

*Environmental Tobacco Smoke exposure
in a sample of European cities.*

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FINAL REPORT

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1- Introduction and objectives.

Environmental Tobacco Smoke (ETS) is a complex mixture formed from the escaping smoke of a burning tobacco product and the smoke exhaled by the smoker. The assessment of the presence of ETS has a great importance since many scientific studies have shown that ETS has adverse health effects on adults and children (including lung cancer, heart disease, respiratory health effects and developmental toxicity) .

The **aim of this project** is to design and test an information system for measuring ETS exposure, in order to monitor progress of smoking control policies and to improve the air quality control across Europe, with a special emphasis in Southern European countries.

The **specific objectives** will be:

- To quantify levels of tobacco smoke in indoor air in public places.
- To compare and contrast these levels between several European cities.
- To disseminate results to raise awareness of the ETS exposure problem and to prompt improvements in actual exposure.

During the first coordination meeting (29-30 October, 2001) the different countries involved in the project defined a common core of tracer settings and methods.

2- Sampling.

Public places sampled

According to the decisions taken in the last meeting, the samplers were set up in the following places (the number of samples and the sampling time is specified for each place):

Public place	Number of places	Location of sample	Number of samples *	Time of sampling
Airport	1	Luggage claim	2	2 weeks
		Cafeteria		“
		Main hall	2	“
		Waiting room	2	“
<i>Subtotal</i>			8	
Train station	1	Cafeteria	2	2 weeks
		Waiting room	2	“
<i>Subtotal</i>		Platform	2	“
			6	
Hospital	5	Waiting room	2	1 week
		Cafeteria	2	“
<i>Subtotal</i>			20	

Restaurant				
With separated smoking area	3	Dining area	4 (2 in smoking area and 2 in nonsmoking area)	1 weekend
With no separation	4	Dining area	2	“
<i>Subtotal</i>			<i>20</i>	
Schools				
Primary	2	Corridor	2	Mon-Fri
Secondary	3	Corridor	2	“
<i>Subtotal</i>			<i>10</i>	
University				
3 (1 medical school)		Cafeteria	2	Mon-Fri
		Corridor	2	“
		Leisure/waiting	2	“
<i>Subtotal</i>			<i>18</i>	
Disco or Bar				
5		Personal sample	2	At least 4 hours
<i>Subtotal</i>			<i>10</i>	
Others				
-		-	-	-
<i>Subtotal</i>			<i>8</i>	
Total number of samples			100	

* Note that the samples in the same location should be placed, if possible, in different places (i.e., in a disco it could be one sample in the dancing room and another at the bar zone).

** To be determined by each country. In some cases it is desirable to select other places because of the specific characteristics of each country. These 8 filters have been left for these specific needs in each country.

Placement of ETS Samplers.

Placement of ETS samplers was done according to the following instructions:

- Air sampling.

Choose a sampling location that represents the exposure area you wish to measure. Do not place it within 1 metre of an area where someone regularly smokes. Do not place it in an area where air does not circulate, such as a corner, or under a shelf. Do not bury it in curtains. A good location is one where the sampler hangs freely in the air, for example from a TV antenna, or from a lampshade.

- Personal Sampler

Clip the sampler to a shirt collar or lapel, with the windscreen (directly under the cap) facing out, away from your clothing.

Clearly label the monitors with a permanent marker pen or taped-labels.

When you are ready to sample, **record the sampler number on the sampling sheet, along with the date, time and location.** Remove the sampler from the plastic cup and clip it in place. The red (or blue) button is the back of the sampler and the front should face into the room being sampled.

When sampling is completed, return the sampler to the plastic cup and close securely into place. Record the date and time on the sampling sheets.

The same sampler may be used, then stored in the cup, and then reused, but the concentration measured will be the average of all the sampling periods combined. Each sampler should sample for at least 50 hours unless concentrations are quite high, in which case 4 hours will suffice; the longer the sampling time, the more sensitive the measurement can be, and a week is a good period of time. Each sampler can be used for one to four weeks continuously. Section 2 of this protocol provides guidelines on sampling times according to location.

3-Methods.

ETS passive samplers were used in order to measure the ETS exposure.

