

## **Spatial analysis of mortality from cancer in municipalities neighboring the iron-steel mills - State of Minas Gerais, Brazil, from 1996 to 2012.**

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### **Introduction**

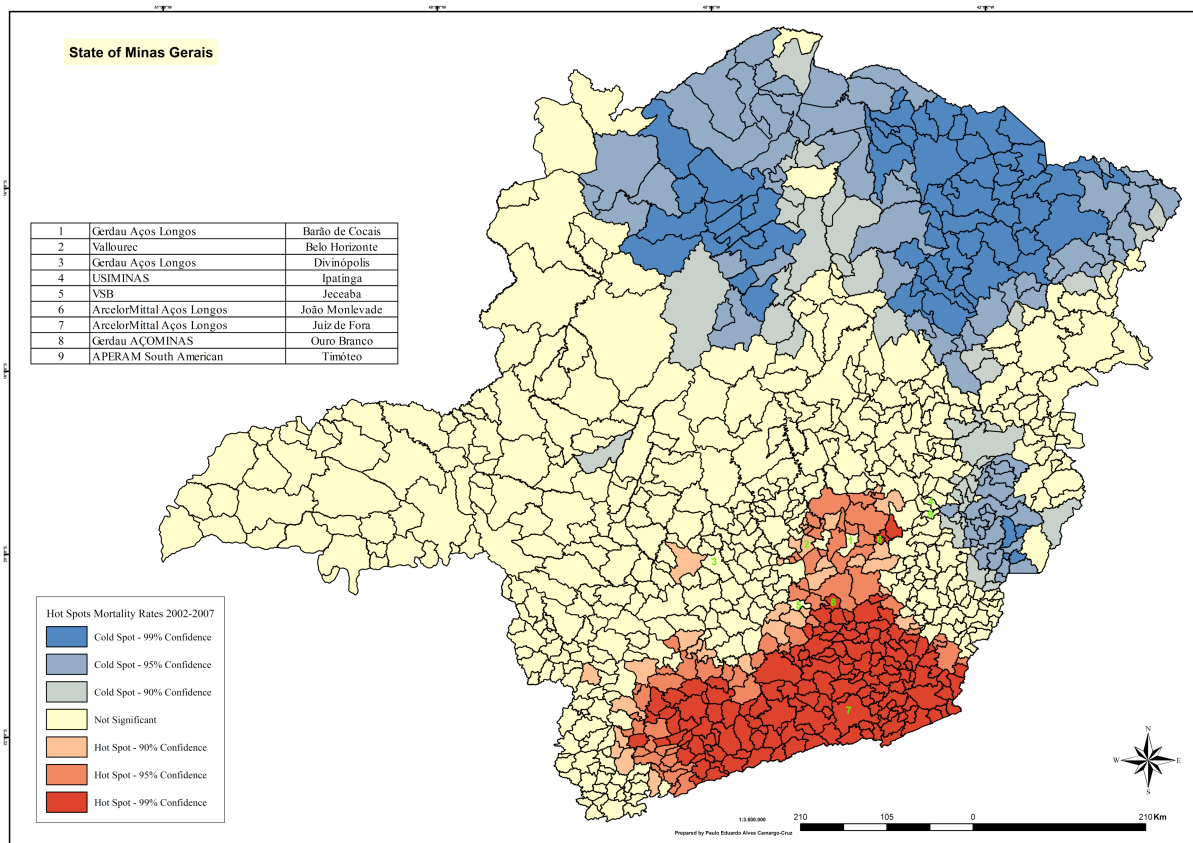
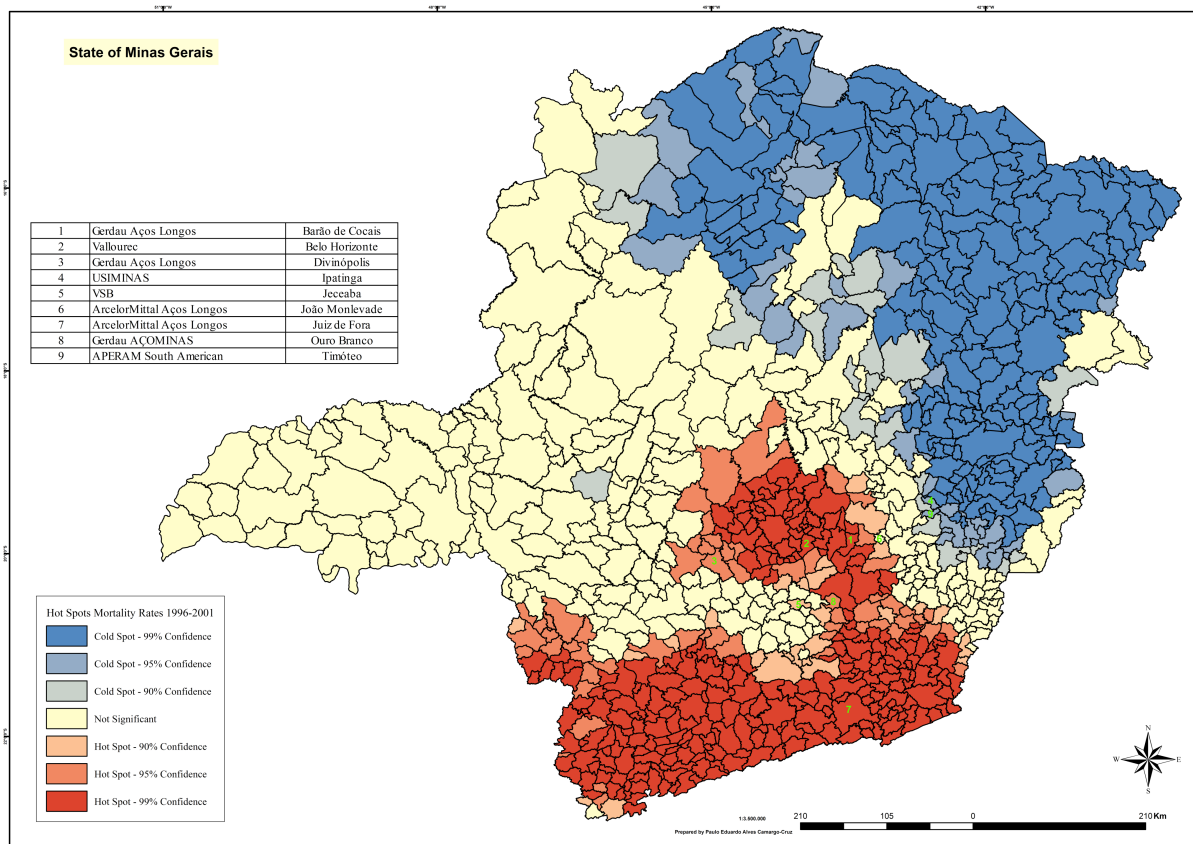
Steelmaking processes have been widely recognized as being important sources of persistent organic pollutants (POPs), in particular dioxins, all of which are recognized by the International Agency for Research on Cancer (IARC) as carcinogens. Studies - in Brazil and other countries<sup>1,2,3</sup> - point to the correlation between dioxins and the incidence of neoplasms (NS) and other studies have shown an association between NS and communities living near the steel mills<sup>4,5,6,7</sup>. However, evidence of specific association between iron-steel mills and higher incidence of mortality from NS in the neighborhood has been researched and suggested but not established yet. The objective of this study is to investigate possible links between environmental exposure to steel mills emissions and mortality from NS in a state (Minas Gerais) that concentrates the production of steel in Brazil. Our hypothesis is that the spatial distribution of mortality from NS in this state has a common pattern with the regions where the steel plants, presenting a greater risk than others.

