Mortality by cause of death in Colombia 1998-2013: A local analysis using spatial econometrics

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Abstract

Colombia has undergone major changes in mortality patterns during the last decade, in particular due to reductions in external causes, which has had a significant impact on young males. While cause-specific analyses have been performed at the national and, to a lesser extent, departmental levels, very little is known about trends at the municipal level, despite their great epidemiological interest. Our objective is therefore to identify geographic clusters of mortality in Colombia, their evolution over time and local factors that can explain these spatial patterns. To do so, we will use different techniques of spatial econometrics and apply them to several large groups of causes: infectious diseases, tumors, cardiovascular diseases, external causes and others of specific character that will be defined later. These clusters may show a positive spatial association of type (+, +), (-, -) or negative (+, -), (-, +). The first two of these associations are related to spaces where there are high or low mortality rates for a specific cause that are surrounded by places with high or low mortality rates of the same cause. The other associations identify atypical cases essential in the geographic characterization of mortality: foci of high mortality or unique low mortality sites in an area of high mortality.

The study analyzes the evolution of standardized rates for causes of death for both sexes at municipal level during the years 1998-2014 that have been calculated from microdata supplied by the National Administrative Department of Statistics (DANE). To overcome the problem of under-registration of mortality in Colombia, an indirect method will be applied that corrects the total number of deaths in each municipal area and will be explained in detail in the final text. The denominators used in the estimation are the official estimates of local population. The standard population applied in calculating mortality rates by cause is the Colombian population derived from the 2005 census. The extended abstract presents the methodology and some preliminary results.

Extended abstract (1572 words excl tables and graphs)

Background

The study of mortality is fundamental to know the health status of a population, which is why it is necessary to identify the main causes, their spatial distribution, by age, among other variables, to make decisions in accordance with the needs of each region, whether in either health or other aspects (López, 2008). Mortality is an indicator of both the health situation and of living conditions, which justifies the need for good information on this phenomenon (ECLAC, 2007). Mortality conditions are not only related to demographic factors but also to other factors such as social, biological, cultural and political factors.

Interest in the study of mortality in Colombia has increased in recent years due to the changes in the cause-of-death pattern from communicable to chronic diseases. The most studied themes have focused on intensities (mortality rates and life expectancy) for which updated information is available for departments. An important emphasis has also been given to external causes because of the country's distinct characteristics. On the other hand, information on the impact of specific causes of death on life expectancy is limited, as well as analyses based on geographical models that allow the identification of mortality clusters.

Although different contributions have been made to the analysis of cause-specific mortality in Colombia, especially in violent causes (eg Cendales et al., 2007, Moreno and Cendales, 2011), a gap remains regarding the geographic analysis and life expectancy changes due to large groups of causes at the municipal level. The main contributions on the subject have been made on avoidable mortality, infant mortality, perinatal mortality, dengue (e.g. Chaparro-Narváez et al., 2016; Misnaza et al., 2016), analysis of the main causes at the departmental or even municipal level, but are especially descriptive or on the potential years of life lost rather than with the aim of explaining those spatial patterns.

While mortality is transiting from communicable diseases to chronic diseases, it still has significant rates of both emerging and re-emerging communicable diseases even though chronic diseases are increasing. In the country's interior some departments have different patterns, reason why this investigation will have a geographical component that allows identifying groups or clusters of the main causes of mortality. To date, there are descriptive analyzes of geographic data for avoidable causes of mortality at the departmental level, but there is no information on a model that helps to understand what variables are involved in the formation of mortality clusters (National Institute of Health, 2014).

To estimate the impact of causes of death on life expectancy, information is available for specific events such as breast and uterine cervical cancer (Agudelo et al., 2010), diabetes mellitus (Agudelo-Botero & Dávila-Cervantes, 2015), traffic accidents (Escanés et al., 2015) and for some specific cities or departments. The objective of our study is to meticulously analyse the formation of clusters of the principal causes of death at the municipal level.

Methodology

For the analysis it is necessary to have specific mortality rates by sex, age and cause-of-death for the municipalities of Colombia. Mortality rates for each major cause were estimated according to the Pan American Health Organization's 6/67 list, from 1998 to 2013 (Table 1). The source of the information for numerators was vital statistics, which were obtained directly from the national data file (ANDA) corresponding to non-fetal deaths for the period 1998-2013. The denominators for each municipality/department were obtained from the DANE population projections for each corresponding year.

The first step consisted in the organization of the information to calculate the specific death rates by major causes, the proportion of deaths by each cause for each municipality was then calculated and finally the standardization of the rates for each municipality, large cause group and sex for the following periods: 1998-2001, 2002-2005, 2006-2009, 2010-2013.
In order to eliminate the possible structure effect caused by the unequal distribution of the population by age and sex at different times in time and in municipalities and thus allow the comparison of different groups, rates have been standardized through the direct standardization method by applying the mortality rates of the sub-populations, in this case the municipalities, to a single predetermined age structure. In order to standardize, the Colombian national population of both sexes, derived from the 2005 census distributed according to the following age structure (0, 1-4, 5-9, 85-89, 90-94, 95 -99, 100+). To obtain the Standardized Rate (ET), the specific mortality rate by cause, age and sex for the municipality of interest by the standard population is multiplied. The sum of the products of divides by the total population of Colombia:

$$TE^{municipio} = \frac{\sum_{x=0}^{\omega} m_x^{municipio} \times P_x^{COL}}{\sum_{x=0}^{\omega} p^{COL}}$$