Parts of an ETS Passive Sampler:

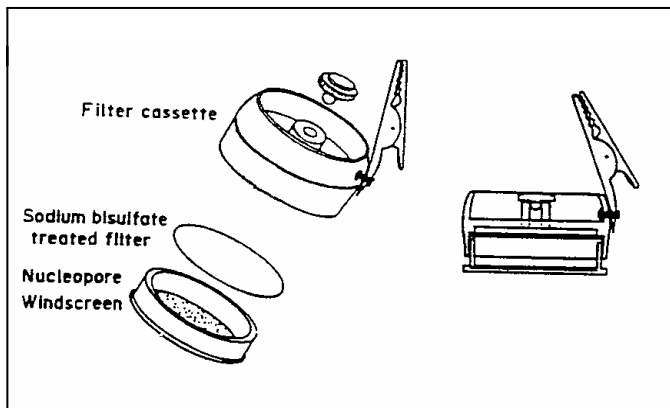


Diagram of an ETS passive sampler (Hammond et al, 1990).

- Plastic industrial hygiene sampling cassettes (Millipore Catalog No. N000037A0 modified)
- Filter (Pall Gelman Sciences. Cat.No. 7217 Type EMFAB TX40HI20-WW. 37 mm. Qty. 100/pk.)
- Windscreen (Schleiker and Schull TE36 37 mm Membrane Filter)

Number of samplers/ country: 14.

Number of filters/ country: 100.

Instructions on how to use an ETS Passive Sampler

- Open the sampler (to make it easier you can use a coin). It will be in two parts, one of them with a soft white front (called the windscreen) and the other with a blue (or red) button .
- Using tweezers take a filter from the urine cup, and put it in the part of the button with the rough side surface facing towards you (if you are unsure, you may refer to the filter given to each representative from the countries at the time of the first coordination meeting in Barcelona; the letter "u" is marked on the rough side). **Make sure you do this task in a tobacco-free environment in order to avoid contamination of the filters.**
- Next close the sampler by placing the windscreen on top of the filter.
- Press down on the sampler with a piece of wood to make sure the sampler body is secure and will not come apart by simply pulling on it.
- Place the sampler inside a urine cup and close the cup with a cap.
- **Before placing the sampler, it will be necessary to identify each one of them with a code composed by a letter that will depend on the country (P: Portugal, E: Spain, S: Sweden, A: Austria, I: Italy, F: France and G: Greece) and a different number for each sample.** This code will be written in a label and placed along the outside circular edge.
- In order to obtain as much information as possible, please fill in the log (see annexe II) for every sample and where possible take photographs (or provide a sketch diagram) of the location of the samplers within the establishment.

Quality Assurance Issues and calculations

To assure the quality of the measurement, collect at least one blank sample for each 10 samples. This means that for each ten filters used in a public place, there should be one filter that is not used. The unused filters must be placed in a container with a code, and sent with the other filters to be analysed.

Collect duplicate samples, 5-10% of total samples.

The airborne concentration of nicotine is calculated by dividing the number of ug of nicotine found by the volume of air sampled, which is the number of minutes of sampling times * the flow rate:

$$\text{Concentration of nicotine} = \frac{\text{nicotine, micrograms}}{\text{Volume...air...sampled}} = \frac{\text{nicotine, micrograms}}{\text{Flowrate * minutes}}$$

Directions on how to collect and reuse the samples

- Remove the sampler and return it into the urine cup (**perform this task out of the smoke-filled room to avoid capturing smoke in the cup**).
- **In a tobacco-free environment** open the sampler and, using tweezers, remove the filter. Put the filter in the container and close it (remember that only one sample must be placed in each container). After doing this, take out the label from the sampler and put it in the container.

Finally, to assure that the container remains absolutely closed, you may roll sticky tape around the container, after which it is ready to be stored (it is not necessary to store the sample in a refrigerator, but remember to store the samples in a nonsmoking place).

- When you have collected all the samples, send (by mail) the identified containers to the Municipal Laboratory of Public Health of Barcelona, where they will be analysed.

Please note that all the expenses of mailing will be reimbursed (at standard express mail fees). Send also the logs and the pictures to the Municipal Institute of Public Health (they could be sent by e-mail).

- After using a sampler, wash the part of the button with water and soap, and let it dry.

Leave the windscreen overnight in a non-smoking environment in order to be ventilated.

All the samplers could be reused as many times as necessary.

