HEALTH IMPACT ASSESSMENT OF AIR POLLUTION

ENHIS-1 PROJECT: WP5 HEALTH IMPACT ASSESSMENT

LOCAL CITY REPORT

VALENCIA

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Summary of main findings for Valencia

In 2002 the ozone annual mean (SD), P5 (5th percentile) and P95 of the maximum daily 1-hour concentration in the city of Valencia were 67.8 (25.3), 24.6 and 108.5 µg/m^3. For the summer period of the same year, the correspondent concentrations of the maximum daily 8-hour moving average concentration were 69.8 (17.3), 45.3 and 100.0 µg/m^3 of ozone (O_3) Only one day exceeded the limit value for health protection established in 2002/3/CE Directive (120 µg/m^3 for daily 8-hour moving average).

PM_{10} data fulfilling the APHEIS criteria was not available for year 2002 and, consequently, estimates of its health impact have not been calculated for Valencia.

Regarding short-term effects of O_3 in summer, all other things being equal, each reduction by 10 µg/m^3 of the daily maximum 8-hour moving average concentrations would delay 8.16 deaths per year among the general population in the study area, 3.99 from cardiovascular diseases, and 3.31 from respiratory causes. In terms of hospital admissions, this would represent 0.70 respiratory admissions in the adult population and 8.01 in the population over 64 years old.

Summary of HIA of outdoor air pollution in Valencia 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: 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	8.16	
Cardiovascular mortality (ICD9 390-459 - ICD10 I00-I99)					1.0046 (1.0022-1.0073)		3.99	
Respiratory mortality (ICD9 460-519 - ICD10 J00-J99)					1.0113 (1.0074-1.0151)		3.31	
Total postneonatal mortality	1 month- 1 year	Corrected PM_{10}[3]	Year	Annual	1.048 (1.022-1.075)	Lacasaña et al 2005		not available
Postneonatal respiratory mortality (ICD9 460-519 - ICD10 J00-J99)					1.216 (1.102-1.342)			not available
Postneonatal Sudden Infant Death Syndrom Mortality (ICD9 798.0 - ICD10 R95)					1.12 (1.07-1.17)	Woodruff 1997		not available
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		not available
Hospital respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	15 - 64 years	**O_3 8h max**	Summer		1.001 (0.991-1.012)		0.70	
Hospital respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	> 64 years				1.005 (0.998-1.012)		8.01	

[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}. If the local air quality network uses automatic methods (TEOM or other) a correction factor is required to compensate for loss of volatile compounds: if available, a local correction factor recommended by the air quality network or, by default, the European factor 1.3.

Introduction

Valencia has an estimated population of 764010 inhabitants for the midyear of 2002, the corresponding year for this report. A 17.5% of people are over 65 years old. The demographic trends show a rising in the city population besides a decreasing in the elder population percentage (figures for year 2000 were 742813 inhabitants with 19% of people over 65 years).

The city is situated on the shores of the Mediterranean, and it retains, yet diminishing, important zones dedicated to agriculture in the whole area of the municipality (around 30% of the land area). The climate in the city, provided its location, is that known as mesothermal (temperate), with mild, humid winters and warm, hot summers. Given the low level of rainfall it is classified as semiarid. The average of mean daily temperature for the year 2002 was 18.9ºC, with 14.2 and 23.5ºC as the correspondent averages for daily minimum and maximum temperatures.

As in other developed countries, cardiovascular diseases account as the major causes of deaths in Spain. More specifically, the first three causes of death in the city of Valencia in 2002 for men were ischemic heart disease (proportional mortality: 12.2%), lung cancer (8.8 %) and cerebrovascular disease (6.7%), whereas for women causes were cerebrovascular disease (11.6%), ischemic heart disease (9.4%), and senile and pre-senile organic psychoses (6.9%). Infant mortality, as in general in all Europe is quite low and when it occurs it does during the first days of life (Conselleria de Sanidad, 2005). During the year 2002, a total of 31 children younger than 1 year died in Valencia, of whom only 7 were more than 1 month old. The major causes were congenital malformation and chromosomal disorders, and perinatal processes. Among the seven postneonatal deaths one was for respiratory cause and another was a sudden infant death.