The statistical significance of a small region as a municipality, with n annual deaths in year t, will always be lower than that of Bógota. To identify those territories that present significantly higher or lower mortality than Colombia, a 95% confidence interval is calculated based on the number of events and their age distribution:

$$TE^{municipio} \pm IC^{municipio} = TE^{municipio} \pm \left[1{,}96 \left(\frac{\left(\sum_{x=0}^{\omega} \left(\left(P_x^{municipio} \times m_x^{municipio} \right)^2 / d_x^{municipio} \right) \right)^{\frac{1}{2}} \times 1000}{\sum_{x=0}^{\omega} P_x^{municipio}} \right) \right]$$

The last part of the methodology corresponds to the spatial analysis. From the values obtained with the standardized rates by sex, cause of death and municipality a study of the spatial

dependence of the data is also conducted. Here we only show the results of some causes for men. For this purpose, a global and local spatial autocorrelation indicator have been used. It should be noted that spatial statistics is a tool of analysis that treats the data of the municipalities as parts of a whole, a territorial structure where neighborhood relations are established and where it is possible to analyze to what extent statistical association exists between the values of a variable that is distributed in the territory. That is why it is necessary, before calculating the indicators, to establish a criterion that clearly determines the municipalities that are neighbors. Based on this criterion, a matrix of weights is constructed that relates each municipality to all others and that serves to calculate the value of the spatial indicator. In the specific context of this work, we use the rook criterion to establish neighborhood relations.

In the first case we used the *Global Moran's I* indicator, which is calculated from the following formula:

$$I = \frac{N \cdot \sum_{i=1}^{N} \sum_{j=1}^{N} w_{ij} \cdot (x_i - \bar{x}) \cdot (x_j - \bar{x})}{S_o \cdot \sum_{i=1}^{N} (x_i - \bar{x})^2} \qquad i \neq j$$

where x_i is the value of the quantative variable x in zone i; $\bar{x}$ is the median value of the areas; w_{ij}, the matrix weights W; N the sample size and $S_0 = \sum_i \sum_j w_{ij}$, the sum of the weights.

This indicator gives a view of the degree and type of spatial association according to the analyzed variable. With its calculation a global autp-correlation test can be performed where the null hypothesis is the spatial independence of the variable (the values of a variable do not depend on those of its neighbors). There are several alternatives to estimate the probability that the distribution of the data is random, but here we will use an approximation to the value of *Global Moran I* from a random permutation (specifically 999 permutations, a methodology that has an associated probability of 0.001).

The Local Moran I statistic has been calculated for the second type of spatial autocorrelation analyzed. The mathematical formulation of this indicator is, given an area i, the following:

$$I_i = \frac{z_i}{\sum_i z_i^2 / N} \sum_{j \in J_i} w_{ij} z_j$$

where z_i is the value of area i of the normalised variable and J_i the total of the neighbouring areas i. The elements of the weights matrix are, as in the previous indicator, w_{ij}.

There is one last important consideration to take into account here. It concerns both indicators and is the aspect related to the typology of spatial auto-correlation that is established

with the calculated values, namely that this methodology allows to determine the positive spatial auto-correlation (high values of one variable surrounded by high ones and low values surrounded by low ones) and negative spatial auto-correlation (high values of one variable surrounded by low ones and vice versa). Thus, a positive spatial auto-correlation indicates the presence of clusters of similar values in the territory and is undoubtedly information that will help us to locate the mortality patterns due to similar characteristics throughout the Colombian territory.

Preliminary results

The preliminary results we have obtained are briefly presented below:

Colombia is currently characterized by a territorial convergence of mortality levels at regional and municipal levels. However, the departments still maintain strong territorial discrepancies that amount to differences of respectively 10 and 8 years of life expectancy between men and women among the departments (Table 2). These differences are of greater magnitude in the municipalities (table 3).

Table 4, where Global Moran is presented for the different causes of death, shows significant values of spatial association in global mortality and 3 of the causes analyzed: neoplasms (tumors), diseases of the circulatory system and, especially, external causes. These results and maps 1-4 confirm that, despite the overall reduction in mortality and some territorial convergence observed in the decrease in the coefficient of variation, there is a clear continuity of the territorial conglomerates (maps 1-4).

Brief preliminary conclusions

The objective of this study is to analyze the possible existence of geographic clusters of mortality in Colombia, their evolution over time and local factors that may explain the geography of mortality from causes in Colombia between 1998 and 2013. Our preliminary conclusion is that the hypothesis we proposed in this paper is confirmed, through the spatial indicators and the cartography provided. In the final document we will expand the study to the causes of death for women and we will refine our analysis with a proposal of territorial grouping of municipalities that endows a greater statistical significance to our results.

