Retrospective cohort study on health effects in the population residing around a waste Incinerator and other sources of pollution

Santoro M[1], Minichilli F[1], Linzalone N[1], Maurello MT[2], Sallese D[2], Bianchi F[1,3]

[1] Unit of Environmental Epidemiology - Institute of Clinical Physiology, National Council of Research, Pisa, Italy
[2] Department of Prevention, AUSL 8, Arezzo, Italy
[3] Fondazione Toscana Gabriele Monasterio, Pisa, Italy

INTRODUCTION

The epidemiological knowledge on the health effects of modern Waste Incinerators is still inconclusive. Despite the moderate concentrations of pollutants emitted, the long-term exposures could be a relevant issue for public health.

AIMS

The aim of the study is to evaluate the mortality and hospitalization risk due to emissions of a Waste Incinerator (WI) operating in Tuscany-Italy since 2000 in an area with other linear and point sources of pollution

METHODS

Concentration maps of PM10 and Cd (ADMS model) were used to estimate the exposure to WI and other sources (industrial plants and highway) in the area (Fig.1). Three exposure classes were defined using the 50th and 80th percentiles of the concentrations distribution (Fig.2). The distance was used to estimate the exposure to the main roads. Inhabitants in 2001-2010 were included in the cohort (Fig.3). Individual exposure history to each source was reconstructed considering movements inside and outside the area. A cohort of 50,871 individuals corresponding to 371,700 person years was analyzed. Nine causes of mortality and hospitalization were linked to the geo-coded cohort. Health data were selected by regional mortality and hospital discharge registries. Hazard Ratio (HR) with 95% CI and p-value of the highest class of exposure compared to the lowest one, adjusted for the other environmental exposures, age and socioeconomic status, was estimated by a Cox time-dependent model. Trend (TR) of HR was evaluated too.
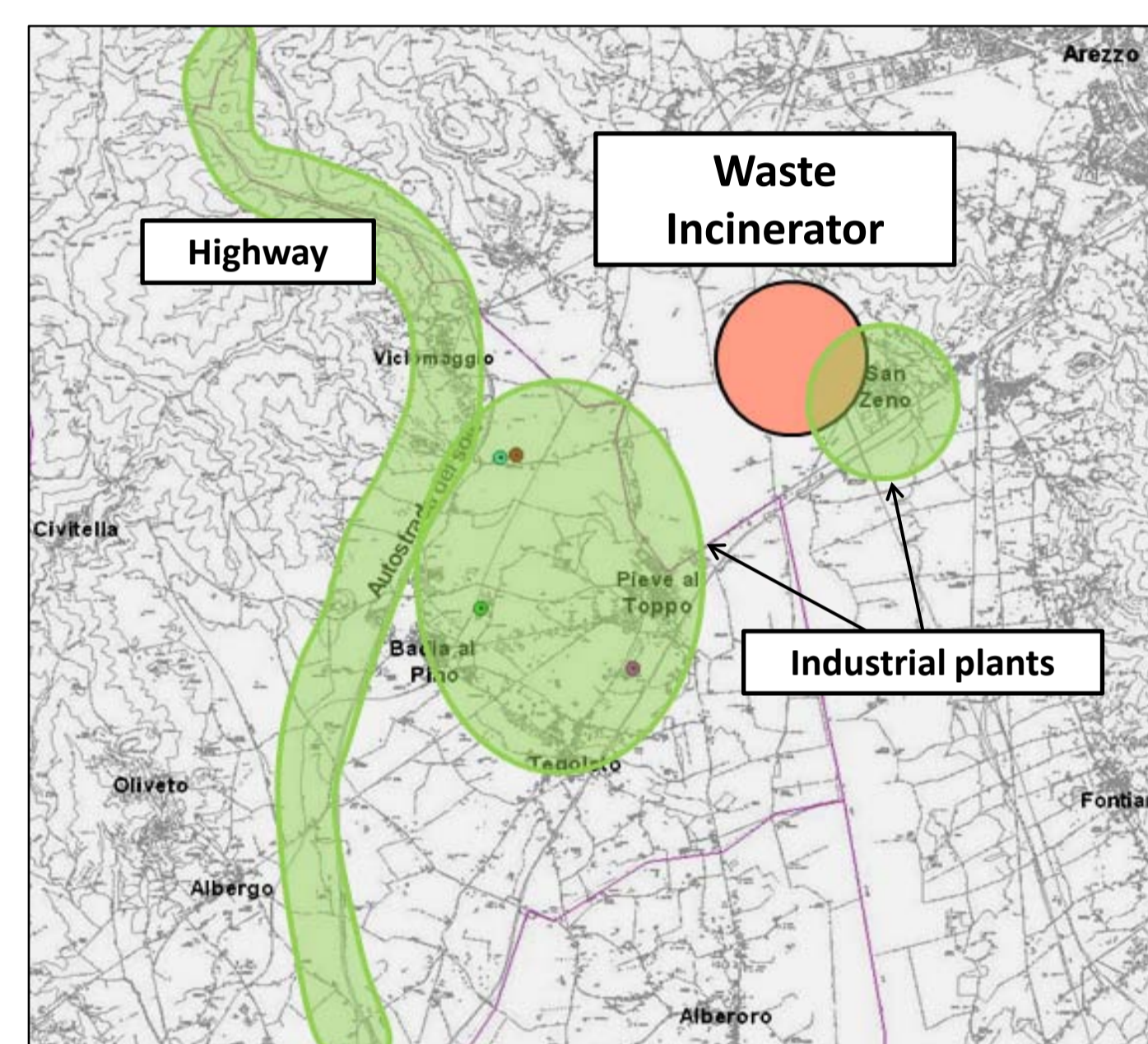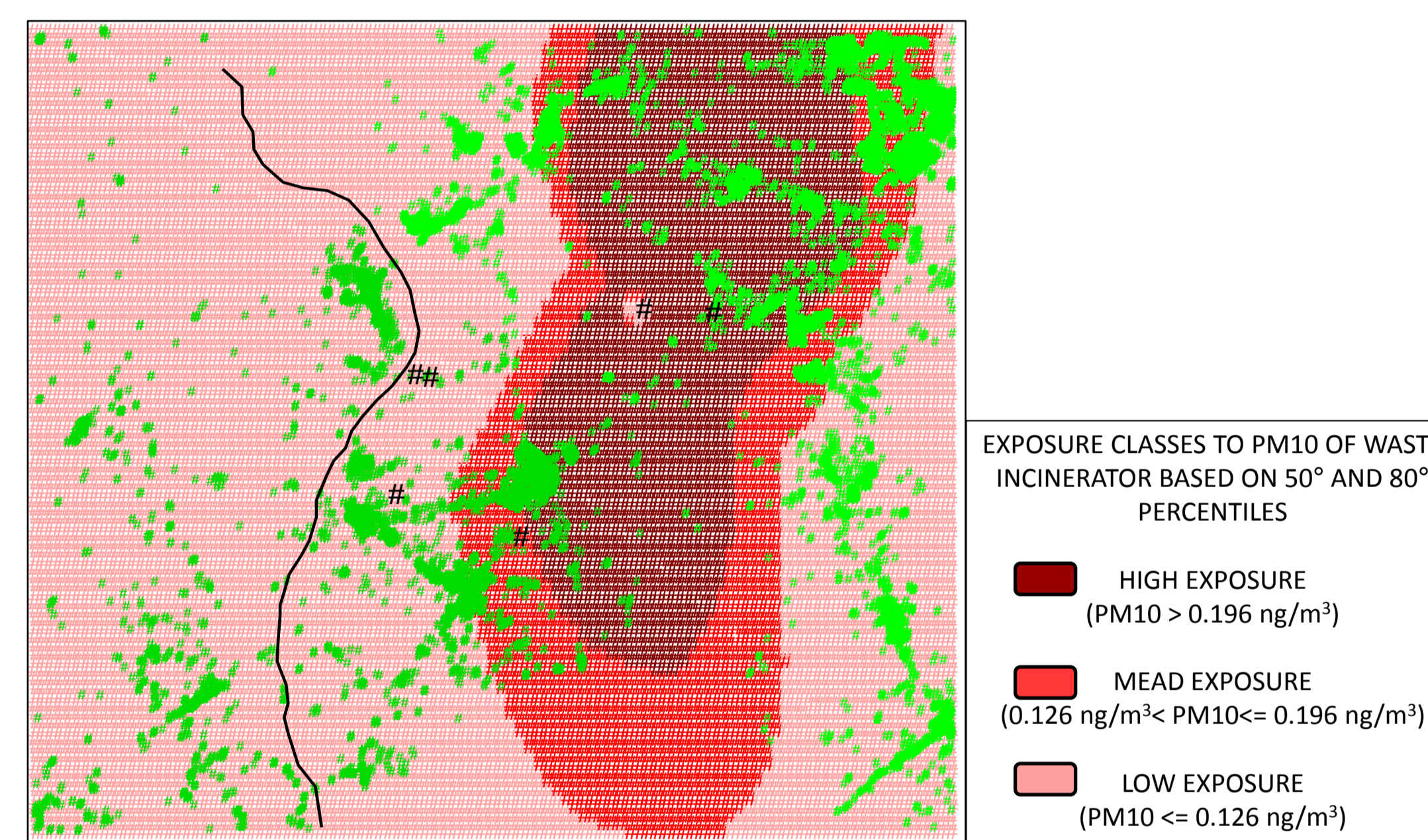

