Study of the Impact of Urban Air Quality on Human Health Based in a Children Population – Proposal for a Model

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1 Introduction

Urban air quality is a factor of major importance nowadays. A good exterior air quality is essential to human health and to the equilibrium of the environmental system. Exterior air pollution is directly related with the quality of life of the population in general, but affects specially children, old people and people with respiratory system diseases. By other hand, air pollution is also directly related with the growing and productive capacity of plants. And at a global level the atmospheric pollution is related with a large group of problems of our planet, like acid rain, global warming and ozone layer depletion. The human activities are with no doubt, the main cause of emission of pollutants to the atmosphere (Seinfeld, 1986), and in this activities two of the most important are traffic and industry. The main objective of this study is try to anyway correlate this kinds of emission sources (traffic and industry) with human health, specially children. So a study is made in a city in the south of Portugal – Barreiro, were a lifting of the pollution sources have been made and related with data acquired from a exterior air quality acquisition net of the city, and medical data from the Hospital of the city, with a sample of 115 children.

2 City of Barreiro

The city of Barreiro is located in the district of Setúbal, 30 km south of Lisbon at the margins of river Tagus. The city is almost plane, and its highest point is approximately 10 meters higher than sea level. Its population is 85800 habitants. The major economic activities of the city are metalomechanical and chemical industries. A large number of its habitants work in Lisbon, so there are a large diary migration of people to the capital. The city of Barreiro is, after Lisbon and Oporto the city in Portugal with larger index of cars per number of habitant. So it is a city were the sources traffic and industry are very important to air quality in this town.

3 Characterisation of the emissions

The main pollution sources of the city are related with its industrial activities and with roadway traffic. One other source not very important but also considered in this study is the railway traffic. So we can list the sources considered in this study as:

Industrial sources	**Roadway traffic**	**Railway traffic**
Co-generation central power station (CPPE)	Alfredo da Silva street	Barreiro
Industrial complex of Quimigal/Lavradio	Avenue do Bocage I	Barreiro A
Phosphate factory of Quimitecnia	Avenue do Bocage II	Lavradio
Sulphate aluminium factory of Quimitecnia	Miguel Bombarda street	
Factory of alimentary oils of Lusol	Barreiro speedway	
Acrylic fibres factory of Fisipe	Av. Esc. Fuzileiros Navais	
	Dr. M.Pacheco Nobre street	

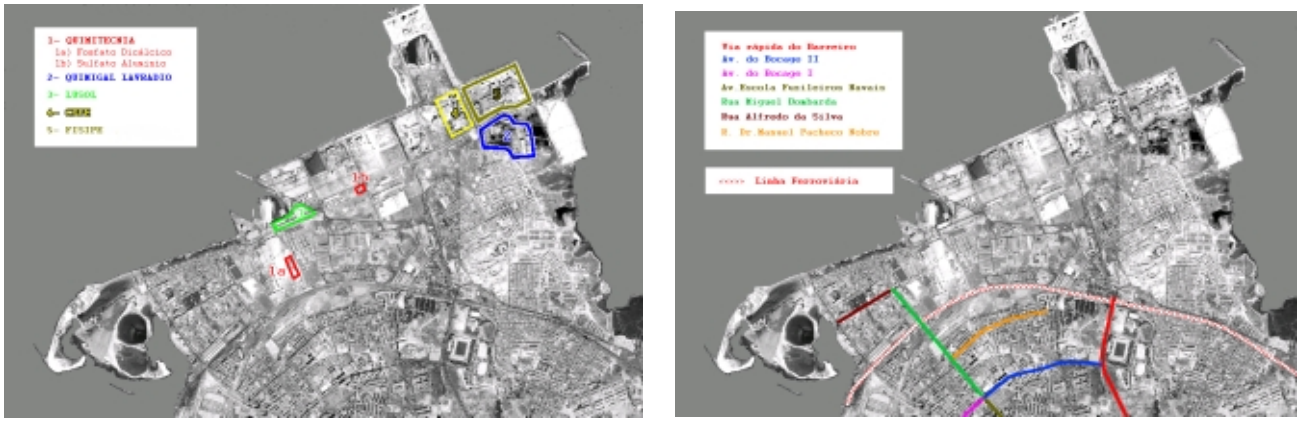

Figure 1 Localisation of the industrial and traffic line sources considered (D.R.A.L.V.T., 1999).

The values of industrial emissions for the pollutants considered (SOx, NOx and particles) are shown in the next table.

Table 1 medium and maximum values of the industrial sources.