Table 1: Cause-of-death classification according to the OPS-WHO 6/67 list

	Cause	Code CIE-10
INFECTIOUS DISEASES		**(A00-B99, G00-G03, J00-J22, P35.0)**
1.01	Intestinal infectious diseases	A00-A09
1.02	Tuberculosis, including sequelae	A15-A19, B90
1.03	Certain vector-borne diseases and rabies	A20, A44, A68, A75-A79, A82-A84, A85.2, A90-A91, A95, B50-B57
1.04	Certain vaccine-preventable diseases	A33-A37, A80, B05, B06, B16, B17.0, B18.0, B26, B91, P35.0
1.05	Meningitis	A32.1, A39, A87, B00.3, B01.0, B02.1, B37.5, B38.4, G00-G03
1.06	Septicemia	A40-A41
1.07	Infections with predominantly sexual transmission mode	A50-A64
1.08	HIV / AIDS disease	B20-B24
1.09	Acute respiratory infections	J00-J22
1.10	Other infectious and parasitic diseases	REST OF (A00-B99) : A21-A31, A32.0, A32.7- A32.9, A38, A42-A43, A46-A49, A65-A67, A69-A74, A81, A85.0-A85.1, A85.8, A86, A88-A89, A92-A94, A96-A99, B00.0-B00.2, B00.4-B00.9, B01.1-B01.9, B02.0, B02.2-B02.9, B04, B07-B15, B17.1-B17.8, B18.1-B19.9, B25, B27-B36, B37.0-B37.4, B37.6-B37.9, B38.0-B38.3, B38.7-B38.9, B39-B49, B58-B89, B92-B99
NEOPLASMS (TUMORS)		**(C00-D48)**
2.01	Stomach cancer	C16
2.02	Colon cancer	C18
2.03	Cancer of the digestive organs and peritoneum, excluding the stomach and colon	C15, C17, C19-C21, C26, C48
2.04	Liver and Bile Duct Cancer	C22-C24
2.05	Cancer of the pancreas	C25
2.06	Cancer of the trachea, bronchi and lung	C33-C34
2.07	Cancer of the respiratory and intrathoracic organs, except trachea, bronchi and lung	C30-C32, C37-C39
2.08	Breast cáncer	C50
2.09	Cancer of the uterus	C53-C55
2.10	Prostate cancer	C61
2.11	Cancer of other genitourinary organs	C51-C52, C56-C57, C60, C62-C68
2.12	Cancer of lymphatic tissue, hematopoietic organs and related tissues	C81-C96
2.13	Other malignant tumores	REST OF (C00-C97): C00-C14, C40-C47, C49, C58, C69-C80, C97
2.14	Carcinoma-in-situ, benign tumors	D00-D48
CIRCULATORY SYSTEM DISEASES		**(I00-I99)**
3.01	Acute rheumatic fever and chronic rheumatic heart disease	I00-I09
3.02	Hypertensive diseases	I10-I15
3.03	Ischemic heart disease	I20-I25
3.04	Enf. Cardiopulmonary, pulmonary circulation and other forms of inf. From the heart	I26-I45, I47-I49, I51
3.05	Heart attack	I46
3.06	Heart failure	I50
3.07	Cerebrovascular diseases	I60-I69
3.08	Atherosclerosis	I70
3.09	Other diseases of the circulatory system	I71-I99
CERTAIN CONDITIONS ORIGINATED IN THE PERINATAL PERIOD		**(P00-P29, P35.1-P96)**
4.01	Fetus and newborn affected by certain maternal conditions	P00, P04
4.02	Fetus and newborn affected by obstetric complications and birth trauma	P01-P03, P10-P15
4.03	Fetal growth retardation, fetal malnutrition, low birth weight and short gestation	P05, P07
4.04	Respiratory disorders specific to the perinatal period	P20-P28
4.05	Bacterial sepsis of the newborn	P36
4.06	Haemolytic disease of the fetus and newborn and kernicterus	P55-P57
4.07	Other conditions originating in the perinatal period	P08, P29, P35.1-P35.9, P37-P54, P58-P96
EXTERNAL CAUSES		**(V01-Y89)**
5.01	Land transport accidents, including after-effects	V01-V89, Y85.0
5.02	Other and unspecified transport accidents, including sequelae	V90-V99, Y85.9
5.03	Falls	W00-W19

	Cause	Code CIE-10
5.04	Accidents caused by machines and sharp or sharp instruments	W24-W31
5.05	Accidents caused by shooting of firearms	W32-W34
5.06	Accidental drowning and immersion	W65-W74
5.07	Exposure to smoke, fire and flames	X00-X09
5.08	Accidental poisoning by, and exposure to, harmful substances	X40-X49
5.09	Complications of medical and surgical care, including sequelae	Y40-Y84, Y88
5.10	Other accidents, including sequelae	W20-W23, W35-W64, W75-W99, X10-X39, X50-X59, Y86, Y89.9
5.11	Intentional self-inflicted injuries (suicides), including sequelae	X60-X84, Y87.0
5.12	Aggressions (homicides), including sequels	X85-Y09, Y87.1
5.13	Legal intervention and war operations, including aftermath	Y35-Y36, Y89.0-Y89.1
5.14	Intention events not determined, including sequels	Y10-Y34, Y87.2
ALL OTHER CAUSES		**(D50-D89, E00-E90, F00-F99, G04-G98, H00-H95, J30-J98, K00-K92, L00-L98, M00-M98,**
		N00-N99, O00-O99, Q00-Q99)
6.01	Diabetis mellitus	E10-E14
6.02	Nutritional deficiencies and nutritional anemias	E40-E64, D50-D53
6.03	Mental and behavioral disorders	F00-F99
6.04	Diseases of the nervous system, except meningitis	G04-G98
6.05	Chronic diseases of the lower respiratory tract	J40-J47
6.06	Other inf. Upper respiratory tract	J30-J39
6.07	Lung diseases due to external people	J60-J70
6.08	Other respiratory diseases	J80-J98
6.09	Appendicitis, abdominal cavity hernia and intestinal obstruction	K35-K46, K56
6.10	Certain chronic liver diseases and cirrhosis	K70, K73, K74, K76
6.11	Rest of diseases of the digestive system	REST OF (K00-K93) : K00-K31, K50-K55, K57-K66, K71, K72, K75, K80-K92
6.12	Diseases of the urinary system	N00-N39
6.13	Hyperplasia of the prostate	N40
6.14	Pregnancy, childbirth and the puerperium	O00-O99
6.15	Congenital malformations, deformities and chromosomal abnormalities	Q00-Q99
6.16	Residue	REST OF (A00-Q99) : D55-D89, E00-E07, E15-E34, E65-E89, H00-H95, L00-L98, M00-M99, N41-N99
SYMPTOMS, SIGNS AND ILL-DEFINED CONDITIONS		(R00-R99)