Last year, in the framework of the APHEIS programme, a Health Impact Assessment (HIA) of air pollution was made. Data used for that report corresponded to the year 2000. Black smoke was the only air pollutant indicator for background exposure (i.e. non traffic or industry oriented) to particulates in the city of Valencia. Average of daily mean levels of background black smoke in 2000 in Valencia was 20.1 µg/m^3 (Standard deviation: 11.4). Percentile 5 was 8.3 µg/m^3 and percentile 95 was 40.4 µg/m^3. 135 days exceeded the level of 20 µg/m^3 of black smoke, and 7 days exceeded the level of 50 µg/m^3 of black smoke.

Regarding health data, for 2000, the daily mean for total mortality (ICD9<800) was 15.8 and Standard Deviation 4.7. In 2000, 5775 people died in Valencia for all causes except external ones. According to the HIA conducted last year, if the 153 days with daily mean black smoke levels higher than 20µg/m^3 had been reduced to 20µg/m^3, the consequent benefit for short-term effect would have resulted in 14 deaths or (2 deaths per 100 000 inhabitants).

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

Sources of air pollution

Air pollution in Valencia mainly derives from motor vehicle exhaust emissions, with industrial pollution playing a smaller part. Other potential emissions are combustion from agriculture or food activities (i.e. bakeries). Heating is not a major source in Valencia because of the mild climate during the winter. Particulate matter and NO_2 are the most problematic pollutants in the city of Valencia. Levels of NO_2 sometimes exceed the limit values within the Directive of the European Union. On the other hand, ozone pollution represents an important problem in some inland areas of the Valencian Community where episodes with high concentrations in summer are usual. However, as in populated areas, the ozone concentrations in the city may be lower than the regional concentrations due to chemical scavenging by local nitrogen oxide emissions.

