

## O1 - Comunicación Oral/Oral communication

Métodos I: Métodos en estudios ambientales  
y geográficos

Methods I: Methods in geographic  
and environmental studies

Jueves 2 de Octubre / Thursday 2, October  
9:00:00 a/to 11:00:00

Moderador/Chairperson:  
Javier García León

### VALIDATION STUDY ON THE ASSESSMENT OF RADIO FREQUENCY EXPOSURE DUE TO CELLULAR TELEPHONE USE DURING THE DAY TO DAY USE

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**Objective:** The objective of the study is to validate self-reported cellular phone use information by comparing it with the cumulative radio frequency exposure measured by software modified cellular phones (SMP). The information was obtained using a questionnaire developed for the international case control study on the risk of the use of mobile phones in head and neck tumours.

**Method:** Volunteered participants were asked to use SMPs instead of their own cellular phones for a period of one month. The SMP recorded the power emitted by the mobile phone handset during each base station contact. Traffic records were also collected prospectively for the same period to provide particular information on each personal phone call of the participants (number and duration of calls). About three months later, participants were personally interviewed about their cellular phone use during this period. Pearson correlation coefficient and linear regression model were used to analyse the association between information from the interview and from the SMP.

**Results:** In total, for 45 persons 1757 personal mobile phone calls were recorded by SMP and traffic records. The correlation between the self-reported information about the number and the duration of calls with the cumulative power of calls was 0,50 ( $p=0,0005$ ) and 0,48 ( $p=0,0009$ ), respectively. Nearly 25% of the variance of the cumulative power was explained by either the number or the cumulative duration of calls. Including possible confounding factors in the regression model, the variance increased only up to 28%. Small confounding factors were "network provider", "contract form", and "different cellular phone models".

**Discussion:** The number of calls alone is an adequate variable for estimating the cumulative power emitted by the handset of a cellular telephone. The cumulative power emitted by these phones is only associated with number of calls and not with possible confounding factors. For example, using the mobile phone while driving, in cities, or in villages is not associated with the recorded cumulative power in the SMP.

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007

### METHODOLOGICAL ASPECTS IN THE GEOGRAPHICAL ANALYSIS OF MORTALITY

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**Introduction:** Several analysis of the geographic variation of mortality rates in space have been proposed in the literature. In this talk we plan to present an overview of the different models already used and illustrate them with different real data sets of mortality from the province of Navarra, Spain in the period 1988-1994. Specifically we have the following objectives: 1) To describe the Poisson-normal model which accommodates full spatial autocorrelation and a mixture of structured and unstructured extra-variability with respect to the traditional Poisson model. 2) To describe a finite discrete Poisson mixture model, which is adequate when spatial autocorrelation is absent but overdispersion persists. 3) To describe a zero-inflated Poisson model which is able to explain an excess of zeros in certain mortality data sets.

**Methodology:** Relative risks for each local health area of Navarra province will be provided using a suitable model for the different data sets we will be using here. Particularly: overall cancer mortality in women -full spatial autocorrelation model-, traffic accidents in men -structured and unstructured variability will be included in a Poisson-normal model-, cardio-vascular accidents in women - a finite discrete mixture model- and brain cancer in men - a zero inflated Poisson model-. We will use as a reference the global mortality in the province. Previous to the fitting of the corresponding models we tested for overdispersion, zero-inflation and spatial variability. The models will be fitted using penalized quasi-likelihood and maximum likelihood techniques as appropriate (statistical package: S-PLUS).

**Results:** overall cancer mortality in women: • model estimation using a Poisson-normal model re-parameterized as in Dean, Ugarte and Militino (2001) ( $\lambda = 1$ ) • the local health area with the highest estimated relative risk or SMR is Alsasua (1.161). traffic accidents in men: • model estimation using a Poisson-normal model reparameterized as in Dean, Ugarte and Militino (2001) ( $\lambda = 0.696$ ) • the local health areas with the highest estimated relative risks or SMRs are: Alsasua (1.465), Echarrí-Aranaz (1.352) and Iruzun (1.333). cardio-vascular accidents in women: • model estimation using a discrete Poisson mixture model. Two clusters of means 0.976 and 1.197, respectively. • the local health areas with the highest estimated relative risks or SMRs are: Iruzun (1.333) and Elizondo (1.195). brain cancer in men: • model estimation using a zero-inflated Poisson model ( $\lambda = 0.696$  and  $\pi = 0.16$ ) • there are not local health areas with high SMR.

**Conclusions:** Its is important to point out the relevance of choosing an appropriate model for analyzing real mortality data which show different characteristics: overdispersion, an excess of zeros, spatial variability, etc. The consequences of these analyses also provide information for establishing prevention programs in certain local health areas of the province of Navarra, Spain.