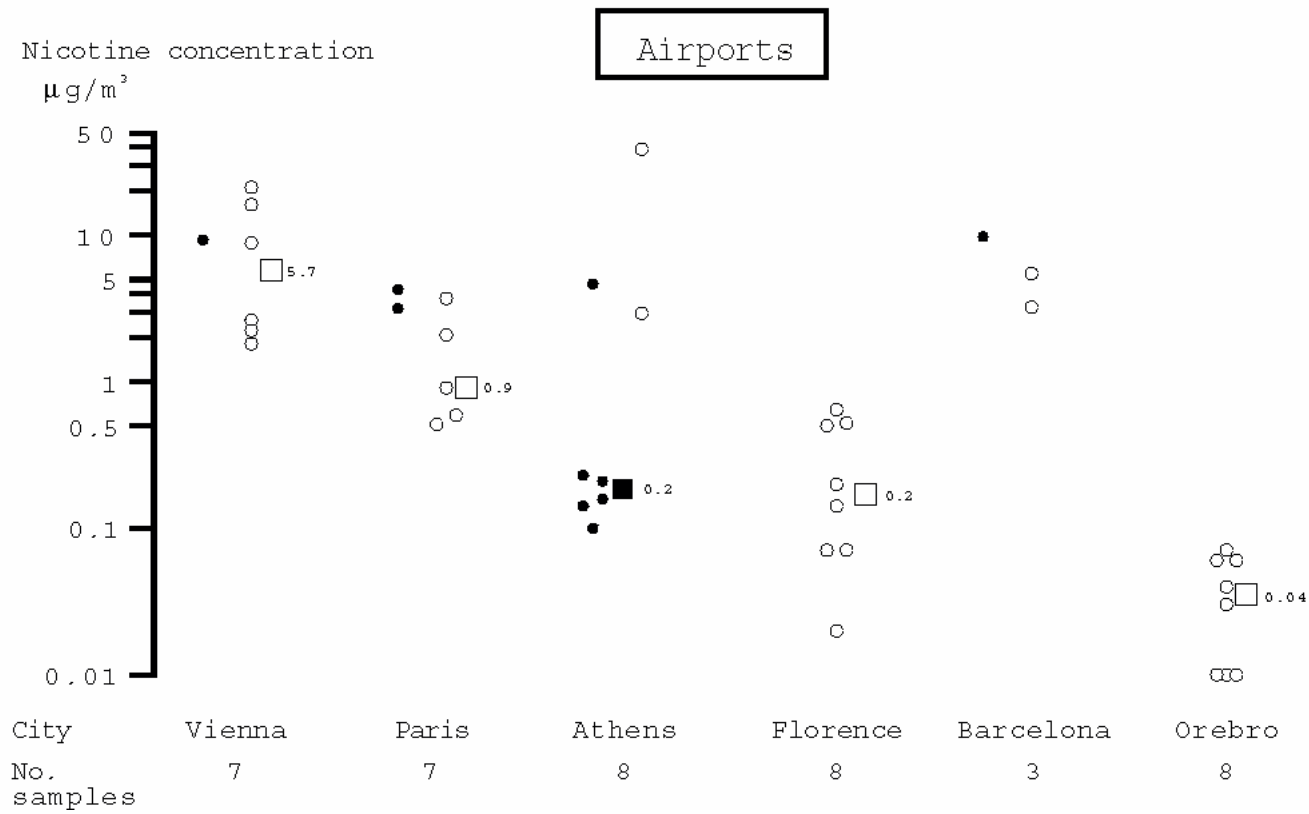
You will not receive more than 14 samplers, so try to keep them in good condition until the end of the study.

