

VALENCIA CITY REPORT

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Spain

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Background

Valencia has an estimated population of 742813 inhabitants for the midyear of 2000, the corresponding year for this report. A 19% of people are over 65 years old. 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 2000 was 18.3°C, with 13.6 and 23.7°C as the correspondent averages for daily minimum and maximum temperatures. For the same period average of daily relative humidity was 67%.

Last year, in the framework of the APHEIS programme, a Health Impact Assessment (HIA) of Air pollution was made, for the first time, in the city of Valencia, Spain. Data used for that report corresponded to the year 1999. 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 1999 in Valencia was 23.5 $\mu\text{g}/\text{m}^3$ (Standard deviation: 15.6). Percentile 10 was 10.5 $\mu\text{g}/\text{m}^3$ and percentile 90 was 44.9 $\mu\text{g}/\text{m}^3$. 153 days exceeded the level of 20 $\mu\text{g}/\text{m}^3$ of black smoke, and 31 days exceeded the level of 50 $\mu\text{g}/\text{m}^3$ of black smoke. Regarding health data, for 1999 the daily mean for total mortality (ICD9<800) was 17.3 and Standard Deviation 5.88. In 1999, 6310 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 20 $\mu\text{g}/\text{m}^3$ had been reduced to 20 $\mu\text{g}/\text{m}^3$, the consequent benefit for short-term effect had resulted in 28 deaths or (3.7 deaths per 100 000 inhabitants). The corresponding reduction in excess cases for hospital admissions for cardiovascular diseases had been 23 people.

Objectives for APHEIS 3 in Valencia

During this third year the local team of APHEIS programme in Valencia set up two objectives:

1. To go on with the HIA in Valencia, providing accurate and up-to-date results.
2. Participate in the process to obtain new exposure-response functions on short-term effects of air pollution, specially for respiratory hospital admissions
3. Explore and understand the information needs of local policy makers and environmental health professional concerned with the impact of air pollution on public health.

The results for the first objective are presented in this report. The correspondent findings for the second objective will be presented jointly for the participating cities.

Finally, in order to develop the third objective, a local communication study ('mini' case study) was set up through interviews with representatives of environmental and public health

services in the municipality. By this we intend to explore the interests and information needs of the public-health and environment sector at the local level through the APHEIS center and programme. Results for this part will be presented in the Communication package report.

Update on local characteristics: population data, study area, study period

In this report we are presenting the results of the HIA in Valencia corresponding to the 3rd year of the project. The data in this report corresponds to the year 2000. For this year, again, only black smoke has been available for air pollution background exposure.

Sources

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 NO₂ are the most problematic pollutants in the city of Valencia. Levels of NO₂ sometimes exceed the limit values within the Directive of the European Union.

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 14 manual and six automatic monitoring stations. A complete description of type and number of monitoring sites is given in Appendix 3 of the second year report.

In the context of Health Impact Assessment of the APHEIS, particulates -measured as PM10 or black smoke- are included for this report. Data for PM10 in Valencia is only partially available from a monitoring station and it is oriented to industrial sources; so we did not include it. From the manual stations we obtained the 24-hour average levels for black smoke (reflectometry method).

As recommended in the Methodological Guidelines of the APHEIS1 Report, we included data from background stations. Following the indications in that report we included monitoring stations having at least 75% of valid values. Among the four background stations measuring for black smoke, three of them (named Viveros, Cementerio and Cruz Cubierta) reported more than 75% valid data for 1997 to 2002. So we obtain these data and, when possible, filled in the missing values using the APHEA2 procedure.

Finally, for the purposes of this report, we calculated the daily average of background levels in Valencia as the mean of the completed series from these three stations in year 2000.

- The annual average of daily mean levels (and standard deviation) of black smoke in Valencia in 2000 corresponding to these three background stations was 20.1 (11.4) µg/m³.

- P5 and P95: The levels of black smoke during the 358 days (98%) with available data reached the lowest level (5th percentile) at 8.3 µg/m³ and the highest (95th percentile) level at 40.4 µg/m³.
- Number of days when air pollutants exceeded limit levels:

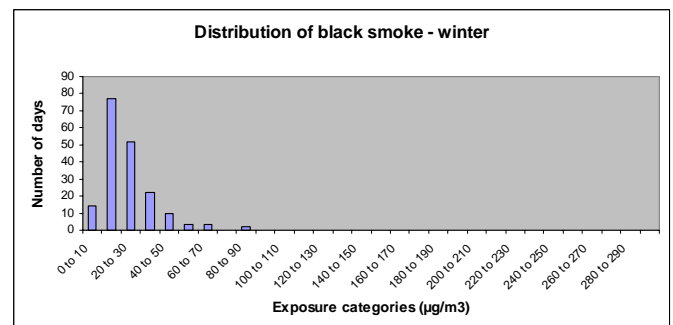
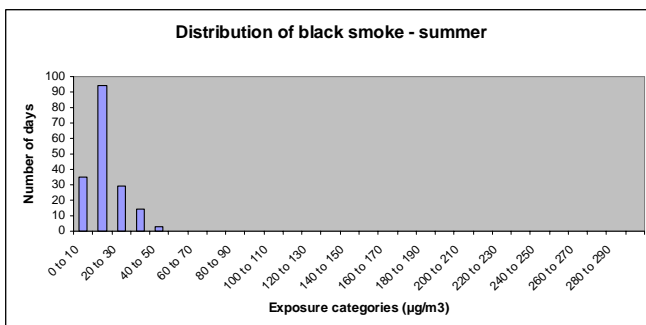
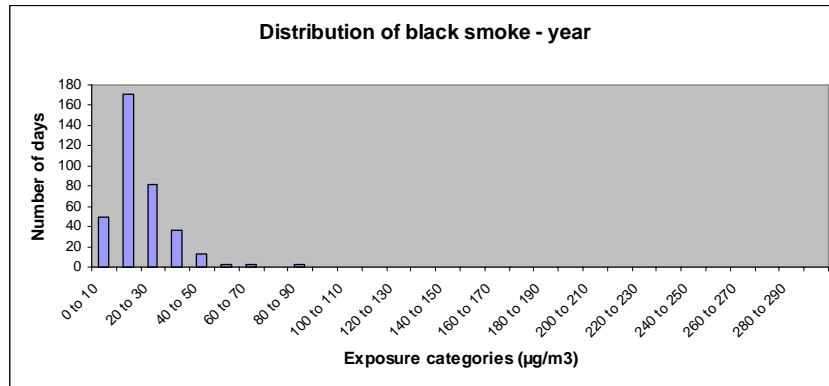
Table 1 .Number of days when air pollutant exceeded limit levels. Valencia, 2000.

	Black Smoke
Number of days above	20 µg/m ³
	135
Number of days above	50 µg/m ³
	7

- Distribution of pollutant

The next three figures represent the distribution of background black smoke levels for year 2000 (and for summer and for winter, respectively) in Valencia.

The round year minimum concentration was 6 µg/m³ and maximum concentration was 83 µg/m³. In winter higher levels of black smoke were recorded being 23 µg/m³ the daily mean average in winter and 17 µg/m³ in summer. All the 7 days with levels above 50 µg/m³ were recorded in the winter period.



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 (Table 2). 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 2000 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.

The age-standardised mortality rate (per 100 000 inhabitants) using European population for year 2000 was 806.7 per 100 000.

Table 2. **Daily mean number (standard deviation) and annual rate per 100 000 of deaths and hospital admissions. Valencia, year 2000.**

Health outcome	Daily mean (SE)	Annual rate per 100 000
Total mortality, except external (ICD9 < 800 - ICD10 A00-R99)	15,78 (4,73)	777,58
Cardiovascular mortality (ICD9 390-459 - ICD10 I00-I99)	5,66 (2,52)	278,94
Respiratory mortality (ICD9 460-519 - ICD10 J00-J99)	1,81 (1,56)	89,39
Cardiac admissions (ICD9 390-429 - ICD10 I00-I52)	9,85 (3,49)	485,32
Respiratory admissions (ICD9 460-519 - ICD10 J00-J99)	13 (5,61)	640,54

Health impact assessment

Different scenarios were used to evaluate the short and long term exposure to particulate pollution.

Short term exposure

We used the following scenarios to estimate the acute effects of short-term exposure to black smoke on mortality and hospital admissions over one year:

Short term HIA for BS

- for a reduction of BS levels on all days above 24-hour value of $20 \mu\text{g}/\text{m}^3$ to $20 \mu\text{g}/\text{m}^3$
- for a reduction of BS levels on all days above 24-hour value of $50 \mu\text{g}/\text{m}^3$ to $50 \mu\text{g}/\text{m}^3$
- for a reduction by $5 \mu\text{g}/\text{m}^3$ in the annual mean value of BS

Tables 3,4 and 5 present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 6 presents the results for cardiac and respiratory hospital admissions.

Table 3. Deaths all causes except external (ICD9 < 800). Potential benefits of reducing daily BS levels above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of BS. Valencia, year 2000.