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### CUBIC SPLINES MODELS IN ENVIRONMENTAL EPIDEMIOLOGY

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**Introduction:** The main goal of environmental health research is to assess the human exposure to environmental pollutants or pollutant dose. Sometimes collected data do not follow standard functional form. The dependence of a response variable  $y$  on an explanatory variable  $x$  may be expressed as  $y=f(x)+e$ . Nonparametric or semiparametric estimation methods are suitable for finding the estimator. One of the methods is smoothing cubic splines. The objective of our study was to estimate the relationship between internal dose of heavy metals (lead, manganese and cadmium) and health indices (arterial blood pressure (ABP) and blood color index (BCI)) applying technique of cubic splines.

**Methods:** Data of health survey of 1117 adults differently exposed to heavy metals was analysed. Lead (Pb), manganese (Mn) and cadmium (Cd) concentration in hair was used as indicator of internal dose of different exposure. The estimator of function  $f(x)$ , which defines dependence of health index on heavy metal concentration, is a cubic spline. That is a function  $g$  such that on each of the intervals  $(a, t[0])$ ,  $(t[0], t[1])$ , ...,  $(t[k], b)$ ,  $g$  is a cubic polynomial, and the polynomial pieces fit together at the knots  $t[i]$  in such a way that  $g$  itself and its first and second derivatives are continuous at each  $t[i]$  and hence on the whole of the interval  $(a, b)$ . The cubic spline is solution of the problem to minimize a functional  $F(f)$ :

$$F(f) = \sum (\text{Square } (y[i]-f(x[i]))+I^* \text{Integral}(\text{Square}(f''(x))))dx,$$

where  $i=0, \dots, k$ .

**Results:** Cubic splines models for arterial blood pressure were built separately for men and women. Two threshold values of Pb concentration for men systolic ABP were found: systolic ABP increased rapidly until 4 microg/g, after that decreased slowly until 32.5 microg/g and then increased slowly. Cubic dependence of systolic ABP on Pb concentration of women was revealed. Threshold value of Mn concentration for women ABP was identified: ABP decreased rapidly until 3 microg/g and decreased slowly after that value. Cubic splines were calculated for the estimation of heavy metals effect on blood color index. According to models BCI decreased linearly as Pb concentration increased. Umbrella-form dependence of BCI on Cd concentration in hair was determined.

**Conclusions:** We can conclude that cubic splines are suitable for the estimation of the relationship between heavy metals concentrations in hair and health indices. Models of cubic splines revealed nonmonotonous increase or decrease of arterial blood pressure and blood color index in dependence on lead, manganese and cadmium internal dose.

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### SENSITIVITY ANALYSIS BY APPLYING DIFFERENT CONVERGENCE PARAMETERS TO GAM FUNCTIONS IN THE ESTIMATION OF AIR POLLUTION EFFECTS

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**Introduction:** Recently, a discussion about reliability of results in time series studies of air pollution effects obtained with S-Plus generalized additive models (GAM) has been raised, because of laxness in the convergence criteria which the model has built-in by defect, as well as problems in resolution algorithm. The data of some projects have been re-analysed with stricter parameters, and their conclusions have gone in a different ways. Our aim is to investigate how much more stringed parameters affect the association of cardiovascular morbidity with pollutants within the EMECAS project, a multicenter study of the impact of air pollution on health in Spain.

**Methods:** A GAM with family Poisson was used to relate daily hospital circulatory admissions (ecir), heart diseases (ecar), ischemic heart disease (eisq), and cerebrovascular diseases (ecbs) to 7 pollutants measurements and lags (lag 0 to lag 3 and 0-1 and 2-3 lag average for 24h indicators: black smoke, total suspended particles, PM10, NO2, SO2 and 8h indicators: CO, O3) for 15 EMECAS project cities. 594 analysis for each disease with and without more stringed parameters (maximum number of iterations up to 1000 and precision up to 10<sup>-8</sup>) were carried out. For every cause three measures of bias were obtained: The absolute and percentual change in coefficients and the percentual change in Relative Risk (RR). These calculations were done for individual estimations in each city and for combined estimators. Results are presented as median and 5 and 95 percentile interval (P50, [P5, P95]). Changes in statistical signification were also identified as some conclusions could not be the same.

**Results:** When analysing the percentual change in coefficients, for all individual estimates on cardiovascular diseases, we observed a median change of 8.64% [1.59%, 160.56%] and an absolute change of 0.0001 [0.0000, 0.0022]. It means that strict estimates only affect the third decimal position for a few percentage of observations. Considering RR the percentual changes are less than 0.5%. Similar results were observed for other causes. For combined estimators the median percentual change is of 13.17% [0.71%, 220.31%] in ecir. That is a 95% percentile of absolute change of less than 0.001 for ecir and ecar. For ecbs and eisq the 95% percentiles of absolute change are .0012 and .0036 respectively.

**Conclusions:** In our case these changes don't affect in great magnitude to the estimates. Having in mind the interest to obtain more precise estimations, we think it is better to make a more strict analysis but this small changes do not nullify reported results which were obtained by default parameters. Changes in results could be due to other causes, not only to S-Plus GAM function problems, and further efforts to improve the building of the models in time series analysis of air pollution and health must be done.