### **Materials and methods**

To achieve the proposed objective - the study of the correlation between mortality by NS and the location of steel plants - we use the spatial statistics tools for identifying hot spots, where the incidence of mortality NS is greater and coincides with the municipalities where these steel plants are located. Also calculated by NS mortality rates for municipalities where they are located steelmakers. The age range used in the study was 15 to 59 years old, chosen because it is the economically active population and mortality rates are in the ratio of 1 death per 100,000 inhabitants. The data used (population, number of deaths and digital maps) were obtained from public databases of the Ministries of Planning and Health (IBGE and DATASUS). For the analysis of these data, we grouped mortality rates covered by the study (1996-2012) in other three periods (1996-2001, 2002-2007 and 2008-2012) to compare the evolution or the fall in mortality rates and the formation of agglomerates (clusters), grouped in turn through spatial statistical tools (hot spots). We use the software Arc GIS 10.0 to carry out the maps and data interpretation.

### **Results and discussion:**

The spatial distribution of mortality from NS follows a pattern of high concentration of deaths in the central, south, southeast and southwest of the state of Minas Gerais, for the three periods studied. Figures 1, 2 and 3 show these results. Municipalities that have steel plants in their limits, and they are located in clusters with higher concentrations, are described in Table 1. We note that only municipalities 4 (Ipatinga) and 9 (Timóteo) are outside the areas of highest concentration during all periods. Instead, municipalities 7 (Juiz de Fora) and 8 (Ouro Branco) are the areas of greatest concentration of deaths from neoplasms in all periods. The steel plants of these two municipalities are controlled by the two largest steel producers groups in Brazil, respectively, Arcelor-Mittal (7) and Gerdau (8)<sup>8</sup>. The spatial distribution and mortality rates of concentrations found in this study indicate there may be an association between high rates of deaths from NS in closer to steel mills locations, exposing these communities will a higher risk than those without these plants in its limits.



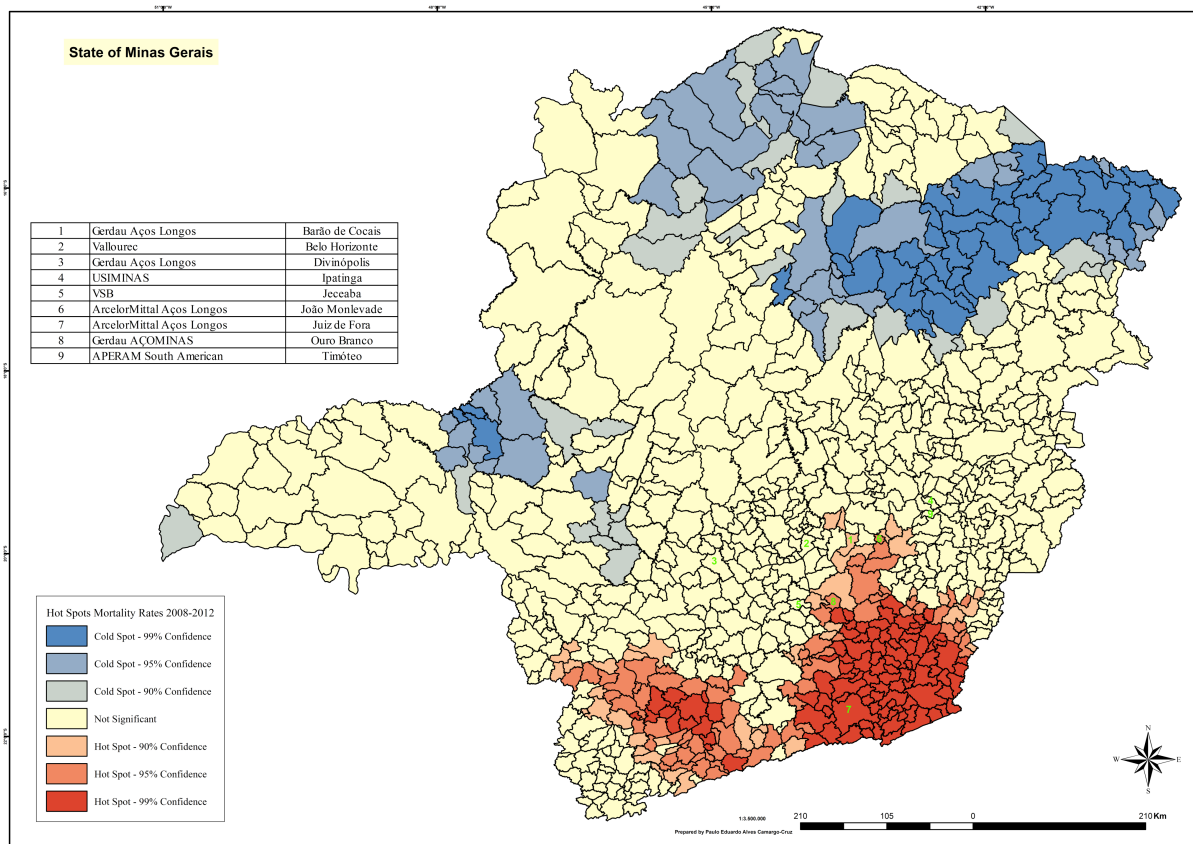


Table 1

Municipalities with plants in their limits	Inserted in the area of highest concentration in the period (1996-2001)	Inserted in the area of highest concentration in the period (2002-2007)	Inserted in the area of highest concentration in the period (2008-2012)
1	Yes	No	Yes
2	Yes	Yes	No
3	Yes	No	No
4	No	No	No
5	Yes	Yes	No
6	No	Yes	Yes
7	Yes	Yes	Yes
8	Yes	Yes	Yes
9	No	No	No

**References:**

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