Population Exposure to Air Pollutants in Europe
PEOPLE project in Lisbon

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Project description

Among the health related activities conducted at Emissions and Health Unit of the Joint Research Centre, the PEOPLE (Population Exposure to Air Pollutants in Europe) project is designed to assess human exposure to pollution. The project measures outdoor, indoor and personal exposure levels of/to air pollutants in about ten European larger agglomerations in the EU 15 and new EU member/candidate countries. The study focuses on pollutant emissions from transport and smoking, using benzene as a tracer pollutant.

Citizens were invited to participate into the project, through invitations launched in the media, to assess their personal exposure to benzene. In each city a number of maximum 125 volunteers were selected, according to well defined selection criteria.

Measurements were also taken over a 24-hour period at a wide range of indoor locations –at such as homes, offices, shops, schools, bars and restaurants and public transport, as well as outdoor locations throughout the city.

In Lisbon, the Joint Research Centre of the European Commission coordinated and carried out the study in conjunction with the Institute for the Consumer (IC), Presidency of the Council of Ministers. Other entities participating were the Regional Administration of Environment and Land Use Planning for Lisbon and Tagus Valley (DRAOT-LVT); the Ministry of Cities, Land Use Planning and Environment (MCOTA); the Department of Environmental Sciences and Engineering (DCEA); the College of Science and Technology, the New University of Lisbon (FCT-UNL); the Public Health Regional Center for Lisbon and Tagus Valley, the Ministry of Health (CRSP-LVT, MS); the City Department for Environment and Green Spaces, Lisbon Municipality (DMAEV, CML); the Quercus — National Association for the Conservation of Nature (QUERCUS) and the Research Center on Information Technology and Participatory Democracy (CITIDEP).

Air pollution by benzene

Benzene is a carcinogenic compound that is associated with an increased risk of developing leukaemia. In cities, benzene is mainly generated by automotive traffic. It is present in gasoline and is also formed as product of the incomplete combustion of gasoline.

The risk level established by the World Health Organisation ranges between 3.8 and 7.5 cases of myeloid leukaemia per one million people exposed during lifetime to 1 _g/m^3 of benzene.

Benzene is the first carcinogen to be regulated by EU air quality directives (2000/69/EC). The new benzene directive imposes a limit value of 5 _g/m^3 to be reached by 1st January 2010.

As a primary pollutant emitted by traffic, benzene is also a good tracer for other pollutants generated by traffic, such as carbon monoxide, nitrogen oxides, volatile organic compounds and particulate matter.

Smoking is also an important source of benzene strongly affecting personal exposure to this pollutant. It should be noted that benzene is however one of many toxic compounds emitted by smoking.

PEOPLE objectives

At the moment of the entry into force of the new EC directive on air pollution by benzene, the PEOPLE project aims to provide:

- Preliminary assessment of benzene levels for the establishment of measurement regimes and in support to monitoring network design, mainly in the new EU member/candidate countries
- Impact of outdoor and indoor emission sources (including smoking) on human exposure to benzene levels, in support to risk assessment of urban populations in Europe and the validation of exposure models.
- Comparative assessment of the air pollution by benzene in various European capitals, in function of local mobility policies and air pollution abatement measures.
- Support to local, national and European decision making.
- Raising the awareness of citizens with regard to air quality in general, and in particular to the impact of personal behaviour (mode of living, mode of transport, smoking habit).

This last aspect constitutes a key element in the PEOPLE study approach. The development of the Clean Air For Europe (CAFE) programme is based on the participation of all possible stakeholders: EC and national authorities; international research organisations and agencies; NGO's; industry. However, the success of the CAFE policy can only be guaranteed if it is understood and endorsed by citizens. To raise the awareness and inform the public constitutes a major tool to change the perception and the behaviour of the population towards air pollution. This is why in Lisbon, one of PEOPLE's partners, CITIDEP, promoted an educational project, the "PEOPLE-Citizenship", described below.

Measurement campaign

On 22 October 2002, citizens from Lisbon participated in the project. They were selected according to well defined criteria, in function of their specific activities: non-smoking citizens not exposed to automotive sources (control group), smokers, commuting citizens using a personal car as transport means, citizens using public transport, citizens using a bike or walking. Each citizen carried a sensor for 12 hours to measure their personal exposure to the

pollutant. These measurements were possible thanks to the use of a newly developed diffusive sampler allowing measurements in short periods of time.

