0,18)	0,95 (0,39-1,42)
	to 20 µg/m³	0,45 (0,20-0,71)	3,55 (1,58-5,60)
	to 40 µg/m³	NA	NA
Respiratory	by 5 µg/m³	0,10 (0,05-0,15)	0,79 (0,39-1,18)
	to 20 µg/m³	0,33 (0,15-0,55)	2,60 (1,18-4,34)
	to 40 µg/m³	NA	NA
SIDS	by 5 µg/m³	0,03 (0,02-0,04)	0,24 (0,16-0,32)
	to 20 µg/m³	0,10 (0,06-0,15)	0,79 (0,47-1,18)
	to 40 µg/m³	NA	NA
MORBIDITY	**Daily levels**		
Cough <18 years	by 5 µg/m³	not available	not available
	to 20 µg/m³	not available	not available
	to 50 µg/m³	not available	not available
LRS <18 years	by 5 µg/m³	not available	not available
	to 20 µg/m³	not availabl e	not available
	to 50 µg/m³	not available	not available
Hospital respiratory admissions <15 years	by 5 µg/m³	2,48 (-0,50-5,20)	1,43 (-0,29-3,00)
	to 20 µg/m³	10,17 (-2,01-21,59)	5,87 (-1,16-12,47)
	to 50 µg/m³	1,21 (-0,24-2,56)	0,70 (-0,14-1,48)

NA: Not applicable if air pollution levels are lower than the scenario level

Regarding short-term effects of O_3, each reduction by 10 µg/m³ of daily maximum 8-hour moving average concentrations would delay 22,08 (95%CI: 12,11 – 37,04) deaths per year in the study area, 10,97 (95%CI: 5,25 – 17,41) from cardiovascular diseases, and 8,86 (95%CI: 5,80 – 11,83) from respiratory causes.

Table 6. Potential benefits of reducing ozone daily levels. Absolute numbers and rates (per 100 000 inhabitants) (95% confidence limits) attributable to the health effects of ozone.

	OZONE reduction	**Number of attributable cases per year**	**Annual rates (per 100.000)**
MORTALITY	**Daily 8-h max**		
Total excluding external causes	by 10 µg/m^3	22,08 (12,11-37,04)	1,47 (0,81-2,46)
	to 120 µg/m^3	NA	NA
Cardiovascular	by 10 µg/m^3	10,97 (5,25-17,41)	0,73 (0,35-1,16)
	to 120 µg/m^3	NA	NA
Respiratory	by 10 µg/m^3	8,86 (5,80-11,83)	0,59 (0,39-0,79)
	to 120 µg/m^3	NA	NA
MORBIDITY	**Daily 1-h max**		
Emergency room visits for asthma <18 years	by 10 µg/m^3	not available	not available
	to 180 µg/m^3	not available	not available
	Daily 8-h max		
Hospital respiratory admissions 15-64 years	by 10 µg/m^3	1,36 (-12,24-16,33)	0,14 (-1,22-1,63)
	to 120 µg/m^3	NA	NA
Hospital respiratory admissions > 64 years	by 10 µg/m^3	21,13 (-8,45-50,71)	6,48 (-2,59-15,56)
	to 120 µg/m^3	NA	NA

NA: Not applicable if air pollution levels are lower than the scenario level

Discussion

PM_{10} annual mean was almost the same the 1999/30/EC Directive limit value for 2005 (40 ?g/m^3) and above for that established for 2010 (20 ?g/m^3). Since April 2002, PM_{10} concentration was below the 1999/30/EC Directive health protection limit for 2005 because PM_{10} concentration was above 50 less than 35 days.

O_3 levels didn't reached any day the information threshold (180 ?g/m^3), nor the alert threshold (240 ?g/m^3) established by the 2002/3/EC Directive.

The reduction of the annual average levels of PM_{10} to 20 ?g/m^3 (limit of 1999/30/CE Directive for 2010) would prevent 0,45 total post neonatal deaths (95%CI: 0,20-0,71). This figure is very low because infantile mortality in Barcelona is very low too.

On the other hand, annual rate of post neonatal population could be overestimate because population in the denominator is represented by people below 1 year, because there is no registry of post neonatal population (1 month-1year).

Reducing PM_{10} daily mean values to 20 ?g/m^3 (limit of 1999/30/CE Directive for 2010) would prevent 10 hospital respiratory admissions (5,9 per 100.000 inhabitants).

As far as short-term effects of O_3 in summer are concerned, all other things being equal, each reduction by 10 µg/m^3 of the daily maximum 8-hour moving average concentrations would delay 22 deaths per year in the general population in the study area (1,5 deaths per 100.000 inhabitants), 11 from cardiovascular diseases (0,7 per 100.000 inhabitants), and 9 from respiratory causes (0,6 per 100.000 inhabitants). Effects on cardiovascular mortality seem to be bigger than on respiratory mortality.

In terms of hospital admissions, this would represent 1 respiratory admission in the adult population (0,1 per 100.000 inhabitants) and 21 respiratory admissions in the population over 64 years (0,1 per 100.000 inhabitants).

The estimates we obtained are directly dependent on the exposure data we used. Following ENHIS guidelines, air pollution experts have selected monitoring stations more representative for the exposure of population. In this sense, it is important to note that in Barcelona, the urban structure is very compact, with people living close to streets with dense or very dense traffic. When interpreting the HIA calculations for Barcelona, this factor should be taken into account.

Finally, a limitation of HIA calculations made for 2002 must be considered: The available data for PM10 covered only the 51,23 % of the whole year.

Conclusion

In Barcelona, APHEIS project contributed initially to coordinate environmental and public health institutions of both local and autonomic levels of government in working on environmental health issues. It was a good starting point in order to more efficiently manage health problems related to air quality. But there were not enough studies about children health or information about exposure like ozone.

In this sense, ENHIS project has filled this gap increasing the knowledge about the effects of air pollution on children health and providing details about new pollution indicators like ozone.

In addition, ENHIS project contributes to increase environmental and public health institutions coordination in order to establish an Environmental Health Information System to help politicians make better decisions.

References

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