Tabla 2. Esperanza de vida de los departamentos colombianos. 2005

Departamento	Hombres	Mujeres	Diferencia
Bogotá	73,81	79,30	5,49
Atlántico	71,84	77,58	5,74
Sucre	71,68	76,87	5,19
San Andrés	71,34	77,03	5,69
Bolívar	71,28	76,37	5,09
Boyacá	71,01	76,72	5,71
Magdalena	70,86	75,71	4,85
Santander	70,77	77,17	6,40
Cundinamarca	70,70	77,00	6,30
La Guajira	70,70	77,31	6,61
Córdoba	70,37	75,88	5,51
Nariño	70,34	75,98	5,64
Colombia	70,20	77,11	6,91
Huila	69,51	75,16	5,65
César	69,36	75,48	6,12
Quindío	69,32	75,87	6,55
Antioquia	69,26	76,83	7,57
Valle del Cauca	68,49	77,66	9,17
Tolima	68,33	75,40	7,07
Caldas	67,70	76,79	9,09
Norte de Santander	67,70	75,51	7,81
Cauca	67,36	73,92	6,56
Putumayo	66,85	74,82	7,97
Risaralda	66,80	76,47	9,67
Meta	66,51	74,34	7,83
Casanare	65,23	72,20	6,97
Arauca	64,80	72,96	8,16
Grupo Amazonía	64,07	74,46	10,39
Caquetá	63,58	72,45	8,87
Chocó	63,07	71,93	8,86

Fuente: DANE. Estimación de la mortalidad. Conciliación Censal 2007. El grupo Amazonía hace referencia a los departamentos del Amazonas, Guainía, Guaviare, Vichada.

Tabla 3: Estadísticos de las tasas estandarizadas por sexo, periodo y causa de muerte a escala nacional. Colombia (1998-2013). Tasas por 100.000

CAUSA DE MUERTE	Hombres				Mujeres			
Todas las causas	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	452,0	430,9	363,1	307,5	246,9	231,0	203,7	173,6
Mediana	419,0	412,5	346,0	279,5	238,5	220,0	188,0	152,0
Desviación típica	260,1	231,6	185,4	180,4	139,4	128,6	116,0	121,8
Máximo	1610,0	1564,0	1314,0	1284,0	835,0	1161,0	969,0	1596,0
Coeficiente de variación	57,5%	53,7%	51,1%	58,7%	56,5%	55,7%	56,9%	70,1%
Cuartil (c1)	268,3	273,3	237,0	187,3	149,3	152,3	131,0	102,3
Cuartil (c3)	609,0	561,0	460,8	384,0	328,8	299,0	253,8	214,8
Transmisibles	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	18,8	16,7	14,2	11,3	14,0	12,0	9,8	8,4
Mediana	14,0	12,0	9,5	6,0	11,0	9,0	6,0	4,0
Desviación típica	19,0	18,7	17,3	18,4	14,9	12,7	12,1	39,1
Máximo	145,0	171,0	198,0	259,0	181,0	115,0	87,0	1243,0
Coeficiente de variación	101,3%	112,3%	122,3%	163,3%	106,3%	105,9%	122,4%	462,7%
Cuartil (c1)	6,0	5,0	4,0	0,0	3,0	3,0	0,0	0,0
Cuartil (c3)	26,0	22,0	18,0	13,0	20,0	17,0	14,0	9,0
Tumores	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	46,0	45,1	41,7	35,1	41,0	39,4	34,5	28,5
Mediana	41,0	41,0	38,0	31,0	38,0	36,0	31,0	25,0
Desviación típica	34,4	33,6	28,9	28,0	29,2	27,9	24,7	23,5
Máximo	271,0	490,0	233,0	191,0	166,0	204,0	132,0	141,0
Coeficiente de variación	74,7%	74,6%	69,3%	79,7%	71,2%	70,9%	71,4%	82,5%
Cuartil (c1)	20,0	22,0	22,0	15,0	18,0	18,3	17,0	12,0
Cuartil (c3)	65,0	62,0	57,0	48,0	60,0	56,0	47,0	39,0
Aparato circulatorio	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	113,1	108,9	105,1	92,9	92,0	87,5	80,0	68,1
Mediana	108,0	107,0	99,0	85,0	88,0	83,0	75,0	62,0
Desviación típica	73,4	66,7	64,5	61,5	58,6	55,8	51,8	47,0
Máximo	496,0	546,0	672,0	531,0	405,0	473,0	620,0	404,0
Coeficiente de variación	64,9%	61,2%	61,3%	66,2%	63,7%	63,8%	64,7%	69,0%
Cuartil (c1)	60,0	63,0	65,0	51,0	50,0	49,3	48,3	37,0
Cuartil (c3)	156,0	148,0	137,8	122,0	126,0	118,8	104,0	88,0
Perinatales	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	7,7	5,7	4,7	3,0	5,5	4,4	3,4	2,3
Mediana	4,0	3,0	2,0	0,0	3,0	1,0	0,0	0,0
Desviación típica	11,1	8,8	8,1	6,9	8,2	7,5	6,2	5,4
Máximo	87,0	72,0	69,0	73,0	67,0	60,0	50,0	65,0
Coeficiente de variación	144,0%	152,8%	169,9%	225,9%	148,1%	168,2%	184,5%	236,1%
Cuartil (c1)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cuartil (c3)	10,0	8,0	6,0	3,0	8,0	6,0	4,0	2,0
Externas	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	189,4	182,5	127,7	100,6	28,8	28,2	21,1	17,1
Mediana	153,5	150,5	105,5	84,0	24,0	22,0	18,0	14,0
Desviación típica	154,7	151,5	95,3	75,9	26,3	25,7	17,2	16,8
Máximo	1261,0	1413,0	941,0	709,0	343,0	238,0	152,0	215,0
Coeficiente de variación	81,7%	83,0%	74,7%	75,5%	91,3%	91,2%	81,8%	98,4%
Cuartil (c1)	80,0	84,0	63,0	49,0	12,0	11,0	9,0	6,0
Cuartil (c3)	257,0	241,5	172,0	133,8	39,0	38,8	29,0	24,0
Resto de causas	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	62,8	62,2	60,0	53,5	53,4	51,6	47,7	41,5
Mediana	54,0	53,0	51,0	41,5	46,0	44,5	40,0	32,0
Desviación típica	50,9	49,7	47,8	51,3	41,4	40,0	37,6	38,3
Máximo	361,0	512,0	422,0	482,0	259,0	467,0	303,0	300,0
Coeficiente de variación	81,0%	79,8%	79,6%	95,9%	77,6%	77,4%	78,8%	92,4%
Cuartil (c1)	24,3	29,0	30,0	24,0	22,3	25,0	24,0	19,0
Cuartil (c3)	89,0	84,0	75,8	65,0	76,0	69,0	62,0	50,0
Mal definidas	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**	**1998-2001**	**2002-2005**	**2006-2009**	**2010-2013**
Promedio	14,2	9,8	9,7	11,1	12,2	7,8	7,1	7,7
Mediana	7,0	6,0	7,0	8,0	6,0	4,0	4,0	5,0
Desviación típica	22,9	13,4	12,2	12,8	19,5	12,5	10,3	10,1
Máximo	275,0	148,0	115,0	159,0	176,0	138,0	111,0	112,0
Coeficiente de variación	160,9%	137,8%	125,5%	115,9%	159,9%	159,2%	144,0%	130,2%
Cuartil (c1)	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0
Cuartil (c3)	17,0	13,0	13,0	15,0	14,0	9,0	10,0	11,0