Fig. 1 Study area

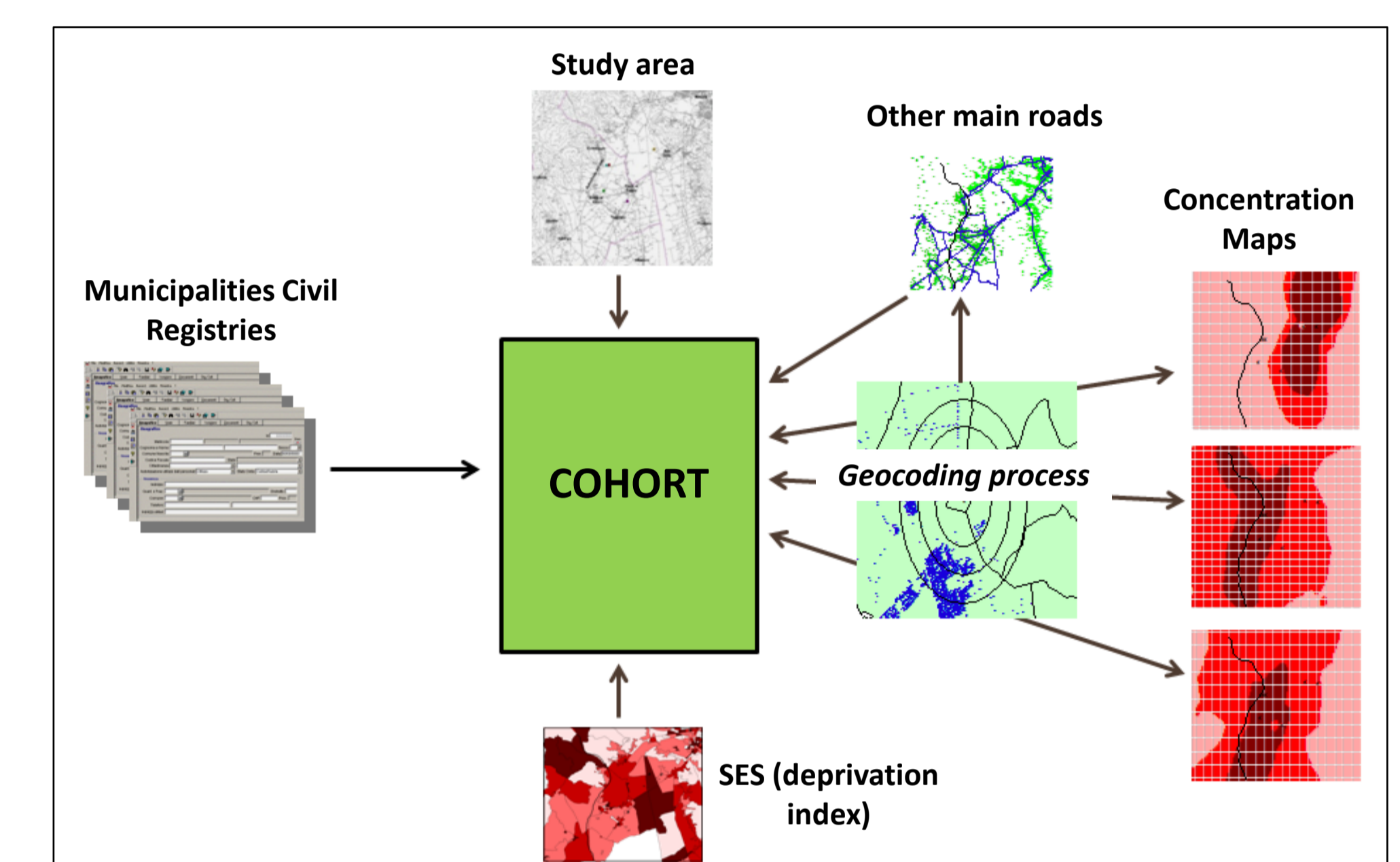**Fig. 2** PM10 Concentration maps of WI by exposure classes and projection of inhabitants (in green)

EXPOSURE CLASSES TO PM10 OF WASTE INCINERATOR BASED ON 50° AND 80° PERCENTILES
- HIGH EXPOSURE (PM10 > 0.196 ng/m3)
- MEAD EXPOSURE (0.126 ng/m3< PM10<= 0.196 ng/m3)
- LOW EXPOSURE (PM10 <= 0.126 ng/m3)