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	135	14,48	9,64	21,76	1,95	1,30	2,93
50 $\mu\text{g}/\text{m}^3$	7	1,20	0,80	1,80	0,16	0,11	0,24
By 5 $\mu\text{g}/\text{m}^3$	NA*	16,77	11,19	25,14	2,26	1,51	3,38

*NA: not applicable

Table 4. Cardiovascular deaths (ICD9 390-459). Potential benefits of reducing daily BS levels above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effect of BS. Valencia, year 2000.

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	135	3,46	1,73	6,06	0,47	0,23	0,82
50 $\mu\text{g}/\text{m}^3$	7	0,28	0,14	0,5	0,04	0,02	0,07
By 5 $\mu\text{g}/\text{m}^3$	NA*	4,03	2,01	7,04	0,54	0,27	0,95

*NA: not applicable

Table 5. Respiratory deaths (ICD9 460-519). Potential benefits of reducing daily BS levels above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of BS. Valencia, year 2000.

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	135	1,66	-0,55	4,18	0,22	-0,07	0,56
50 $\mu\text{g}/\text{m}^3$	7	0,14	-0,05	0,35	0,02	-0,01	0,05
By 5 $\mu\text{g}/\text{m}^3$	NA*	1,93	-0,64	4,81	0,26	-0,09	0,65

*NA: not applicable

Table 6. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions. Potential benefits of reducing daily BS levels above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number (95% confidence limits) attributable to the acute effects of BS. Valencia, year 2000.

Scenarios	Attributable cases per year			
	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths central	N° of deaths lower	N° of deaths upper
Hospital admissions for cardiac diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	135	16,62	6,02	28,85
50 $\mu\text{g}/\text{m}^3$	7	1,40	0,51	2,43
By 5 $\mu\text{g}/\text{m}^3$	NA*	19,02	6,93	32,80
Hospital admissions for respiratory diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	135	5,95	-2,97	14,92
50 $\mu\text{g}/\text{m}^3$	7	0,49	-0,24	1,23
By 5 $\mu\text{g}/\text{m}^3$	NA*	6,94	-3,48	17,34

*NA: not applicable

Interpretation of findings

In year 2000, 5,739 people died in Valencia for all causes except external ones. According to the HIA, if the 135 days with daily mean black smoke levels higher than $20\mu\text{g}/\text{m}^3$ were reduced to $20\mu\text{g}/\text{m}^3$, the consequent benefit for short-term effect would be roughly 14 deaths or (1.9 deaths per 100 000 inhabitants). The corresponding reduction in excess cases for hospital admissions for cardiac diseases would be around 17 people.

Levels of black smoke in Valencia have decreased along the last 16 years. Although a direct comparison can not be made, owing to the fact that in 2000 a monitoring station has been added (Cementerio) background levels of black smoke in year 2000 seem to have slightly decreased compared with the previous year (1999). The average daily mean level in 2000 was $20.1 \mu\text{g}/\text{m}^3$ versus 23.5 in year 1999. Assuming this comparison, this change represents a reduction in the impact of air pollution on health. Thus, for the scenario when a reduction by $5 \mu\text{g}/\text{m}^3$ in the annual mean value of black smoke was done, the attributable cases in 1999 were 19 and 17 in 2000.

As a linear concentration-response relation has been described for the association between black smoke and mortality¹, the last scenario (a sustained reduction on the annual mean) could be more adequate from a public health perspective. That is to say, the finding that the association is not just on high pollution days suggests that measures that attempt to lower

¹ Schwartz, J., F. Ballester, M. Saez, S. Perez-Hoyos, J. Bellido, K Cambra, F. Arribas, A Cañada, M. J. Perez-Boillos, and J. Sunyer. 2001. The Concentration-Response Relation between Air Pollution and Daily Deaths. *Environmental Health Perspectives* 109, no. 10:1001-1006.

routine air pollution concentrations will have greater public health benefits than measures that focus on a few days with the highest concentrations.