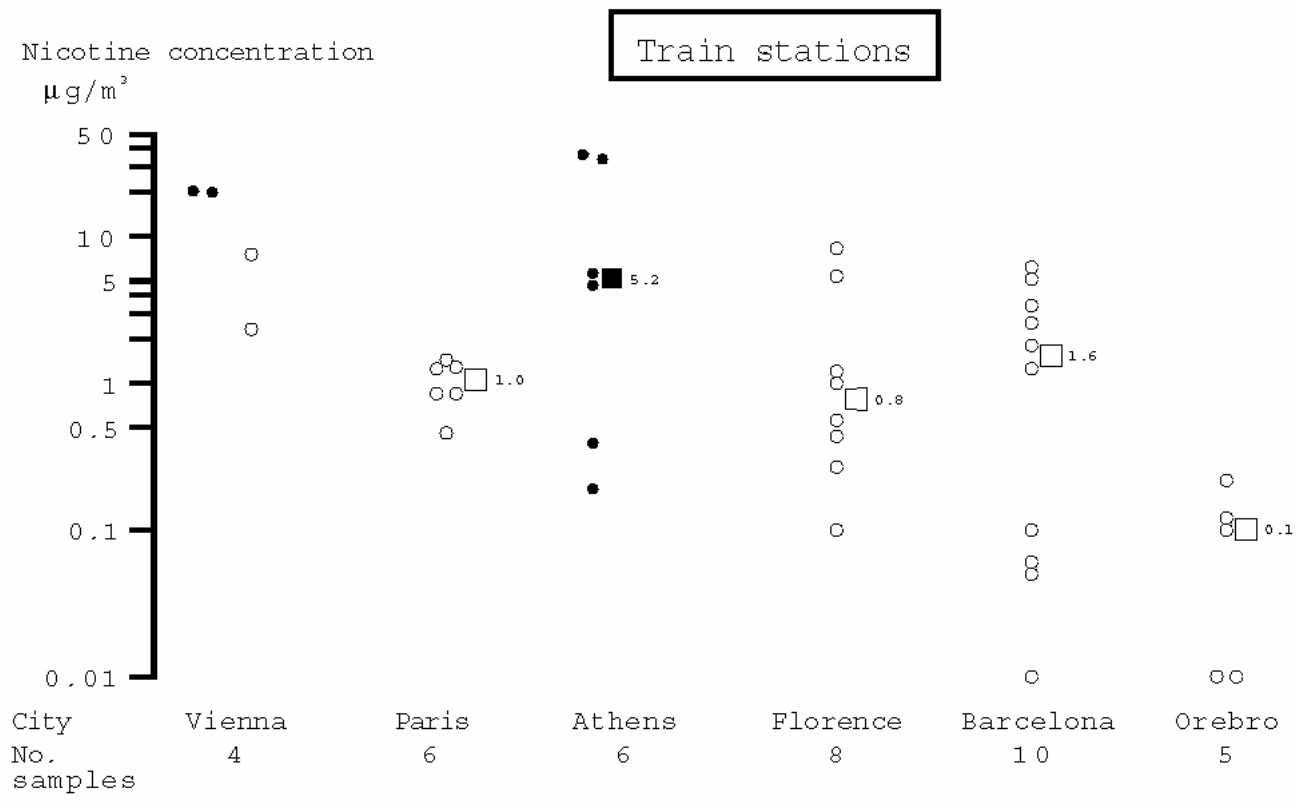
4- Results.