Measurements were also performed for 24 hours in a wide range of indoor locations, such as offices, shops, schools, bars and restaurants and public transport means. Outdoor measurements were further performed in a number of urban sites to assess the levels and the distribution of benzene over the city (See Figure 1).

Results of the campaign in Lisbon

Outdoor pollution levels

Pollution levels in Lisbon, on the day of the campaign, ranged between 1.8 and 7.9, being the highest concentrations associated with areas with dense traffic (Figure 2).

In Lisbon, higher concentrations corresponded to the area between Santa Isabel and Coraçao de Jesus, between S. Jorge de Arroios, Anjos and Penha de Franca, and Campo Grande characterised by dense and bottlenecked traffic. The day of the campaign was consistent in spatial terms with previous longer term monitoring at the city. These results corresponded to a logical situation, according to the orography and traffic profiles of Lisbon.

Measurements from the continuous monitoring network showed that pollution levels on the day of the campaign were high in comparison with the median annual level (80th percentile value).

Indoor pollution levels

Levels were measured in typical indoor city locations, where people usually spend significant amount of time during the day (Figure 3).

Homes

The benzene concentrations are very close to the city background levels in houses of non-smoking sedentary citizens (control group) (median value of 3.5 micrograms per cubic meter), confirming that when indoor sources were not present, the outdoor levels controlled the measured concentrations at these locations.

Schools

The highest values reported at schools corresponded to particular situations; in one case a workshop classroom and in another a teachers' common room. Despite these cases, the median value is close to other indoor environments (4.2 micrograms per cubic meter).

Shops, cafes and offices

The shops showed very low benzene concentrations (median value of 1.6 micrograms per cubic meter), perhaps because of the selection of "clean shops" (pharmacies and other non smoking locations). Nevertheless, in cafes and offices where tobacco smoke may be present, the levels were higher (median values of 4.4 and 5.9 micrograms per cubic meter respectively).

Metro

The concentration levels in metro were comparable to other indoor environments (median value of 5.7 micrograms per cubic meter).

Buses

Buses showed the highest levels of concentration (median value of 9.2 micrograms per cubic meter). Frequently, buses were travelling through areas of high pollution (considered as hot spot), with high outside-inside air exchange rates due to the frequent opening and closing of the doors of the bus. This situation also influenced personal exposure, in particular when people were travelling at rush hours through the city.

Personal exposure

The personal exposure measurements represent the average concentrations to which a citizen was exposed. Exposure to benzene was related to a person's life style and surrounding environments. The main factors that affected benzene exposure were tobacco smoke and the time and mode of travelling (see Figure 4).

Control group

The non-smoking sedentary citizens, who acted as control group in the study, produced the lowest levels of exposure (median value of 3.1 micrograms per cubic meter) as was expected.

Smokers

Smokers were by far the most polluted class of citizens, exhibiting a median value of 6.8 micrograms per cubic meter. The strong variation in concentration levels depended on the number of cigarettes smoked and on the confinement space (e.g. indoor, outdoor).

It should be understood that the exposure value of benzene determined for smokers corresponded to their surrounding area, being the dose of inhaled pollutants studied about 10 times higher than the one measured in their surrounding (CONCAWE report no 2/99).

Travellers

In situations with the absence of smoking or other indoor pollution sources, the mode of travelling was the main factor affecting personal exposure. Amongst the types of travellers measured, car users were the most exposed group (median value of 5.4 micrograms per cubic meter). This level decreased when the travelling media changed. Walkers (median value of 4.4 micrograms per cubic meter) presented in this case, lower values. With respect to public transport users, the exposure was linked to type of transport used, i.e. bus users were more exposed to higher concentrations than metro users.

Stepwise multiple regression technique was used to identify factors affecting exposure levels among the volunteers; of which 20% were non-smokers unexposed to traffic, 20% were smokers and 60% were travellers. It was possible to establish the influence of the variables considered in the personal exposure model in relative terms. Figure 5 shows the influence, as a percent, in the personal exposure level as a function of the activity and location of the people during the study.