Source	Factory	Chimney	MED SOx	MED NOx	MED PS	MAX SOx	MAX NOx	MAX PS
CPPE	Power station	General	217.90	35.42	7.41	333.33	52.70	11.03
QUIMIGAL Lavradio	Ammoniac	Boiler	54.29	4.93	2.80	57.16	5.19	2.95
	Nitric acid	Tail gas	0.00	3.85	0,00	0.00	3.91	0.00
	Urea	Prilling	0.00	0,00	4.10	0.00	0.00	4.79
	Sulphuric acid	Acid rec.	9.77	0,00	0,00	10.28	0.00	0.00
QUIMI TECNICA	Phosphate	Dryer 1	0.85	0.08	4.00	2.77	0.25	6.09
	Phosphate	Dryer 2	0.85	0.08	4.00	2.77	0.25	6.09
	Phosphate	Vapour gen.	0.25	0.02	0.01	1.17	0.11	0.06
	Phosphate	Vapour gen.	0.24	0.02	0.01	0.78	0.07	0.04
LUSOL	Productive proc.	Flour gran.	0.00	0,00	0.01	0.00	0.00	0.01
	Productive proc.	Vapour gen.	0.08	0.01	0.01	0.08	0.01	0.01
	Productive proc.	Vapour gen.	0.15	0.03	0.00	0.15	0.03	0.00
	Productive proc.	Vapour gen.	0.22	0.05	0.00	0.22	0.05	0.00
	Productive proc.	Vapour gen.	0.27	0.05	0.00	0.27	0.05	0.00
FISIPE	Productive proc.	Dryer	0,00	0,00	8.69	0,00	0,00	22.20

Note – All values in g/s

The values for the traffic line emissions of pollutants considered (CO, CO_2, SO_2, NOx and particles) are shown in the table 2 (roadway traffic) and table 3 (railway traffic).

Table 2 Medium and maximum values for roadway traffic sources.

Source	MIN CO	MIN CO_2	MIN SO_2	MIN NOx	MIN PS	MAX CO	MAX CO_2	MAX SO_2	MAX NOx	MAX PS
Alfredo da Silva	0,56	9,2	0,008	0,27	0,09	2,61	29,6	0,026	0,60	0,29
Av.do Bocage I	0,84	11,4	0,010	0,32	0,10	3,24	36,1	0,032	0,74	0,35
Av.do Bocage II	3,37	52,6	0,045	1,45	0,45	11,3	119,5	0,105	2,28	1,10
Miguel Bombarda	2,87	39,0	0,034	1,14	0,48	9,01	81,2	0,070	1,29	0,62
Barreiro speedway	1,76	24,5	0,02	0,66	0,20	5,96	66,0	0,060	1,32	0,64
Av. Esc. Fuz. Navais	1,82	27,6	0,024	0,79	0,25	6,50	75,5	0,067	1,61	0,78
Dr.M.Pacheco Nobre	0,89	13,4	0,01	0,34	0,10	3,00	28,2	0,021	0,46	0,21

Note – All values in g/s

Table 3 Medium and maximum values for railway traffic sources.

Source	MIN CO	MIN CO_2	MIN SO_2	MIN NOx	MIN PS	MAX CO	MAX CO_2	MAX SO_2	MAX NOx	MAX PS
Railway	0.11	13.3	0.06	0.39	0.03	0.19	22.1	0.11	0.65	0.06

Note – All values in g/s

4 Meteorological characterisation

The meteorological variables to this study were supplied by the Portuguese Meteorological Institute, with is climatic acquisition station of Lavradio. We have a predominance of winds from the NW quadrant with a medium frequency of occurrence of 35,1%, followed by the SW quadrant with 15,1% and quadrant NE with 12,7%. The higher medium velocity corresponds to direction S, and it's value is 15,2 km/h. The lowest medium velocity is from E with the value of 7,1 km/h. The annual frequency of calm situations is very significant (10,2%), with is highest value in May (12,2%). We have also a media of 27 days per year with fog, with highest frequency in winter mouths (5 days in January). The next table shows the stability classes of Pasquill-Guifford to the city of Barreiro (C.M.B., 1997).

Table 4 Stability classes distribution for the city of Barreiro.

Classe de estabilidade	Frequência (%)
A e B	5 - 10
C	< 15
D	50 - 60
E e F	< 10

So we can see that the city of Barreiro is characterised by strong fog, due to the proximity of the river Tagus, resulting in bad conditions to the dispersion of pollutants, especially during winter. Besides the dominant winds are from north, favouring the transport of pollutants to the direction of the residential zones in the surroundings of the industrial area.