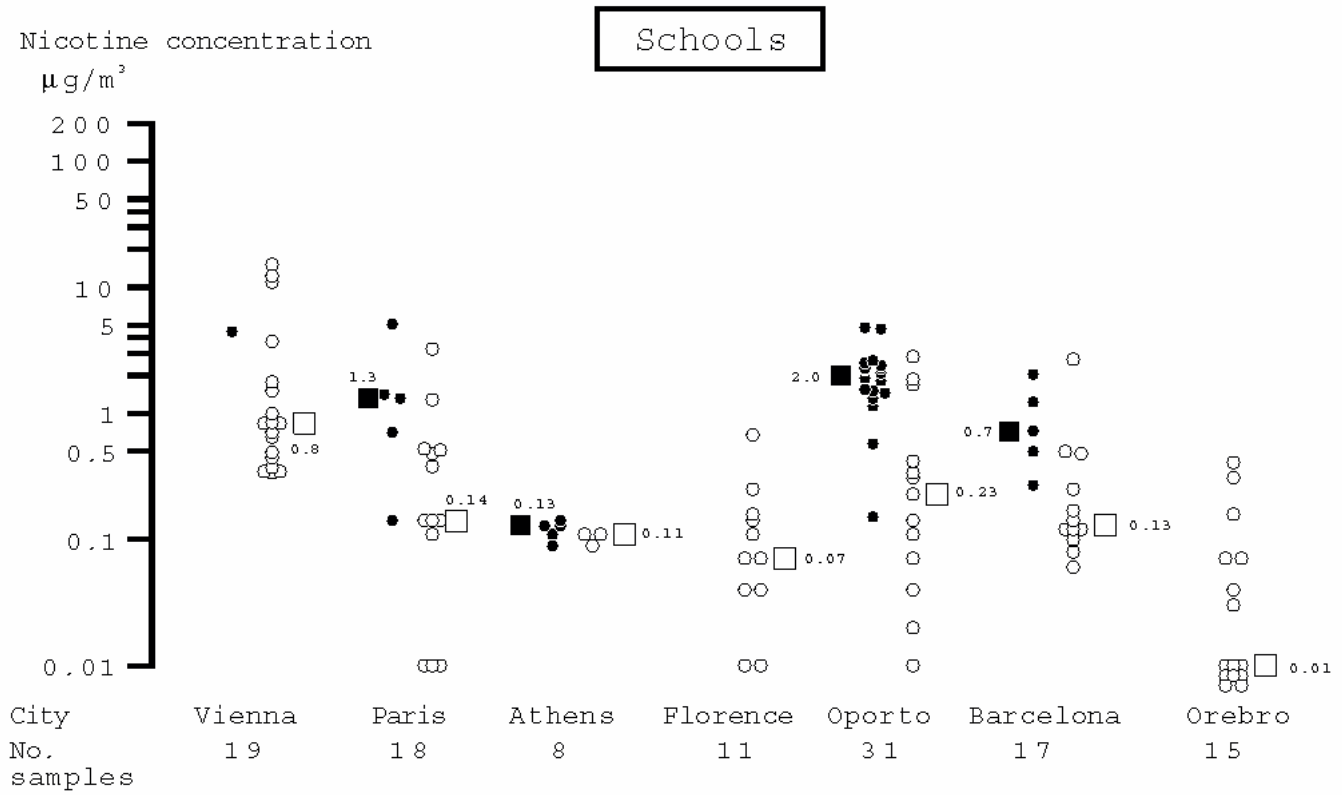
Figure 1 shows the nicotine concentrations found in areas where smoking is allowed (solid circles) and areas where smoking is not allowed (open circles) as well as the median concentration (squares). Bars and discos are the places with the highest concentrations, as expected, though in Orebro (Sweden) the levels were lower than anywhere else (less than $5 \mu\text{g}/\text{m}^3$). Generally, the nicotine concentration ranged from 10 up to $500 \mu\text{g}/\text{m}^3$. None of the places sampled had areas where smoking was prohibited. Restaurants had the next highest levels. It is worth noting that in Vienna, Paris and Florence the levels in parts of the restaurant where smoking was not allowed were not dissimilar to levels in areas where smoking was allowed. In train stations and airports most of the areas sampled had smoking restrictions, but despite this there were appreciable levels of nicotine, generally ranging from 0.1 up to $5 \mu\text{g}/\text{m}^3$ in airports and 0.5 up to $10 \mu\text{g}/\text{m}^3$ in train stations. Nicotine was also found in schools and universities, particularly in Barcelona, and again the levels in non-smoking areas were somewhat similar to those in which smoking was allowed. Schools tended to have the lowest concentrations compared to all the other public places sampled. Low levels were found in hospitals, though in Vienna there were areas (“smoking rooms”), where the nicotine concentration was high. Generally, levels were below $5 \mu\text{g}/\text{m}^3$.

Overall, in our study 22% of the samples had nicotine concentrations greater than $6.8 \mu\text{g}/\text{m}^3$; concentration associated to a lung cancer risk of one in 1000 assuming 45 years of working life, this is equivalent to the “significant harm” action level defined by the U.S. Occupational Safety and Health administration. Repace and Lowrey evaluated the risk of ETS exposure in the workplace and estimated that workplace nicotine exposure of $2.3 \mu\text{g}/\text{m}^3$ for 40 years presents a lung cancer risk of three in 10 000, 35% of the samples in our study are higher than $2.3 \mu\text{g}/\text{m}^3$. World Health Organization declared that there is no evidence for a safe ETS exposure level and our study shows that in many public places there are measurable levels of ETS exposure. The results of this study indicate that well implemented smoke-free policies are necessary to eliminate exposure to tobacco smoke in public areas.