"PEOPLE-Citizenship" project

Schools play a key role in the development of personal and social behaviours. PEOPLE approach facilitates simple forms of participatory science. This is why in Lisbon, one of PEOPLE's partners, CITIDEP, promoted a large educational project, called "PEOPLE-Citizenship" (http://www.citidep.pt/act/peoplecitidep.html). Targeting students between 6 and 16, CITIDEP proposed a challenge to the schools that were part of the PEOPLE network in Lisbon: is it possible to learn participatory democracy through Chemistry? Yes, was their answer, after 280 students from 9 schools participated, with their teachers, in the project. During 9 months, a network of students, teachers and PEOPLE experts in air quality, engaged together in the research, at multiple levels of learning.

Inside and outside the school curriculum, technology and creative methods were used to brake barriers. Students from isolated small villages could ask questions to scientists and interact with their colleagues in Lisbon, through videoconference and internet broadcasts. Older and younger students visited each other, playing educational environmental games designed by them and doing lab experiments together. Creative games like «Let's clean our city», were played through video internet broadcast. A role-play session, representing different benzene-related stakeholders, debated different views. All these activities, with an estimated participation of 50 schools and 500 students, allowed children and youngsters to learn the negative effects of air pollutants, at the same time that they were discovering their personal and social responsibilities towards the risks of damaging environment.

After this educational experiment we believe that these children and young people are, indeed, the best messengers of the PEOPLE results, and the best guardians of environment and public health.

Conclusions and further perspectives

The PEOPLE project clearly identified higher levels of exposure to benzene with tobacco smoking and emissions from automotive traffic.

European Air Quality legislation can only be successful if understood and endorsed by the individual citizen. Raising the awareness of the public can lead to environmentally friendly behaviour. The active support of citizens to pollutant issues is important for the success of environmental policy. The development of local abatement strategies is an effective step in the quest for better air quality in our cities. The enthusiastic participation of the volunteers in Lisbon through the PEOPLE project clearly shows that improved environmental quality is a common goal for children, citizens and policy makers.

Further PEOPLE campaigns were recently conducted in Brussels (22 October 2002), Bucharest and Ljubljana (27 May 2003), and will follow soon in Madrid and Budapest (end of 2003). The study will be extended to other cities 2004. So far the following cities have expressed their interest to be associated in the project: Belgrade, Dublin, Paris, and Roma. The project will be extended to other toxic pollutants in the longer perspective, with emphasis on particulates.

For more information about the PEOPLE project, please contact:

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Figures

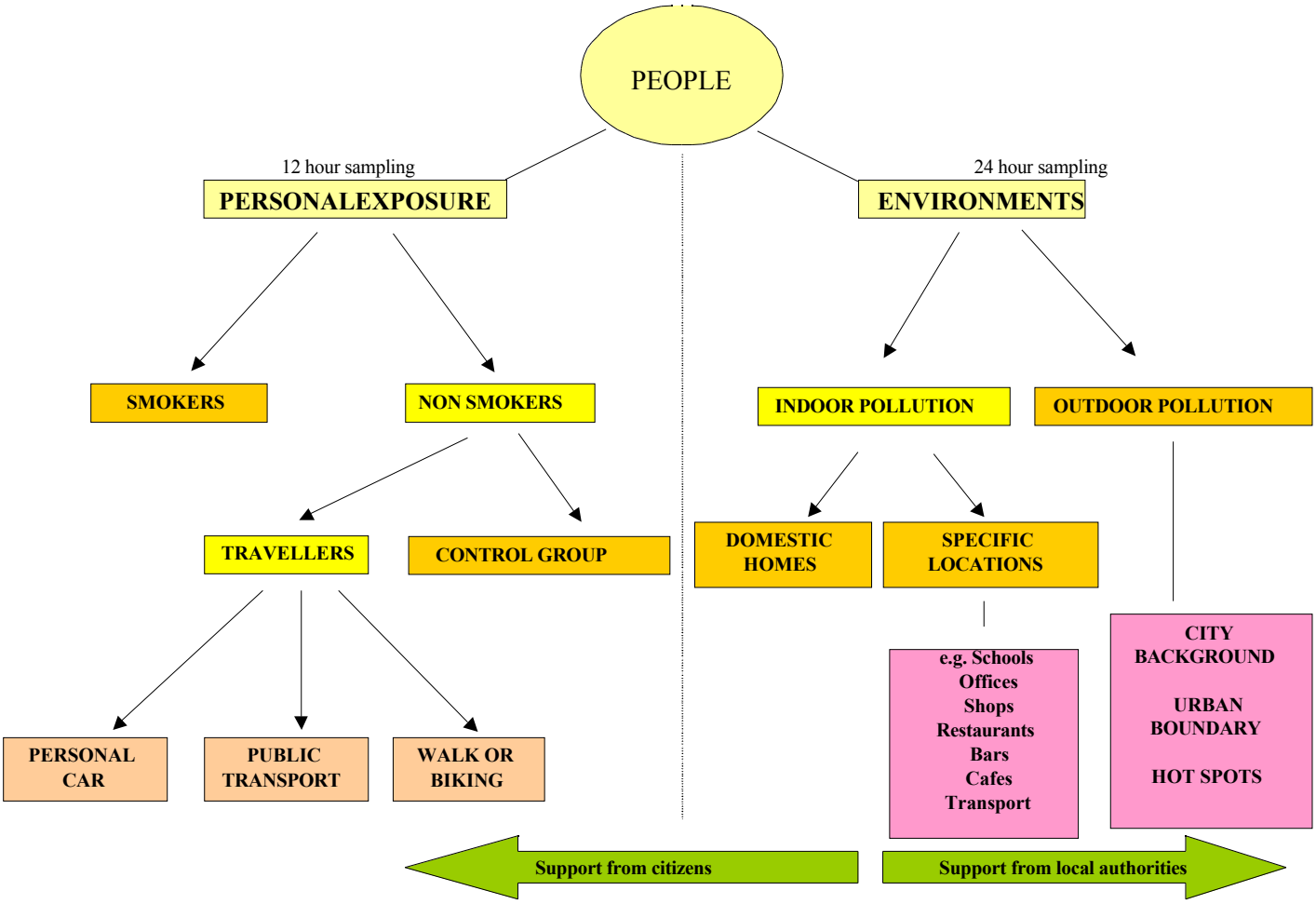

Figure 1. PEOPLE project measurement strategy.