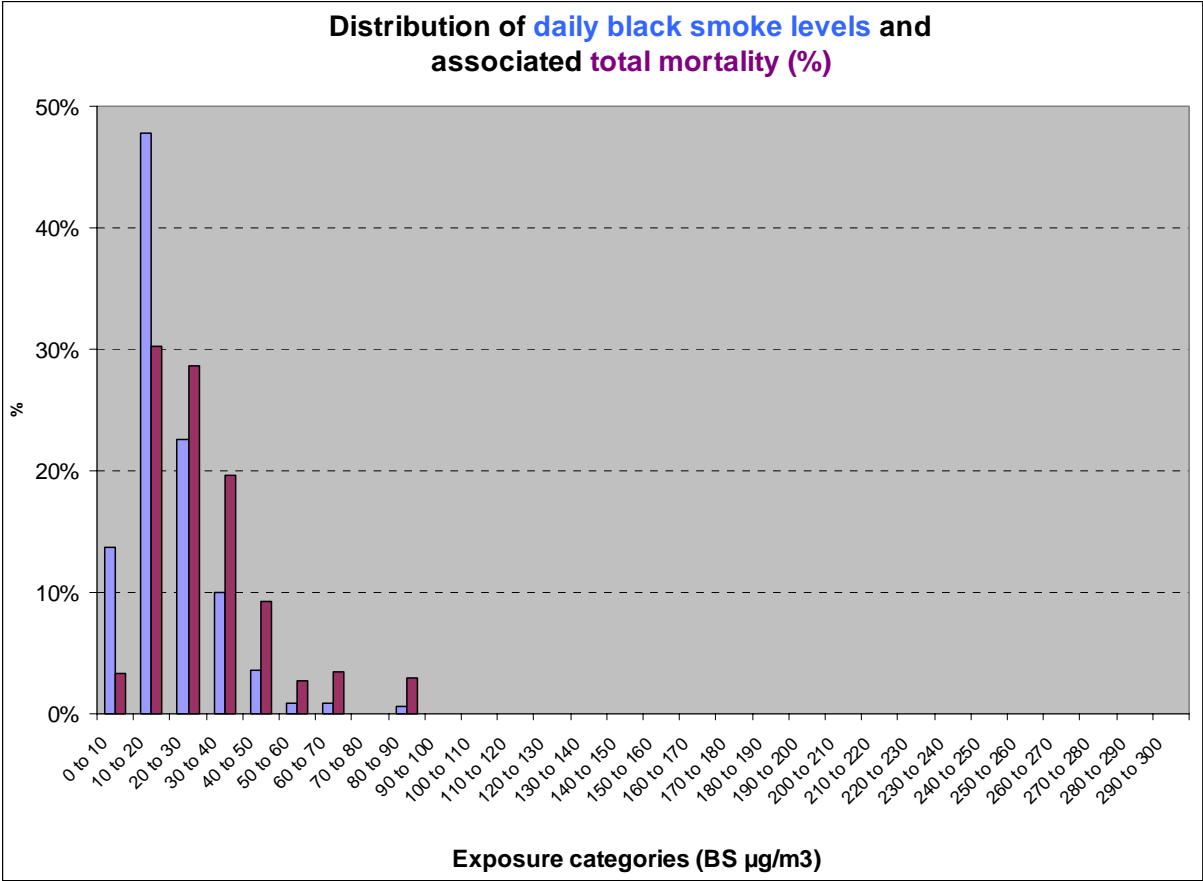


Figure 1, can help to understand this perspective, as it illustrates the relative importance of controlling Air Pollution peaks vs. reduction on daily AP levels. If we consider the potential benefits of reducing days above 50 to 50 µg/m3 we reached only around a 10% of the potential benefits of reducing all values of black smoke by 5 µg/m3

Finally, an important limitation of HIA must be considered. The estimates we obtain are directly dependent on the exposure data we used. Following APHEIS guidelines we have selected monitoring stations oriented to the background levels not to traffic or industry. In this sense, as in the last year report, it is important to note that in Valencia, as in other Mediterranean cities, the urban structure is very compact, with people living close to streets with traffic. The stations included in this report are located in parks or in low traffic areas and could under-represent the actual levels of population exposure. In fact, they could indicate the ‘at least’ actual levels of exposure for everyone living in the city of Valencia. When interpreting the HIA calculations for Valencia, this factor should be taken into account.

Overall, This report shows that even very small and achievable reductions in air-pollution levels have an impact on public health, and that this impact justifies taking preventive measures, even in cities with low or moderate levels of air pollution, as is the case of Valencia

When interpreting the findings on annual mortality, we should remember that the main effects are calculated for long-term exposure. Most of the acute effects on mortality are included in the long-term exposure and represent around 15% of these chronic effects.

General comments

In this HIA we have only evaluated the short term effect of particles, since levels of black smoke were the only ones available. It would be important to have systematic data about PM10 in Valencia, in order to have a complete evaluation (short and long term effects) of particles on health in our city. However, it would be interesting to carry on with black smoke measurements, parallel to PM10 measurements. There are studies which show that black smoke is a good indicator of the effects of particles on health. What is more, BS has proved to be a better indicator of exposure to particles derived from traffic than PM10 and even than PM2,5. These facts, together with the existence of historical series of reliable measurements of black smoke lead us to recommend, from the epidemiological and public health point of view, the maintenance of black smoke measurements together with the establishment of stations measuring PM10 systematically, to fulfil the new European and Spanish regulations. Apart from these two indicators, it would be of great interest that the number of stations measuring and determining fine particles (PM2,5) increased.

Valencia APHEIS partners

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