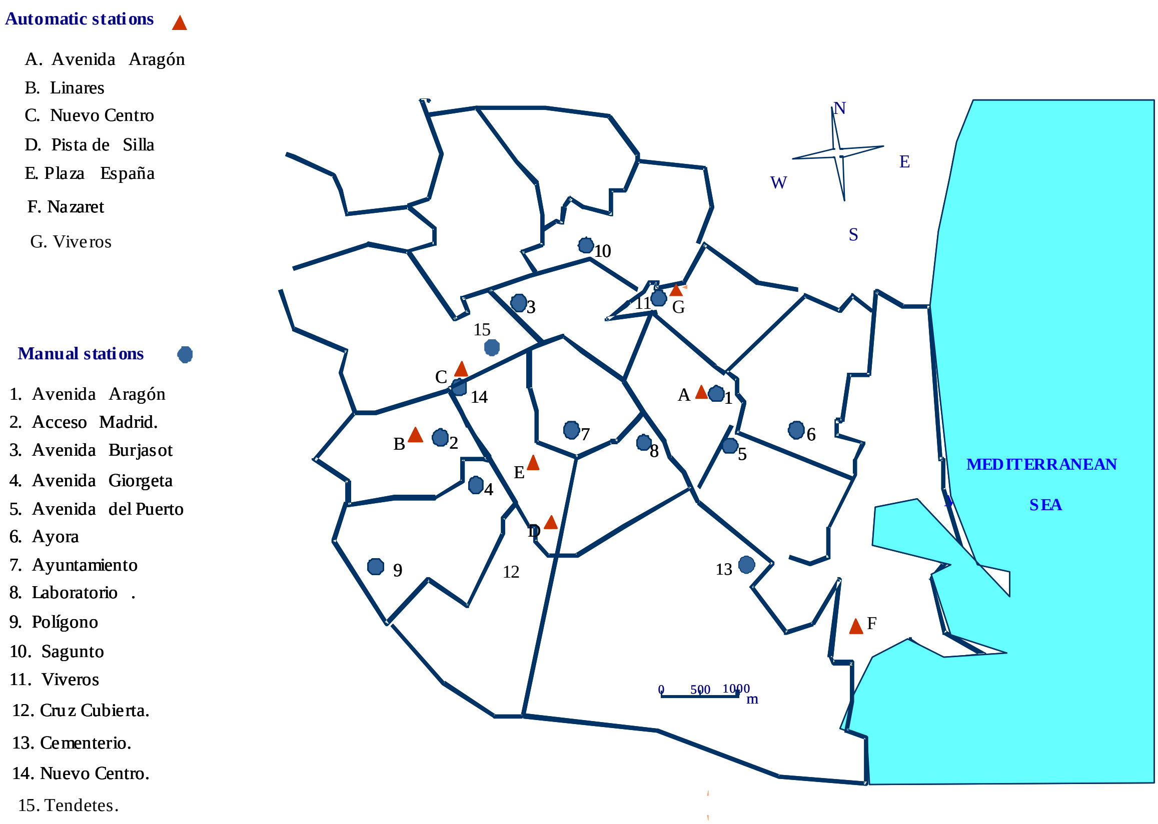
Exposure data

Air pollution levels are monitored by the Environmental Laboratory within the Health Division of the Valencia Council. The air pollution monitoring network consists of 15 manual and seven automatic monitoring stations.

In the context of Health Impact Assessment of the APHEIS, ozone and particulates -measured as PM10 - are included for this report. Data for PM10 in Valencia during year 2002 was only partially available from a monitoring station not fulfilling the criteria for exposure data in APHEIS; consequently, estimates of its health impact have not been calculated for Valencia.

As recommended in the Methodological Guidelines of the APHEIS1 Report, we included data from background stations and having at least 75% of valid values. Among the stations measuring for ozone, two of them were considered as background ones (named Viveros, and Nuevo Centro, see Map 1). Both of them reported more than 75% valid data for 2002. So we obtained these data and, when possible, filled in the missing values using the APHEA2 procedure.

Map 1. Location of monitoring stations in the city of Valencia.



Finally, for the purposes of this report, we calculated the daily average of background levels of ozone in Valencia as the mean of the completed series from these two monitoring stations in year 2002. 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 mean (SD) , P5 and P95 of the summer daily maximum 8-hour moving average concentrations of O_3 were, respectively, 69.79(17.16), 45.28 and 57.47 µg/ m^3, and those of the annual daily maximum 1-hour concentrations 67.83(25.33), 24.55 and 50.53 µg/m^3 (Table 1 and figures 1-2). Only one day exceeded the limit value for health protection established in 2002/3/CE Directive (120 µg/m^3 for daily 8-hour moving average), and no day exceeded the threshold for information to the population for 1-hour established in 2002/3/CE Directive (180 µg/m^3 for daily 1-hour maxima)

Table 1. Descriptive statistics for ozone levels in Valencia, year 2002 (µg/m^3)

	O3 8h - summer	O3 1h max - year	PM10 - year
Number	2	5	NA
Minimum	26.44	5.00	NA
Percentile 5	45.28	24.55	NA
Percentile 25	57.47	50.53	NA
Median	70.08	69.90	NA
Percentile 75	79.59	85.38	NA
Percentile 95	99.99	108.48	NA
Percentile 98	106.50	120.33	NA
Maximum	125.11	148.59	NA
Days exceeding 120 µg/m^3	1	-	-
Days exceeding 180 µg/m^3	-	0	-
Daily mean	69.79	67.82	NA
Standard deviation	17.26	25.33	NA
% missing values	1.06%	1.37%	-