Fuente: Elaboración propia a partir de los microdatos de la Estadísticas Vitales y los denominadores suministrados por el DANE

Tabla 4:

Global Moran por período y causa de muerte para los hombres. Colombia (1998-2013)

	Hombres			
	1998-2001	2002-2005	2006-2009	2010-2013
Todas las causas	0,4923	0,5314	0,4359	0,3190
Enfermedades transmisibles	0,149	0,0933	0,0488	0,1086
Neoplasias (tumores)	0,3733	0,3083	0,2989	0,2509
Enfermedades del sistema circulatorio	0,4191	0,4493	0,4043	0,3117
Perinatales	0,0016	-0,0108	-0,0033	0,0005
Causas externas	0,5234	0,5195	0,4907	0,4624
Todas las demás causas	0,2321	0,1547	0,0787	0,0095
Mal definidas	0,1385	0,1613	0,1324	0,0783
	Mujeres			
	1998-2001	2002-2005	2006-2009	2010-2013
Todas las causas	0,40	0,37	0.30	0.19
Enfermedades transmisibles	0.12	0.07	0.06	0.07
Neoplasias (tumores)	0.41	0.34	0.32	0.24
Enfermedades del sistema circulatorio	0.40	0.38	0.34	0.26
Perinatales	0.02	-0.03	0.02	0.00
Causas externas	0.31	0.35	0.27	0.21
Todas las demás causas	0.28	0.21	0.15	0.10
Mal definidas	0.24	0.13	0.20	0.13

Fuente: Elaboración propia.

Mapa 1: Clúster municipal de todas las causas. Hombres. Colombia (1998-2013)
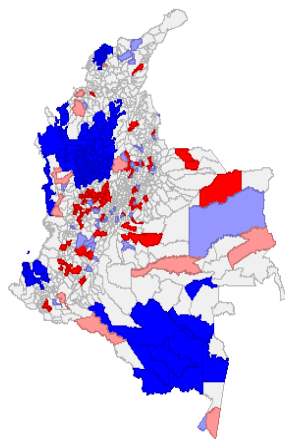
1998-2001   2002-2005

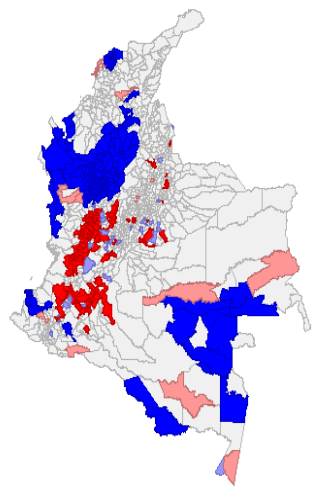2006-2009   2010-2013



Not Significant
High-High
Low-Low
Low-High
High-Low
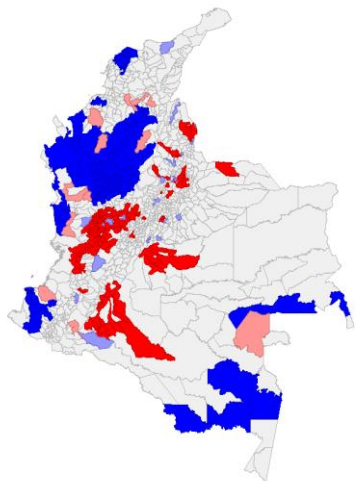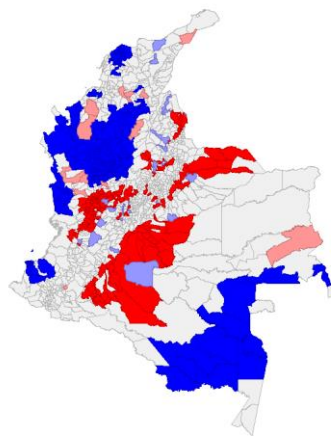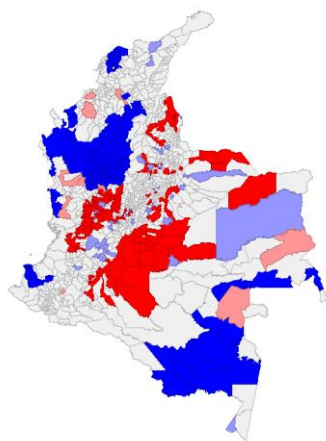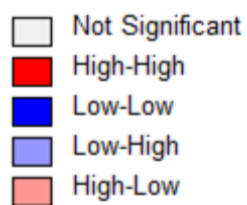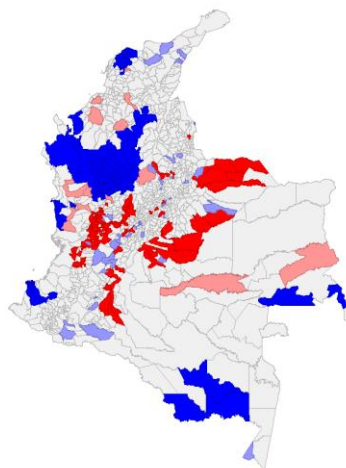
Fuente: Elaboración propia.