010

### GEOGRAPHICAL STUDY ON ENVIRONMENT AND HEALTH STATUS IN AN AREA AROUND A MUNICIPAL WASTE INCINERATOR, PISA, ITALY

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**Introduction:** Private companies presented a project for a new hazardous waste disposal plant to be sited in the southern-east district of Pisa, Italy, in which a municipal waste incinerator (MWI) has operated for 20 years. A dense road network with heavy traffic also affects this area. Concerns of a community living within the above area induced the local administration to support an epidemiological and environmental study.

**Methods:** A 0-4 km area around the site, including a population of approximately 12,000 residents was defined for the study. Soil, surface and ground water samples were drawn to assess environmental status. Direction of main winds was taken into account as well. The population health status was analysed for the 1990-2000 period by evaluating mortality, morbidity (discharge hospital records, DHRs) and adverse reproductive outcomes selected on the basis of literature data. A random sample survey by self-administered questionnaire on symptom reporting and risk perception was carried out. All health events were georeferenced by residence, and the distance from the incinerator was used as a proxy of the exposure. SMRs by causes, age and sex within the study area were calculated using standard rates of Pisa municipality, for mortality and morbidity, and of Tuscany region for mortality. Spatial analysis of sub-areas around the point source, defined by 3, 4 or 7 concentric crowns of different sizes, were performed. Global and focused spatial methods to detect clustering throughout the study area and to evaluate disease patterns around the putative source were used.

**Results:** No significant differences emerged analysing the whole study area for diseases potentially associated with the environmental pollutants investigated. Only hospital discharge record analysis highlighted an excess of leukemia cases among women (N=8, SMR=262.7; CI 95%: 113.3-517.6). Analysis by crowns showed an excess of mortality and morbidity for Chronic Obstructive Pulmonary Disease (COPD) in the most external crowns among men. Statistically significant excesses for non-Hodgkin's lymphoma (2 deaths, 3 DHRs) were observed in the most internal crowns. Analysis of reproductive outcomes found some signs of excess in the district (infant death, congenital anomaly, sex ratio) to be evaluated together with an excess of hospital admissions for miscarriages and fetal problems. The sample survey by questionnaire showed interesting results on symptom reporting and risk perception. The spatial analysis of the environmental measures did not show any particular pattern, although some scattered excesses of selected heavy metals were found.

**Conclusions:** The methodology we adopted allowed us to point out risk associations of great interest for public health and environment management through the descriptive design of the study did not consent to investigate causal relationships. In addition, some findings deserve a further analytical study based on individual exposures and confounders, not only with respect to the incinerator but also to the traffic pollution.

011

**STUDY OF THE SHAPE OF THE RELATIONSHIP BETWEEN  
MORTALITY AND TEMPERATURE IN 13 SPANISH CITIES**

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**Objectives:** The existence of relationship between temperature and mortality is well documented, but some uncertainty remains about its shape. Our objective was to explore the shape and magnitude of the relationship between temperature and mortality in 13 Spanish cities within the EMECAM project (Barcelona, Bilbao, Cartagena, Castellón, Gijón, Huelva, Madrid, Oviedo, Sevilla, Valencia, Vigo, Vitoria and Zaragoza).

**Method:** Poisson Generalized additive models were fitted in each city to regress time series of daily total mortality (all causes, external included), cardio-respiratory mortality and mortality in elderly (>70 years) against temperature. Day of week, holidays, special events, level of particulates, trend, influence, humidity and were considered as potential confounders. The four first ones were included linearly, trend was included using loess and all the other ones by mean of cubic splines. Finally, temperature was added using a 4 d.f. cubic spline. If present, serial autocorrelation was controlled. The effect of temperature was evaluated in each city and the relative risk curves were represented. We summarized these curves with the temperature associated with minimum number of deaths (MMT), and the two slopes on the left (cold slope) and on the right of MMT (hot slope), both obtained assuming linearity.

**Results:** the models varied a lot among cities. For total mortality, the effect of temperature was statistically significant in general. In all but Oviedo (no significant association) the shape of the curve was V, with slopes more or less marked. MMT ranged from 13.9<sup>o</sup> (Vigo) to 23.3<sup>o</sup> (Cartagena), and, in general, increased with temperature mean of the cities. If we focus only on significant curves three different patterns seem to appear, according to the mean temperature of cities. For cardio-respiratory causes and elderly, the results are very similar but the effect is greater and the shape is more variable.

**Conclusions:** Models used for describing the relationship between mortality and temperature show great variability. After control by potential confounders, the shape is, in general, V, although there is much heterogeneity both in MMT value and in opening degree. This heterogeneity does not mask neither the increase of MMT with mean temperature of cities, nor the existence of a evolution in the pattern shape, also related with mean of temperature of cities.

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