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

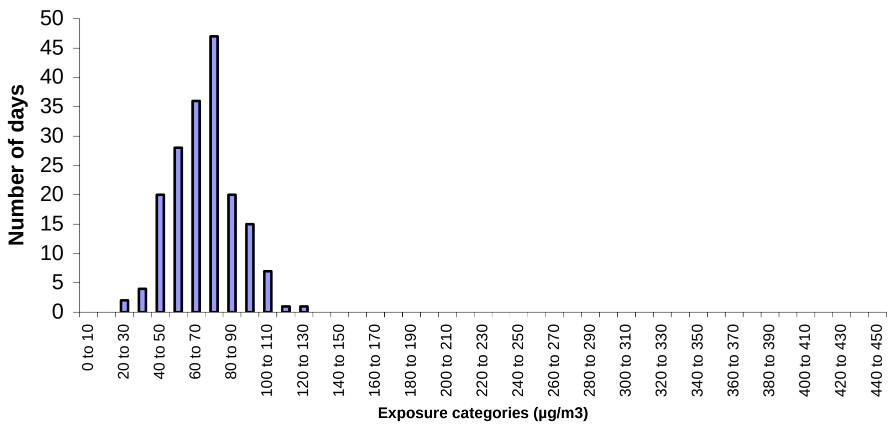
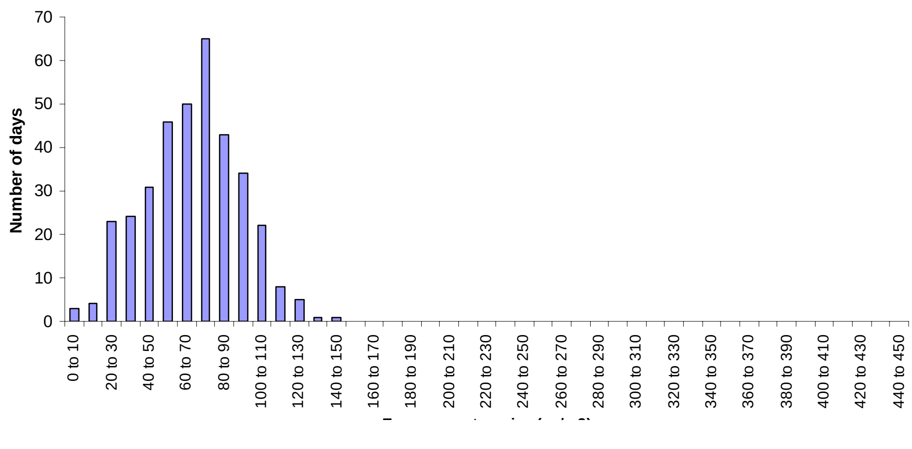


Fig 2. Distribution of daily O3 1h max-year in Valencia. Year 2002



Health data

The daily number of deaths in Valencia was obtained from the Valencian Community Mortality Register. The group to be studied was restricted to city residents only. Some works have been published on the completeness of the register and the quality of patient diagnosis showing that the register is both complete and reliable. Table 2 shows the daily numbers and annual rates of the mortality groups of causes included in this report.

The number of emergency daily admissions was obtained from the registry databases of the five hospitals of the public health system in the city. This system uses a standardised procedure to collect hospital admissions in Spain. In the Community of Valencia, roughly all the population is covered by the regional health system, although some people use some private health services. For the diagnoses used in APHEIS, it is thought that the coverage in year 2002 represented around 90% of the admissions in the city. Also, only admissions for residents of Valencia City were selected. The diagnosis used was the one that motivated the admission reflected in the discharge report.

As shown in Table 2 there were 7 postneonatal deaths in Valencia during year 2002, being the annual rate of 127 per 100 000 infants over 1 month and under one year old. Regarding mortality in all ages, total mortality annual rate excluding external causes was 708.1 per 100 000. Cardiovascular causes accounted for approximately a third of total mortality and respiratory causes represented a 11.7% of the total. The age-standardised mortality rate (per 100 000 inhabitants) using European population for year 2002 was 793 per 100 000.

Table 2. Descriptive statistics for health outcomes in Valencia, year 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			7	127.25			
Respiratory *ICD9 460-519 ICD10 J00-J99*	460-519	J00-J99	1	18.18			
Sudden infant death syndrome *ICD9 798.0 – ICD10 R95*	798.0	R95	1	18.18			
GENERAL POPULATION MORTALITY							
Total mortality all causes *ICD9 <800 ICD10 A00-R99*	<800	A00-R99			14.81 (4.26)	1.94	708.1
Cardiovascular mortality *ICD9 390-459 ICD10 I00-I99*	390-459	I00-I99			4.93 (2.24)	0.65	237.25
Respiratory mortality *ICD9 460-519 ICD10 J00-J99*	460-519	J00-J99			1.73 (1.4)	0.23	83.93
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					992.52
Hospital respiratory admissions - Age 15 -64 years	460-519	J00-J99					266.33
Hospital respiratory admissions - Age > 64 years	460-519	J00-J99					2489.72

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[1] 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[2].