**Mapa 2: Clúster municipal de los tumores. Hombres. Colombia (1998-2013)**
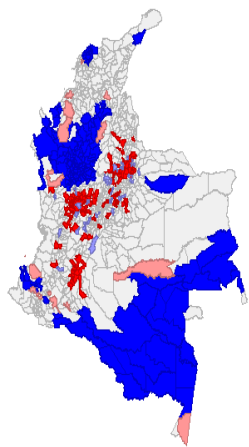
1998-2001

2002-2005

2006-2009

2010-2013

- Not Significant
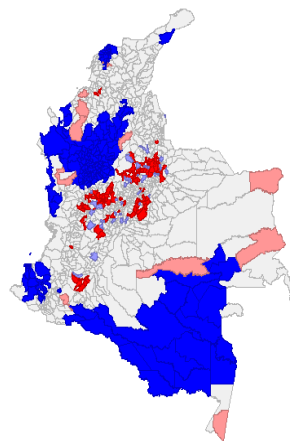- High-High
- Low-Low
- Low-High
- High-Low
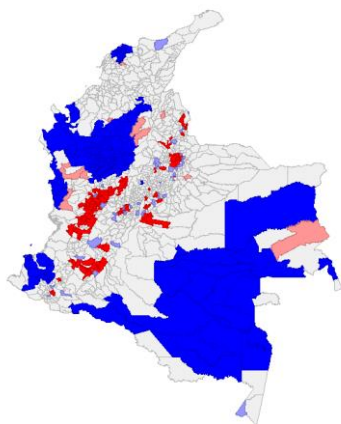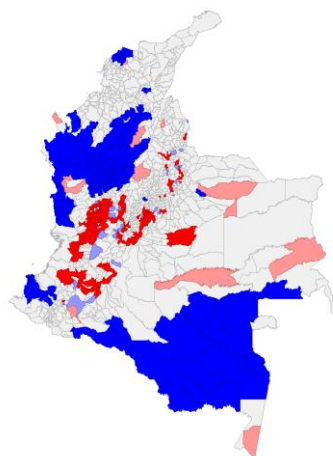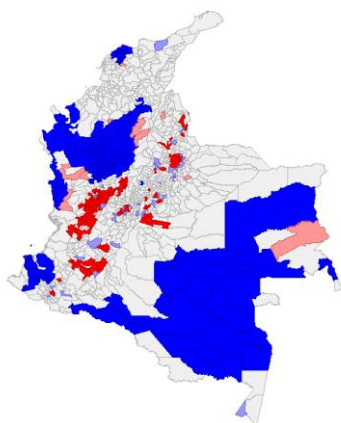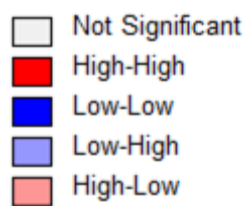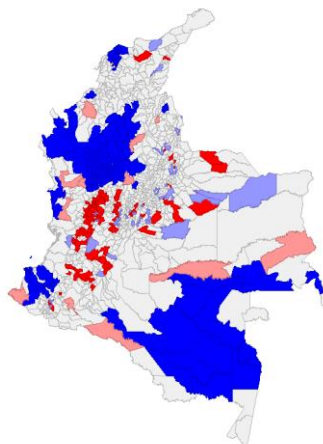
Fuente: Elaboración propia.

Mapa 3: Clúster municipal del aparato circulatorio. Hombres. Colombia (1998-2013)
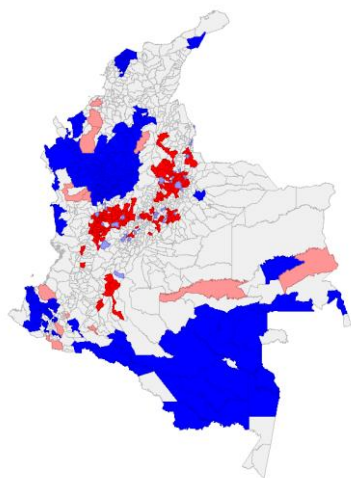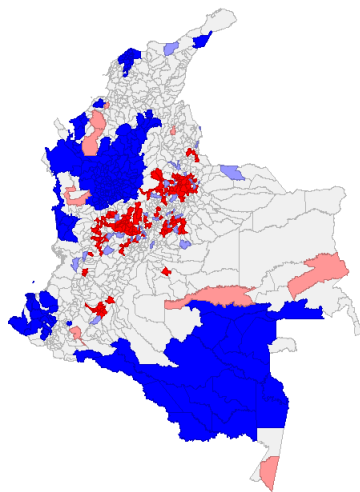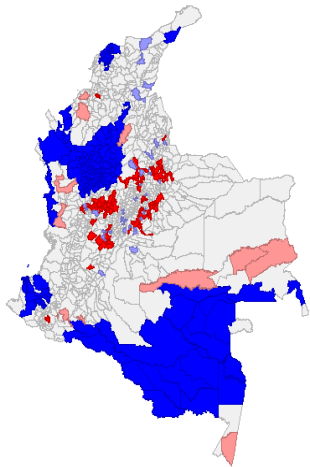
1998-2001   2002-2005
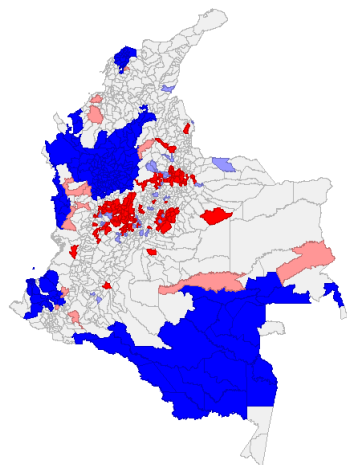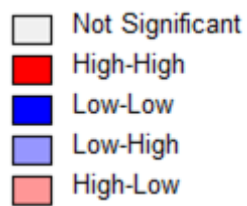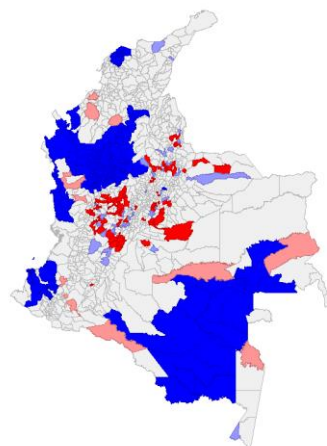
2006-2009   2010-2013