Benzene Concentration

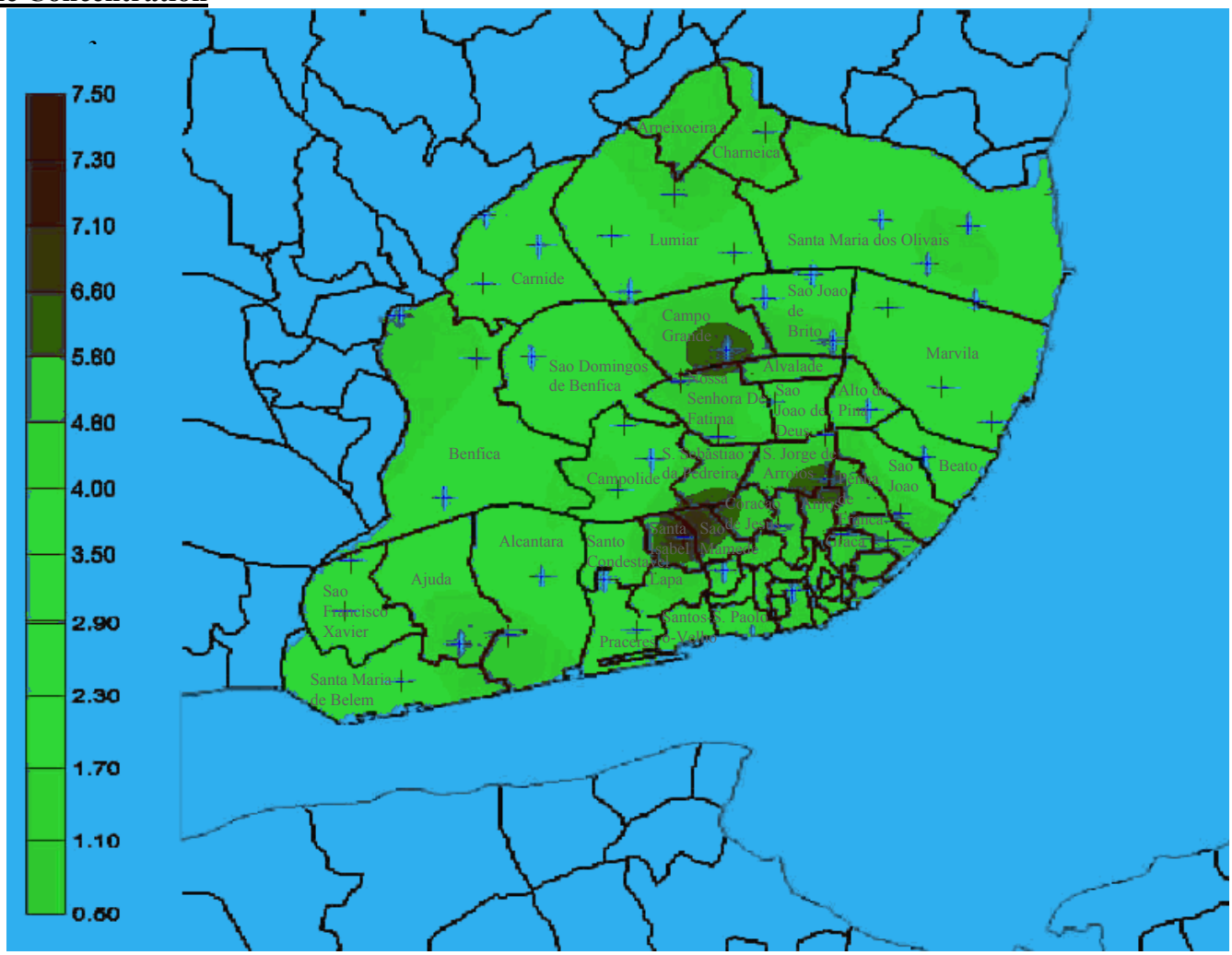

Figure 2. Map showing maximum exposure zones and benzene concentration levels in Lisbon on the day of the campaign (22 October).