Table 3. Health outcomes and Exposure-response functions (ERFs) selected for health impact assessment in ENHIS1

	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)

[1] Cambra K, Alonso E, Cirarda FB, Martínez-Rueda T. Bilbao APHEIS group. Selection of outcomes and exposure response functions for health impact assessment of particles and ozone. Review of the evidence. ENHIS project. WORK PACKAGE 5. Bilbao, February 2005. Http:

[2] 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.

To be coherent with mortality findings, it was decided, following the experts' advice, to include RRs of hospital admissions in the health impact assessment calculations, even if they were not statistically significant. More precisely, it was decided that if no new RR was 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 4). The rationale for such inclusion 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) in ENHIS1

	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/m^3*	*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/m^3*	*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/m^3*	*Anderson et al 2004*

Finally, HIA needs to define the evaluation scenarios, i.e. the hypothetical scenario with which we want to compare the current air pollution situation. Based on the objectives and limits established in 1999/30/CE, and 2002/3/CE Directives. APHEIS program calculates either the impact on health of the (current) air pollution levels in the city which are above the pollution level of the evaluation scenario or the benefits to reduce the pollutant levels in a certain amount. 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. During year 2002, in the city of Valencia only one day exceeded the limit value for health protection established in 2002/3/CE Directive (120 µg/m^3 for daily 8-hour moving average). Taking this into consideration, we decided to evaluate the benefits of a reduction by 10 µg/m^3 in the daily maximum 8-hour moving average concentrations as a more informative scenario.

HIA scenarios for Valencia

HIA scenarios on short-term effects of Ozone

1. Daily maximum 8-hour moving average concentration and **mortality** among general population:

   Reduction **by 10 µg/m^3** in the daily maximum 8-hour moving average concentrations.

2. Daily maximum 8-hour moving average concentration and **hospital admissions:**

   Reduction **by 10 µg/m^3** of the daily 8-hour moving average concentration.

Findings

Regarding short-term effects of O_3, each reduction by 10 µg/m^3 of daily maximum 8-hour moving average concentrations would delay 8.16 (95%CI: 4.47 – 13.68) deaths per year in the study area, 3.99 (95%CI: 1.91 – 6.34) from cardiovascular diseases, and 3.31 (95%CI: 2.17 – 4.42) from respiratory causes.

Table 5. 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	8.16 (4.47 – 13.68)	1.07 (0.59– 1.79)
	to 120 µg/m^3	NA	NA
Cardiovascular	by 10 µg/m^3	3.99 (1.91 - 6.34)	0.52 (0.25– 0.83)
	to 120 µg/m^3	NA	NA
Respiratory	by 10 µg/m^3	3.31 (2.17 – 4.42)	0.43 (0.28– 0.58)
	to 120 µg/m^3	NA	NA
MORBIDITY	**Daily 1-h max**		
Emergency room visits for asthma <18 y	by 10 µg/m^3	not available	not available
	to 180 µg/m^3	…..	
	Daily 8-h max		
Hospital respiratory admissions 15-64 y	by 10 µg/m^3	0.70 (-6.28 – 8.38)	0.13 (-1.18 – 1.58)
	to 120 µg/m^3	NA	NA
Hospital respiratory admissions > 64 y	by 10 µg/m^3	8.01 (-3.20 – 19.23)	5.99 (-2.39 – 14.38)
	to 120 µg/m^3	NA	NA

NA: Not applicable, in Valencia levels of ozone 8 h maximum only one day in year 2002 exceeded 120 µg/m^3

Discussion

The first point to sep in mind in this report is that for year 2002 (the last year for which data about hospital admissions in the city of Valencia were available) we only disposed of information about ozone for the assessment of its impact on health within the ENHIS project. PM_{10} data fulfilling the APHEIS criteria was not available for year 2002 and, consequently, estimates of its health impact have not been calculated for Valencia.