Fig. 3 Conceptual scheme of the definition and characterization of the cohort

RESULTS

Mortality

Cause of death	Gender	Highest class of exposure				Trend	
		N	HR	95% CI	p	TR	p
All causes	F	235	0.932	0.77-1.13	0.468	0.960	0.383
	M	281	1.133	0.94-1.36	0.178	1.102	0.014
	T	516	1.031	0.90-1.18	0.655	no trend	
Diseases of circulatory system	F	111	1.013	0.77-1.34	0.926	no trend	
	M	104	1.199	0.89-1.61	0.231	1.146	0.036
	T	215	1.101	0.90-1.35	0.355	1.066	0.149
Ischemic hearth diseases	F	23	1.211	0.63-2.31	0.562	no trend	
	M	41	1.430	0.87-2.36	0.162	1.210	0.090
	T	64	1.352	0.91-2.01	0.136	1.167	0.113
Diseases of respiratory system	F	19	1.653	0.76-3.61	0.207	1.302	0.098
	M	25	1.014	0.52-1.96	0.968	no trend	
	T	44	1.244	0.75-2.06	0.397	1.116	0.378
Acute Respiratory diseases	F	11	2.536	0.84-7.68	0.100	no trend	
	M	8	1.094	0.34-3.50	0.879	no trend	
	T	19	1.687	0.76-3.75	0.200	no trend	
Chronich Pulmonary diseases	F	5	1.323	0.33-5.25	0.690	no trend	
	M	14	1.223	0.50-3.00	0.661	no trend	
	T	19	1.244	0.59-2.64	0.568	no trend	
Diseases of digestive system	F	4	0.137	0.03-0.74	0.020	0.555	0.031
	M	10	1.072	0.41-2.82	0.888	no trend	
	T	14	0.552	0.25-1.22	0.142	0.756	0.126
Diseases of urinary system	F	4	1.340	0.29-6.09	0.705	no trend	
	M	3	0.338	0.07-1.60	0.172	0.656	0.149
	T	7	0.638	0.22-1.84	0.405	no trend	

Hazard Ratio (HR) adjusted for age, socioeconomic status and other environmental exposures, with 95% CI and p value; Trend (TR) with p value, by cause and gender
F = Female; M = Male; T= Total

MAIN RESULTS
- Overall mortality in males
- Diseases of circulatory system in males
- Ischaemic hearth diseases in males
- Acute respiratory diseases in females

MAIN RESULTS
- Diseases of circulatory system in both genders, significant for males
- Diseases of urinary system

Hospitalization

Cause of hospitalization	Gender	Highest class of exposure				Trend	
		N	HR	95% CI	p	TR	p
Disorders of thyroid gland	F	24	1.354	0.74-2.49	0.330	1.134	0.417
	M	8	1.107	0.36-3.37	0.859	no trend	
	T	32	1.270	0.74-2.17	0.381	1.115	0.416
Diseases of circulatory system	F	314	1.122	0.95-1.33	0.186	1.052	0.221
	M	418	1.228	1.06-1.43	0.007	1.103	0.009
	T	732	1.181	1.06-1.32	0.004	1.080	0.006
Ischemic hearth diseases	F	59	1.057	0.70-1.59	0.788	no trend	
	M	136	1.178	0.91-1.53	0.223	no trend	
	T	195	1.148	0.92-1.43	0.222	no trend	
Diseases of respiratory system	F	143	1.020	0.79-1.31	0.878	1.008	0.892
	M	205	0.940	0.76-1.16	0.565	0.966	0.509
	T	348	0.976	0.83-1.15	0.768	no trend	
Acute Respiratory diseases	F	63	1.151	0.78-1.70	0.479	1.060	0.545
	M	76	0.753	0.53-1.08	0.120	0.870	0.110
	T	139	0.911	0.70-1.19	0.490	0.950	0.434
Chronich Pulmonary diseases	F	20	1.226	0.58-2.59	0.593	no trend	
	M	31	0.955	0.53-1.74	0.879	no trend	
	T	51	1.071	0.67-1.71	0.771	1.036	0.754
Asthma	F	3	0.510	0.09-2.97	0.454	no trend	
	M	5	1.523	0.39-6.00	0.548	no trend	
	T	8	1.015	0.37-2.80	0.977	no trend	
Diseases of digestive system	F	214	1.063	0.87-1.30	0.554	1.031	0.542
	M	250	0.958	0.80-1.15	0.652	0.981	0.676
	T	464	1.008	0.88-1.16	0.910	no trend	
Diseases of urinary system	F	51	1.356	0.90-2.04	0.144	1.145	0.185
	M	65	1.150	0.79-1.68	0.472	no trend	
	T	116	1.244	0.94-1.64	0.124	1.134	0.063

Hazard Ratio (HR) adjusted for age, socioeconomic status and other environmental exposures, with 95% CI and p value; Trend (TR) with p value, by cause and gender
F = Female; M = Male; T= Total

CONCLUSIONS

The study design, including the most relevant pollution sources, allowed to define an accurate estimation of the individual exposure. The results obtained, although not evidenced in both sexes, are useful in decision-making. The estimated risks for some diseases with limited evidence, as well as the effect of the overlap of the concentration maps of different emission sources deserve further investigation.