Figure 1. Levels of nicotine concentration by setting and city

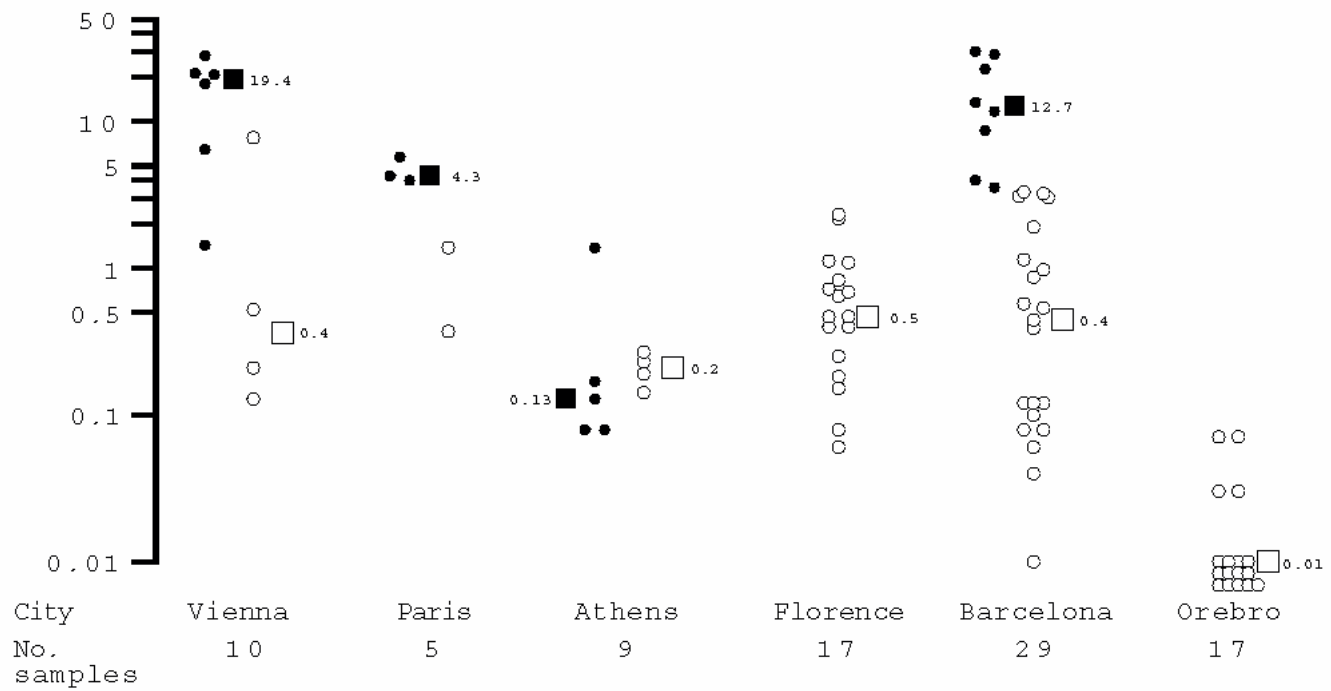


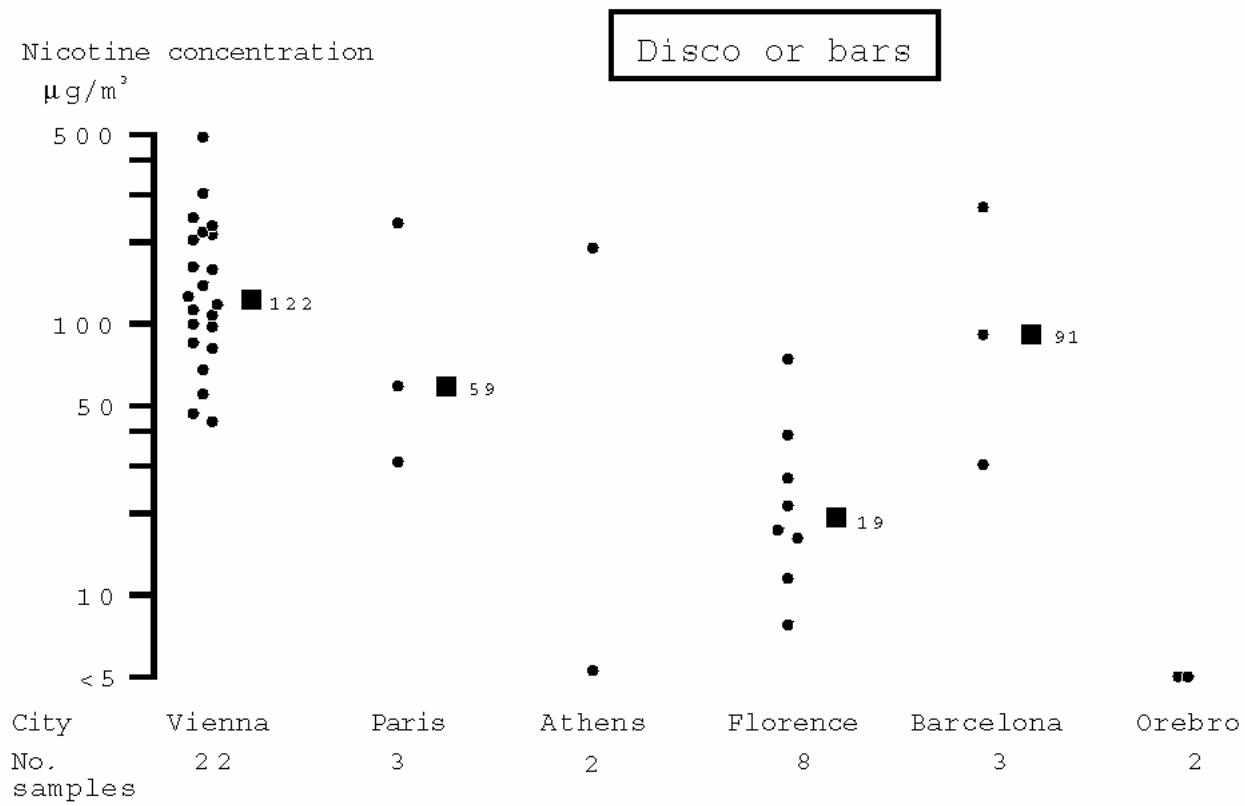


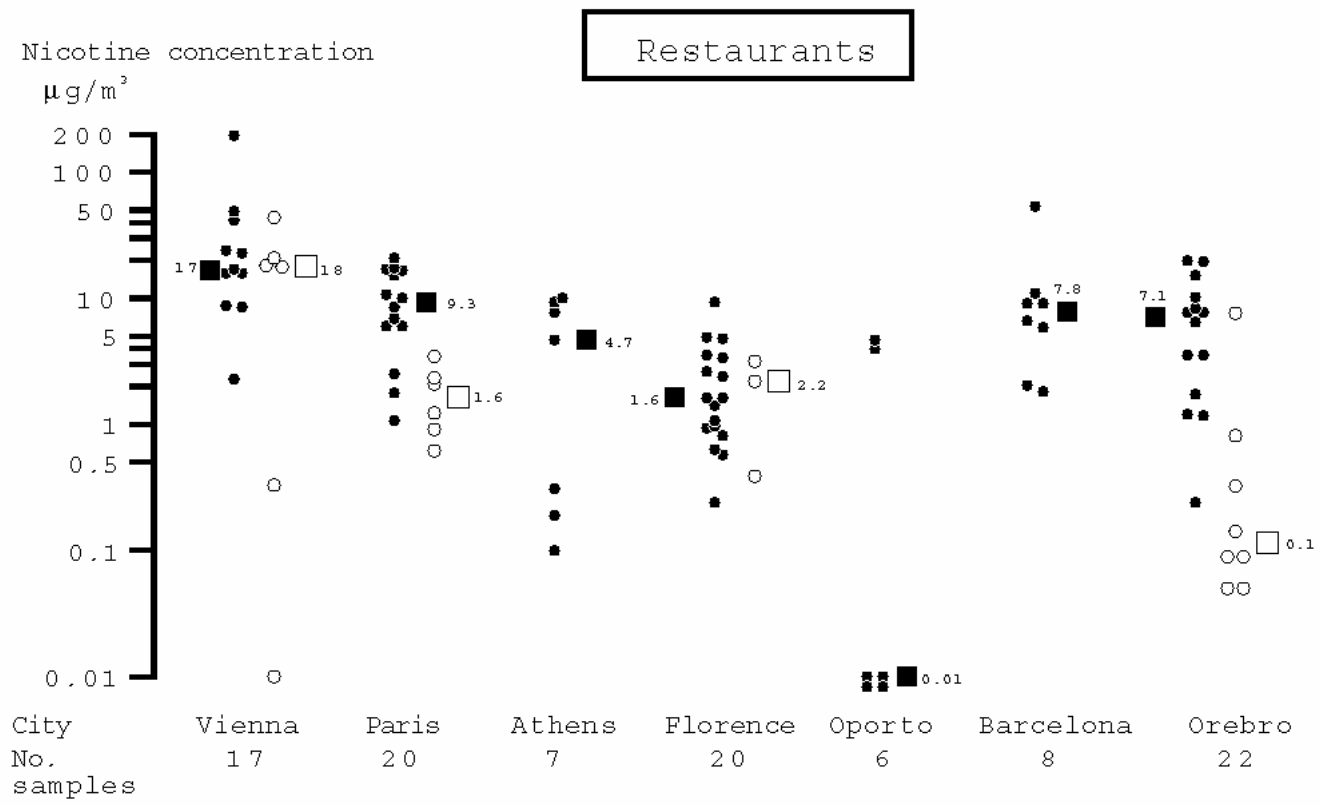