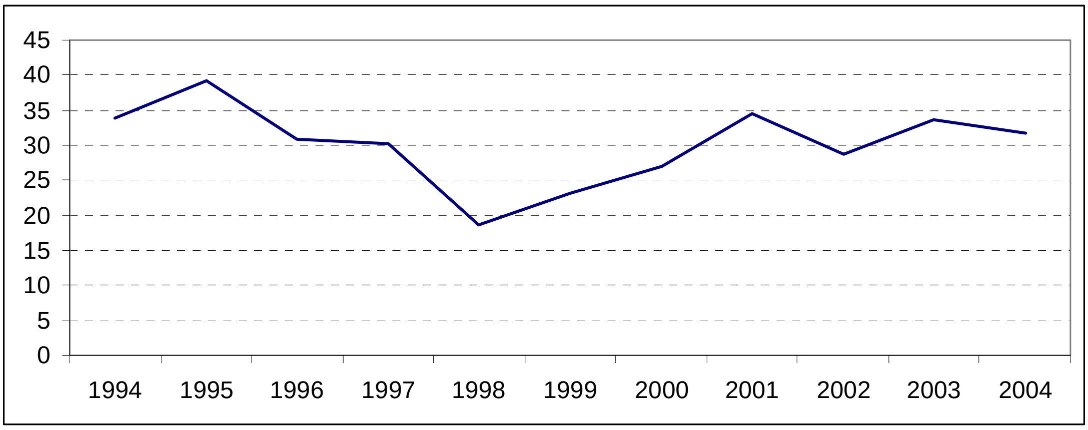
Therefore, it has not been possible to obtain a general idea of the impact of air pollution on health, because, on the one hand, the effects of particulates and ozone seem to be independent, i.e.: they could be additive, and on the other hand, it has not been possible to calculate the long term effects of particulates, which are effects of a greater magnitude than the acute or short term effects. Consequently, the real impact of air pollution on health in the city of Valencia is being underestimated in this report.

Focusing on ozone, and for the year under study, we observe that in the city of Valencia only one day exceeded the limit value for health protection established in 2002/3/CE Directive (120 µg/m^3 for daily 8-hour moving average). It must be taken into account that ozone is a secondary pollutant, which is formed by the ultraviolet radiation of the sun on NO_2. The presence of volatile organic compounds, carbon monoxide and methane favour the formation of high concentrations of ozone. On the other hand, ozone, in the presence of NO sources is reduced by formation of nitrogen oxides. For this reason, although ozone levels depend on the concentration of preceding gases, such levels are higher in areas far from pollution sources, i.e., in rural or residential areas. In the Valencian region this phenomenon is well known. So, while in the inland of the region, the percentage of days when the health threshold level was surpassed in the period between 1997 and 2001 was 17 to 33 %, in the city of Valencia such percentage was 0% (Castells et al, 2003). This means that the impact on health of ozone in the Valencian region will be more important in the inland areas and in areas with little pollution through primary gases.

Regarding Health Impact Assessment for short-term effects of O_3 in summer in the city of Valencia for 2002, all other things being equal, each reduction by 10 µg/m^3 of the daily maximum 8-hour moving average concentrations would delay 8.16 deaths per year in the general population in the study area, 3.99 from cardiovascular diseases, and 3.31 from respiratory causes. In terms of hospital admissions, this would represent 0.70 respiratory admissions in the adult population and 8.01 in the population over 64 years old.

Levels of ozone air pollution in the city of Valencia have changed very little in the last 10 years. In Figure 3 the evolution in annual mean concentrations of ozone in one of the included monitoring stations in the city of Valencia is showed. Between 1994 and 2004, ozone concentrations showed a slight reduction during the first years, followed by an increase and a plateau in the last years. This could imply that, despite the reduction of industrial pollution and the improvement in car engines, the increase in the amount of cars circulating through the city and the increase in house facilities leads to the stabilization of the levels.

Figure 3. Annual mean concentrations for ozone in Valencia. Nuevo Centro monitoring station, 1994-2004.