Fuente: Elaboración propia.

Mapa 4: Clúster municipal de las causas externas. Hombres. Colombia (1998-2013)
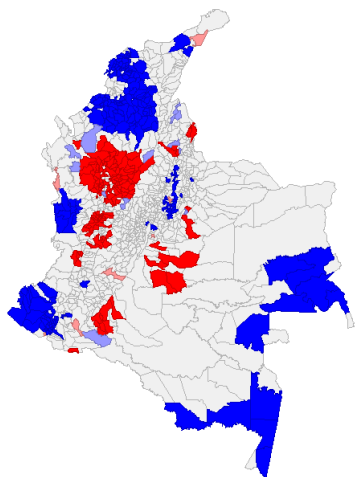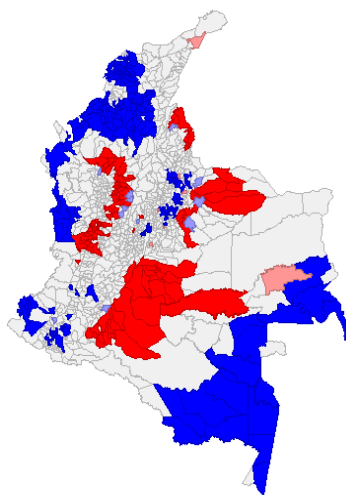
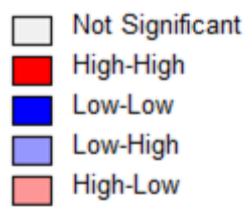1998-2001   2002-2005
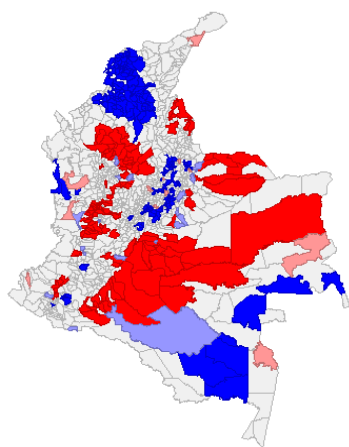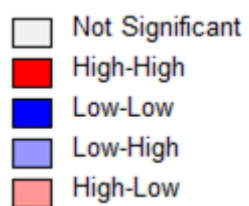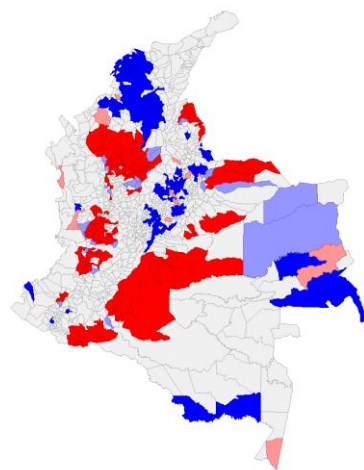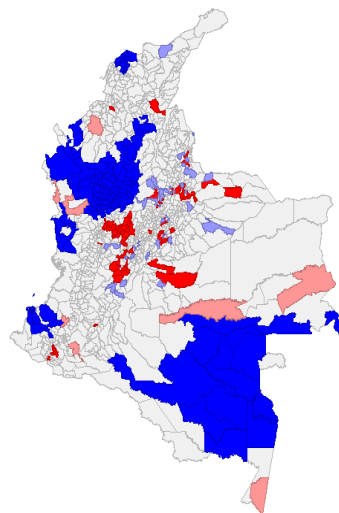

2006-2009   2010-2013

Fuente: Elaboración propia.