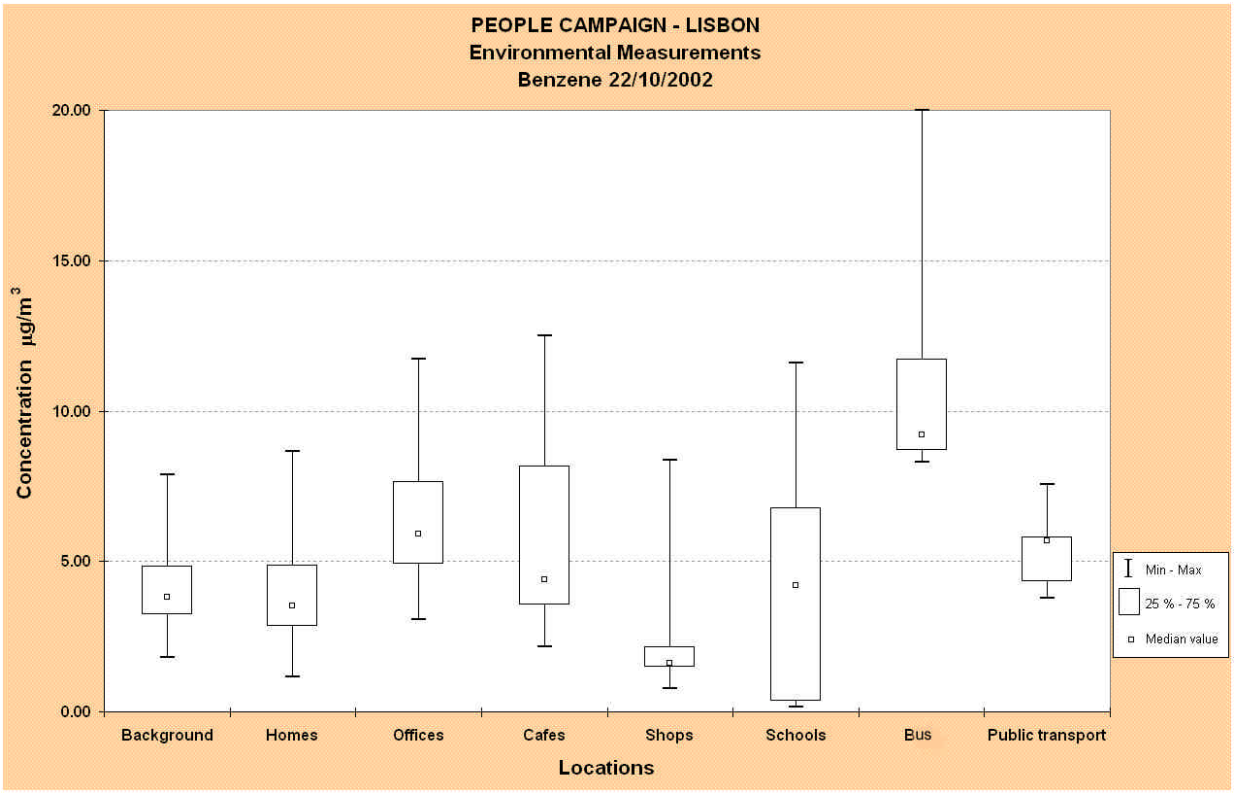

Figure 3. Indoor pollution levels on the day of the campaign (22 October)

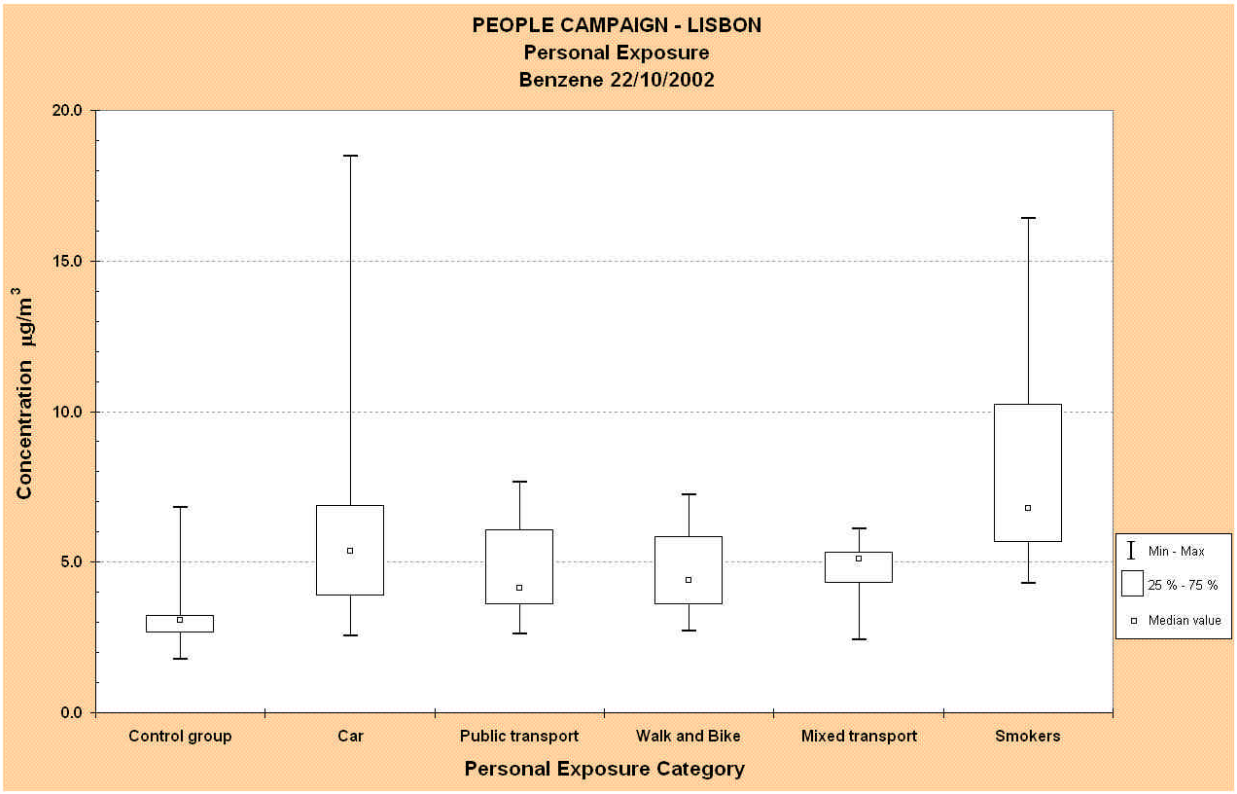

Figure 4. Personal exposure levels on the day of the campaign (22 October)