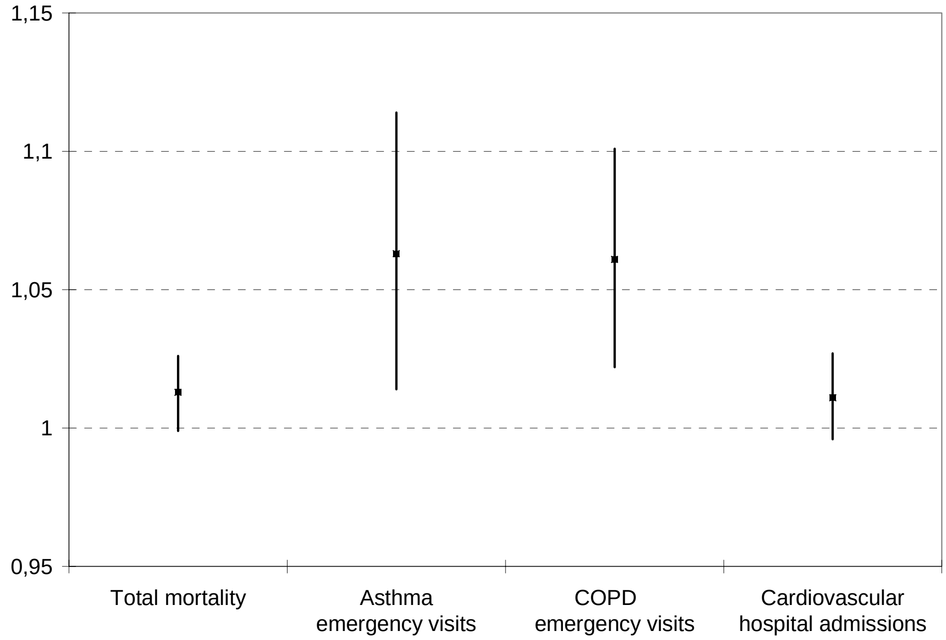


Source of data: Conselleria de Territori i Habitatge (self-made)

Since 1994 epidemiological research assessing the impact of air pollution on health has been conducted in Valencia. In 1997 a national multi-centre study on the air pollution levels and health impacts was set up in 14 Spanish cities (named the EMECAM project)(EMECAM 1999, Sáez et al 2002; Ballester et al, 2002). The co-ordinating centre for this project is the same than for APHEIS in Valencia (EVES). Up to now, this project has provided estimates for the impact of air pollution on mortality in Spain. Nowadays, data from emergency hospital admissions and more recent data on mortality have been analysed within the context of the EMECAS project (Iñiguez et al, 2003; Ballester et al, 2005).

Among the pollutants under study in the city of Valencia, ozone has been one of the most studied. Figure 3 shows the results obtained in studies during the 90s in Valencia for the relationship between the levels of ozone and the main health indicators. One of the main conclusions that can be taken from these results is that the magnitude of the association between pollution and ozone differs considerable depending on the health indicator analysed. This grading of effects is coherent with its seriousness. So, a 10 µg/m^3 increase in the levels of ozone is associated with a parallel increase of 1,3% in the number of daily deaths, of 1,1% in admissions for circulatory diseases, of 6,1% in EPOC emergencies and of 6,3% in asthma emergencies .

Figure 3. Relative risks of different health indicators associated to increases in the ozone levels equivalent to a 10 µg/m^3 increase in the city of Valencia.



Made from Tenías et al, 1998, 1999, 2002 & Ballester et al, 2001.

Conclusion

In order to asses the air quality and to carry out the corresponding evaluation of health impact, it would be necessary to dispose of updated data about PM10 levels in the city of Valencia from a greater number of stations.

Although the impact of the levels of ozone on health registered in the city of Valencia are not very high, an improvement in the precedents of this pollutant would avoid around 8 premature deaths and would also carry the reduction of some cases of emergency hospital admissions for respiratory causes, especially among elderly people. Also, it is expected that it would also carry an improvement of the air quality in areas near the city and, consequently, a reduction of the effects of ozone on the inhabitants of such areas.

Valencia APHEIS partners

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