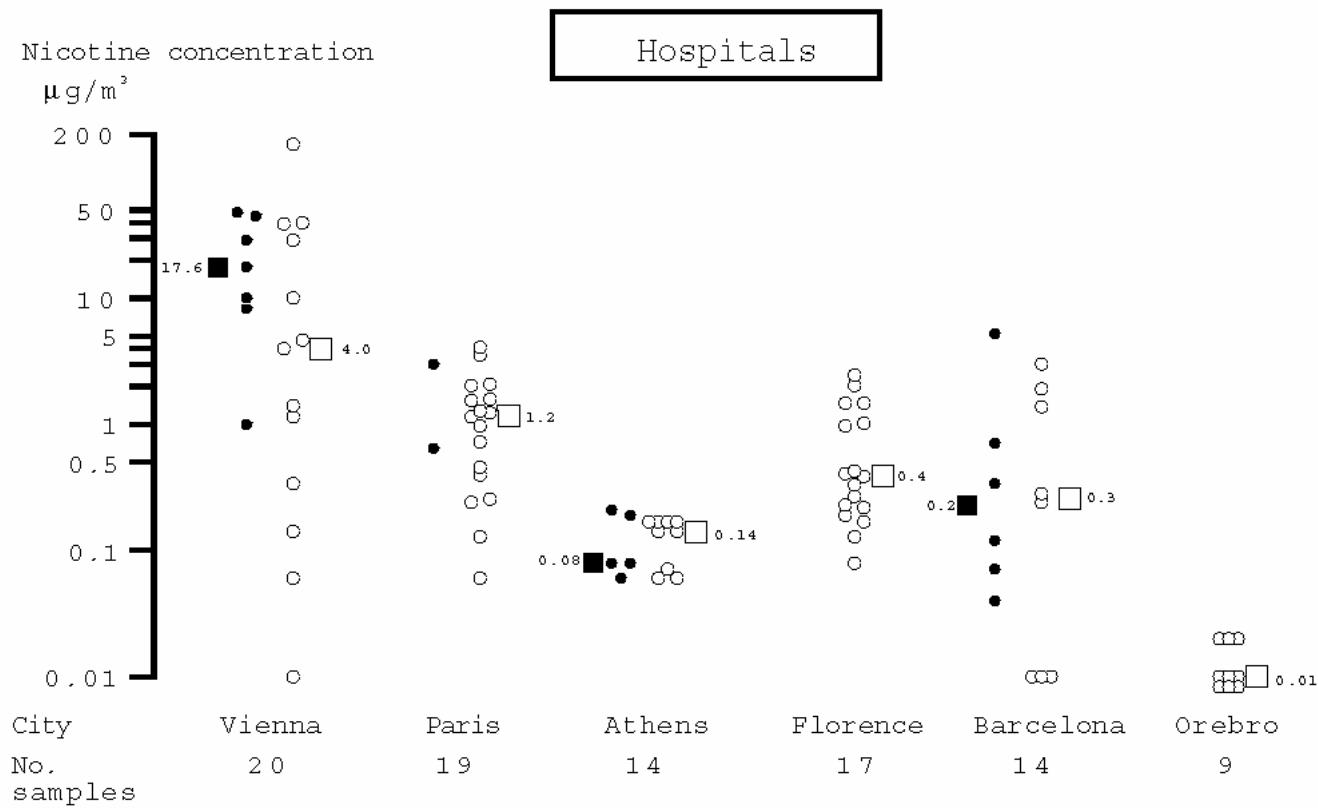
Nicotine concentration
 $\mu\text{g}/\text{m}^3$

Universities









Legend to figure 1.

Solid circles: places where smoking is allowed (or there are no specified policies); the solid squares represent the median concentration.
 Open circles: places where smoking is prohibited; the open squares represent the median concentration

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