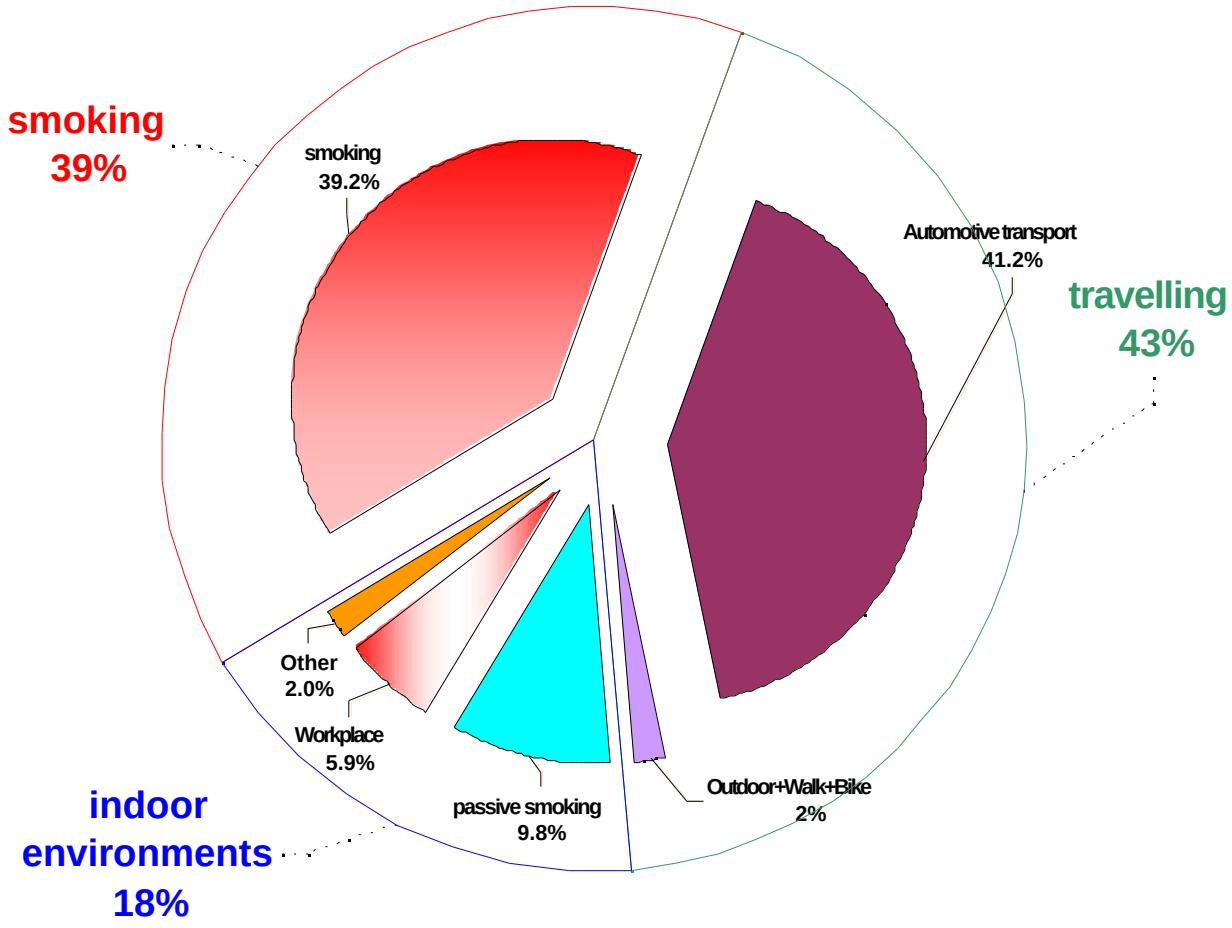

Figure 5. Relative influence of the variables considered in the personal exposure model