Particulate Air Pollution and Chronic Obstructive Pulmonary Disease in Portugal

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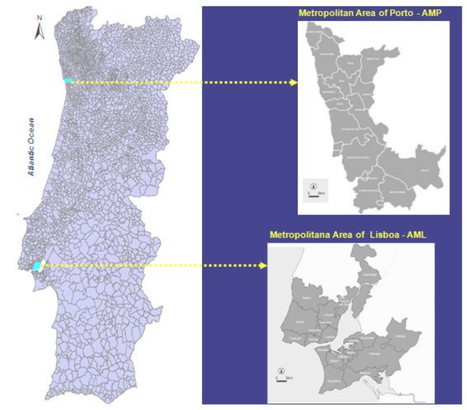
Objectives

The aim of this investigation work is forecasting the number of hospital admissions in the main Metropolitan Areas in Portugal, having in account the relationship with the pollution elements and the meteorological parameters using the **models ARIMA**.



Material and Methods

The hospital admissions were used for illnesses of respiratory branch such as: Asthma (ICD 493), Pneunomia (ICD 480-489), COPD (ICD 490-499) and Respiratory Diseases (ICD 460-519) in the period of seven years.

➢ The data about the daily levels of PM_{10} and Ozone (O_3) were taken from the control net of the Portuguese Agency of Environment.

➢ The data of mean temperature (Tmean) were obtained from the Sea and Atmosphere Institute during the period of Study.

Analysis

We have calculated the monthly mean of the data concerning the hospital admissions for the period from 2003 to 2010 for young people (age between 0-14 years) adults (15-64 years) and aged people (=> 65years) in the metropolitan areas under study.

On the very beginning with the aim of understanding the level and the logic of association among the medical variable points (hospital admissions), environmental and meteorological, we have proceeded to an analysis of simple correlation, using the estimate of the correlation of Pearson (r).

Afterwards we have used the **ARIMA models** (Jenkins, 1976). Several tests were fulfilled, in the attempt of verifying the meaning of the values found trying to choose the best model.

Results

✓ There are associations statistically meaningful for a level of reliance of 95% between the pollution elements (PM_{10} and O_3), Tmean and the hospital admissions due to breathing illnesses.

✓ We found positive and statistically significant associations between variations concentrations levels of PM_{10} (in AML and AMP), principally among individuals older than 64 years at the time of hospital admissions.

✓The results also show that mean temperature and O_3 have a negative association with hospital admissions, as can be seen in AML (r=-0,48; p<0,01 and r=-0,708;p<0,01 for COPD) and AMP (r=-0,52; p<0,01 for Pneunomia, and r=-0,820; p<0,01 for respiratory diseases).

✓ ARIMA models were found for the areas AML and AMP able for reproducing the reality and they will be useful when taking future decisions.

✓ As we can verify through p-value, the model ARIMA $(1,2,1)\ (1,1,0)_{12}$ is the model found for COPD, in AML and ARIMA $(2,1,0)\ (1,2,1)_{12}$ for asthma in AMP , because these have produced he best results.

Conclusions

❖ The present investigation offer evidence of a clear relationship between environmental conditions and the levels of atmospheric pollutants with hospital admissions in different metropolitan areas in Portugal.

❖ There is also evidence of an association between variations in the concentrations levels of PM_{10} and O_3 with respect to daily hospital admissions, although this aspect requires further investigation aimed at quantifying this relationship.

❖ The temporal series are an analytic tool in the studies about epidemiology and in the resources of the health institutions in Portugal.

❖ The flexibility of accompanying, recognizing patterns in the series of data and giving explanations is one advantage which can´t be minimized in the studies concerning the health interventions, Here the model ARIMA was introduced without using the mathematic details or the model extensions as every analysis will be based on these models.

Correlations MAL

Hospital Admissions	Age Groups (years)	PM_{10}	O_3	Tmean
Astma	0-14	0,257*	-0,074	-0,534**
	15-64	0,310**	-0,369**	-0,607**
	>65	0,276**	-0,414**	-0,338**
Pneunomia	0-14	0,356**	-0,483**	-0,787**
	15-64	0,117	-0,225*	-0,812**
	>65	0,108	-0,429**	-0,686**
COPD	0-14	0,197	-0,402	0,574**
	15-64	0,305**	-0,487**	-0,708**
	>65	0,356**	-0,588	-0,863**
Respiratory Diseases	0-14	0,250*	-0,671**	0,734**
	15-64	0,238*	-0,396**	-0,749**
	>65	0,317**	-0,588**	0,783**

Correlations MAP

Hospital Admissions	Age Groups (years)	PM_{10}	O_3	Tmean
Astma	0-14	0,120	-0,145	0,048
	15-64	-0,064	-0,133	0,055
	>65	0,246	0,193	0,318**
Pneunomia	0-14	0,254*	-0,562**	-0,114
	15-64	0,036	-0,323**	-0,656**
	>65	-0,018	-0,318**	0,881**
COPD	0-14	0,127	-0,328**	-0,608**
	15-64	0132	-0,378**	-0,600**
	>65	0,112	-0,497**	-0,706**
Respiratory Diseases	0-14	0,356**	-0,495**	-0,820**
	15-64	0,222*	-0,373**	-0,638
	>65	0,202*	-0,427**	-0,732

Final Model (ARIMA)

Hospital Admissions	Modelos (AML)	Coeficiente	t-student	*p*-value
Astma	(0,0,0)(0,1,1)	0,978	18,8	0,000
Pneunomia	(1,1,0)(2,1,1)	0,896	20,6	0,000
COPD	(1,2,1)(1,1,0)	0,946	18,6	0,000
Respiratory Diseases	(2,1,1)(1,1,1)	0,785	21,3	0,000
PM_{10}	(1,2,1)(1,0,0)	0,877	14,2	0,000
O_3	(0,1,0)(1,1,1)	0,794	18,6	0,000
Tmean	(2,1,1)(1,0,1)	0,833	21,7	0,000
	Modelos (AMP)	**Coeficiente**	**t-student**	***p*-value**
Astma	(1,0,1)(1,2,1)	0,857	14,2	0,000
Pneunomia	(2,1,0)(1,1,1)	0,804	20,6	0,000
COPD	(2,1,0)(1,2,1)	0,965	18,3	0,000
Respiratory Diseases	(1,0,1)(2,1,1)	0,768	19,7	0,000
PM_{10}	(2,1,1)(1,2,0)	0,934	21,2	0,000
O_3	(0,2,1)(1,1,1)	0,895	17,8	0,000
Tmean	(3,1,2)(1,0,0)	0,786	19,3	0,000

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