Mapa 5. Clúster municipal de todas las causas. Mujeres. Colombia (1998-2013)

1998-2001

2002-2005

2006-2009

2010-2013

Legend:
- Not Significant
- High-High
- Low-Low
- Low-High
- High-Low
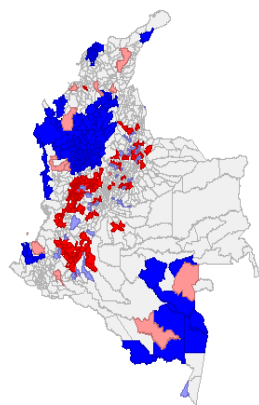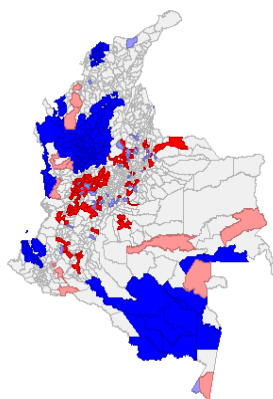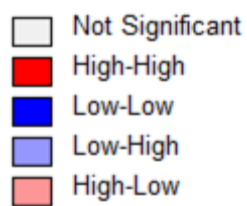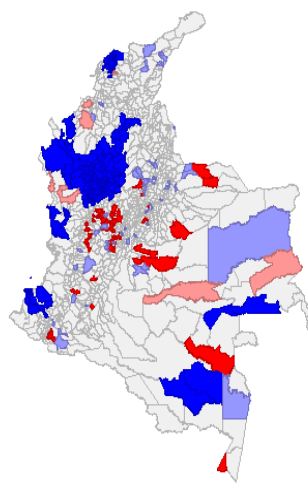
Fuente: Elaboración propia.

Mapa 6. Clúster municipal de los tumores. Mujeres. Colombia (1998-2013)

1998-2001

2002-2005

2006-2009

2010-2013

Not Significant
High-High
Low-Low
Low-High
High-Low
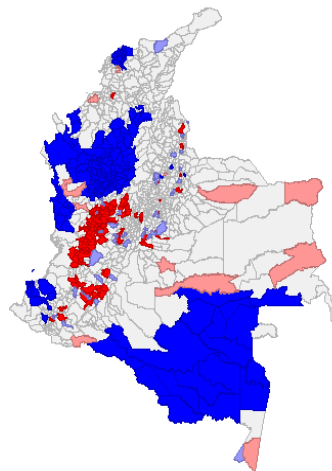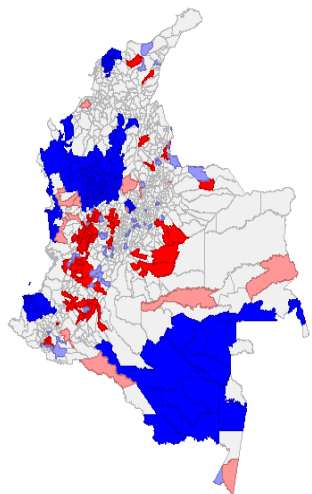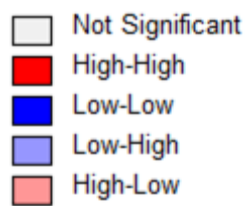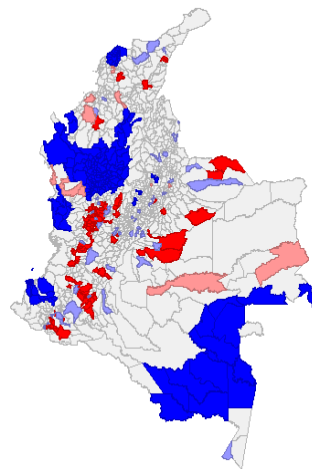
Fuente: Elaboración propia.

Mapa 7. Clúster municipal aparato circulatorio. Mujeres. Colombia (1998-2013)
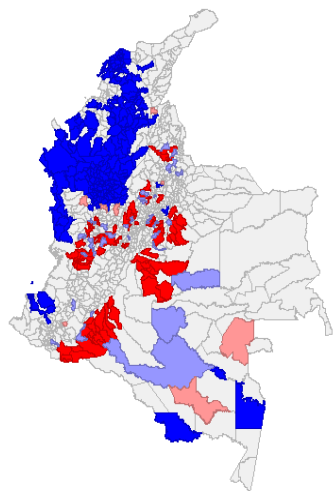
1998-2001

2002-2005

2006-2009

2010-2013

Not Significant
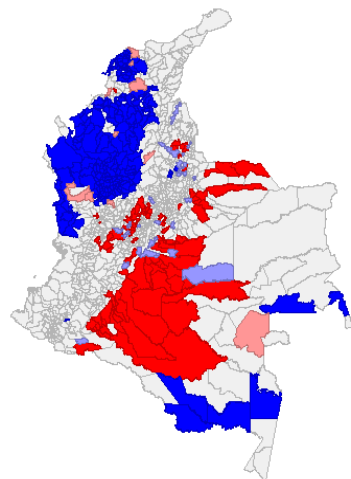High-High
Low-Low
Low-High
High-Low

Fuente: Elaboración propia.

Mapa 8. Clúster municipal causas externas. Mujeres. Colombia (1998-2013)

1998-2001

2002-2005

2006-2009

2010-2013

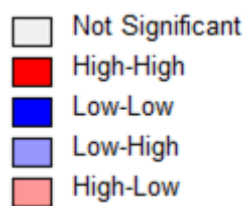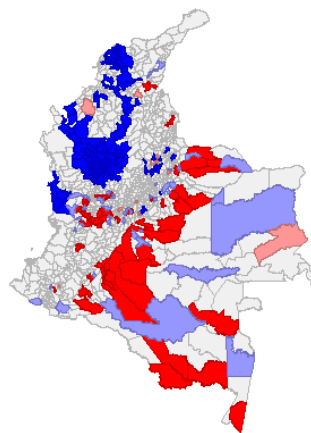|	
	Not Significant
	High-High
	Low-Low
	Low-High
	High-Low
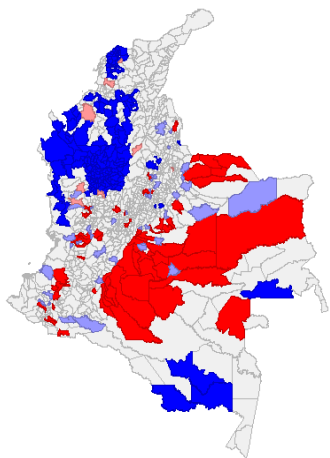
Fuente: Elaboración propia.

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