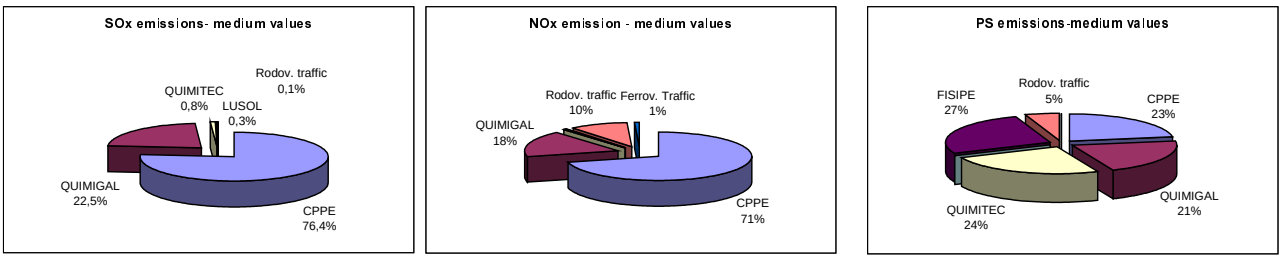

Figure 2 SOx NOx and PS emissions perceptual values.

5 Air quality acquisition net

The air quality data used in this study were amiably supplied by the ***Comissão de Gestão do Ar do Barreiro/Seixal***, data that were collected by is air quality acquisition net, during the mouths of May to December of 2000. This acquisition net is formed by five stations in the city of Barreiro and Seixal. The five stations are ***Câmara Municipal***, ***Escavadeira***, ***Hospital velho***, ***Lavradio*** and ***Paio Pires.***

6 Pediatric sample

The pediatric sample used in this study was obtained from the paediatric service of Nª.Sª. do Rosário Hospital in Barreiro. The data was collected during 7 months (July to December of 2000) in the Barreiro Public Hospital, with 115 children with ages up to 15 years old, supported by doctors. And were considered all identified cases with symptomotology of asthma or respiratory difficulties in the pediatric urgency of the referred hospital. To achieve the proposed objective, of trying to achieve a correlation between the number of cases of children with asthma and the levels of

pollution in the exterior air, it is necessary to have a very large number of data. So this gathering of data will continue, and it is necessary to enlarge the universe to other cities.

7 Results and discussion

The following charts show the obtained results of the pollutants concentrations collected by the measurement stations early refereed, compared with the number of cases of asthma or respiratory difficulties of children observed in the Barreiro hospital. In each chart are presented (to the period of study), the diary media of the pollutants concentrations (NO_2, CO e O_3), and the number of observed children to the same period. Are also presented charts with the temperature and relative humidity versus number of children observed to the period in study

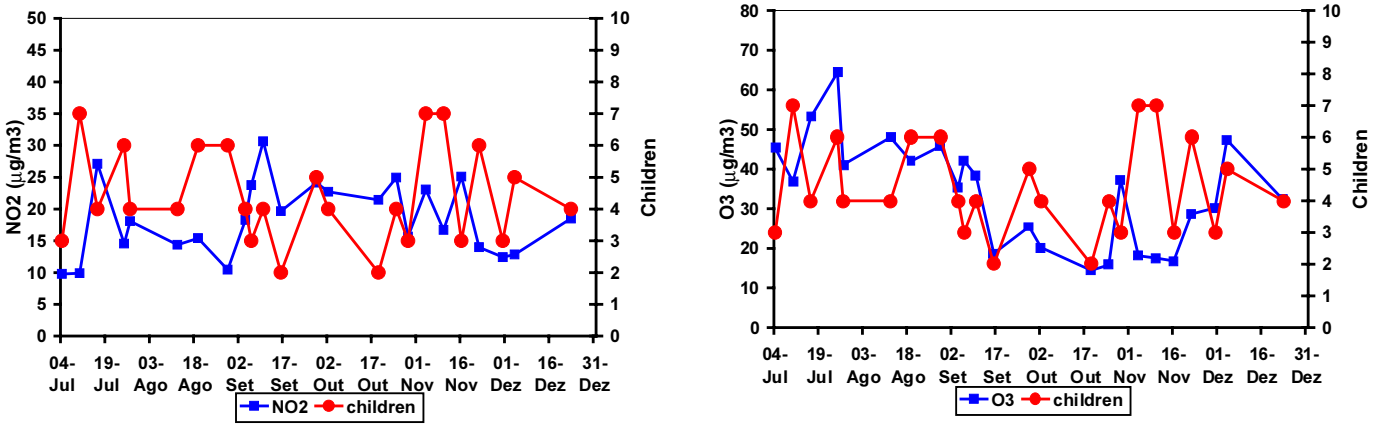

Figure 3 Diary media values of pollutants NO_2 and O_3 versus number of children observed.

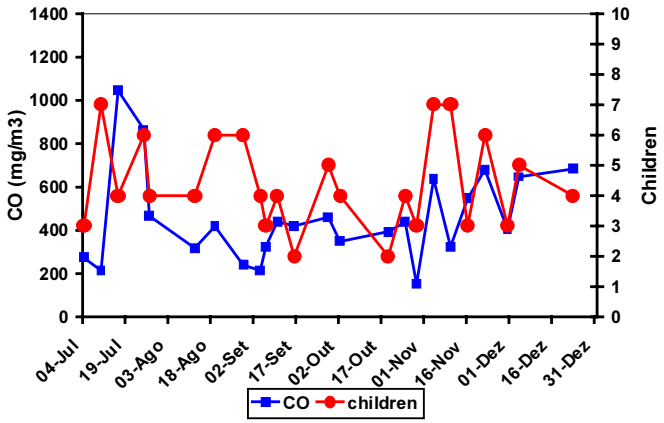

Figure 4 Diary media values of pollutant CO versus number of children observed.

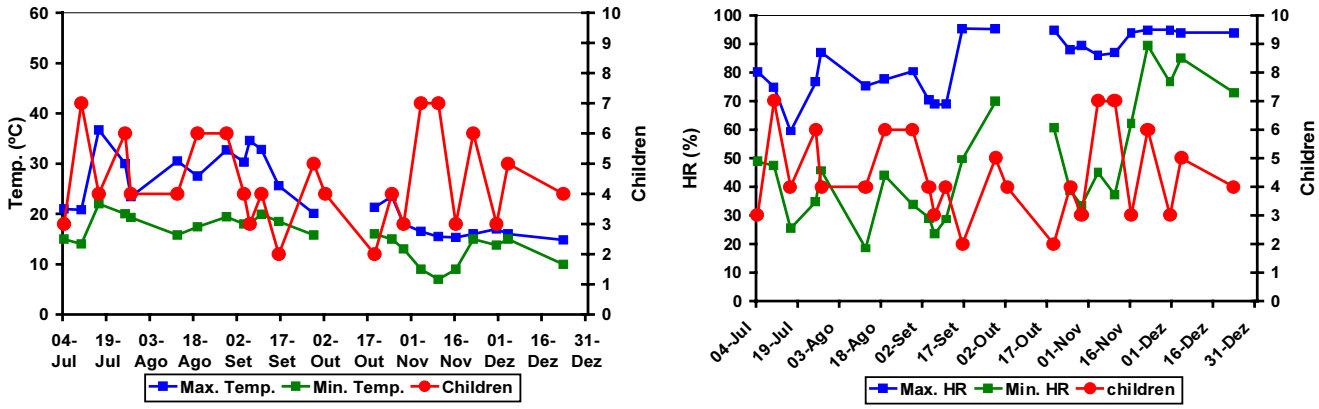

Figure 5 Maximum a minimum values of diary temperature and relative humidity versus number of children observed.

8 Conclusions

The obtained results are of difficult analysis and are not very conclusive yet, due to the following factors:

- Reduced number of data, because the period considered is not very large yet.
- Inexistent diary and systematic pediatric data, due to the fact that the data refers only to one team of urgency doctors
- Some children (especially the younger ones) don't know how to complain, and so many times, they are not identified as respiratory difficulties.

In spite of this, it seems possible to identify one possible relation between the cases of children observed in the hospital and the medium values of the concentrations of NO_2 and O_3, and also a relation between the cases of children observed and the values of relative humidity. It seems possible to identify that high values of concentration of NO_2 and O_3, are followed by high values of cases of children observed. The same seems to happen to high values of relative humidity, that are followed by high values of cases of children observed. So, it is important to continue this study, namely with the acquisition of more data, not only with the extension of the time period considered, but also with the accuracy of the trace methods, with the enlargement of this study to other cities. This study will continue in the future, trying to achieve any kind of correlation between the exterior air quality and the health of children. This kind of correlation, integrated in a global model for air urban air quality management (Valkonen, 1995), may constitute a strong improvement in terms of health control related with air quality.

9 References

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