

Statistical Applications in Geographical Health Studies

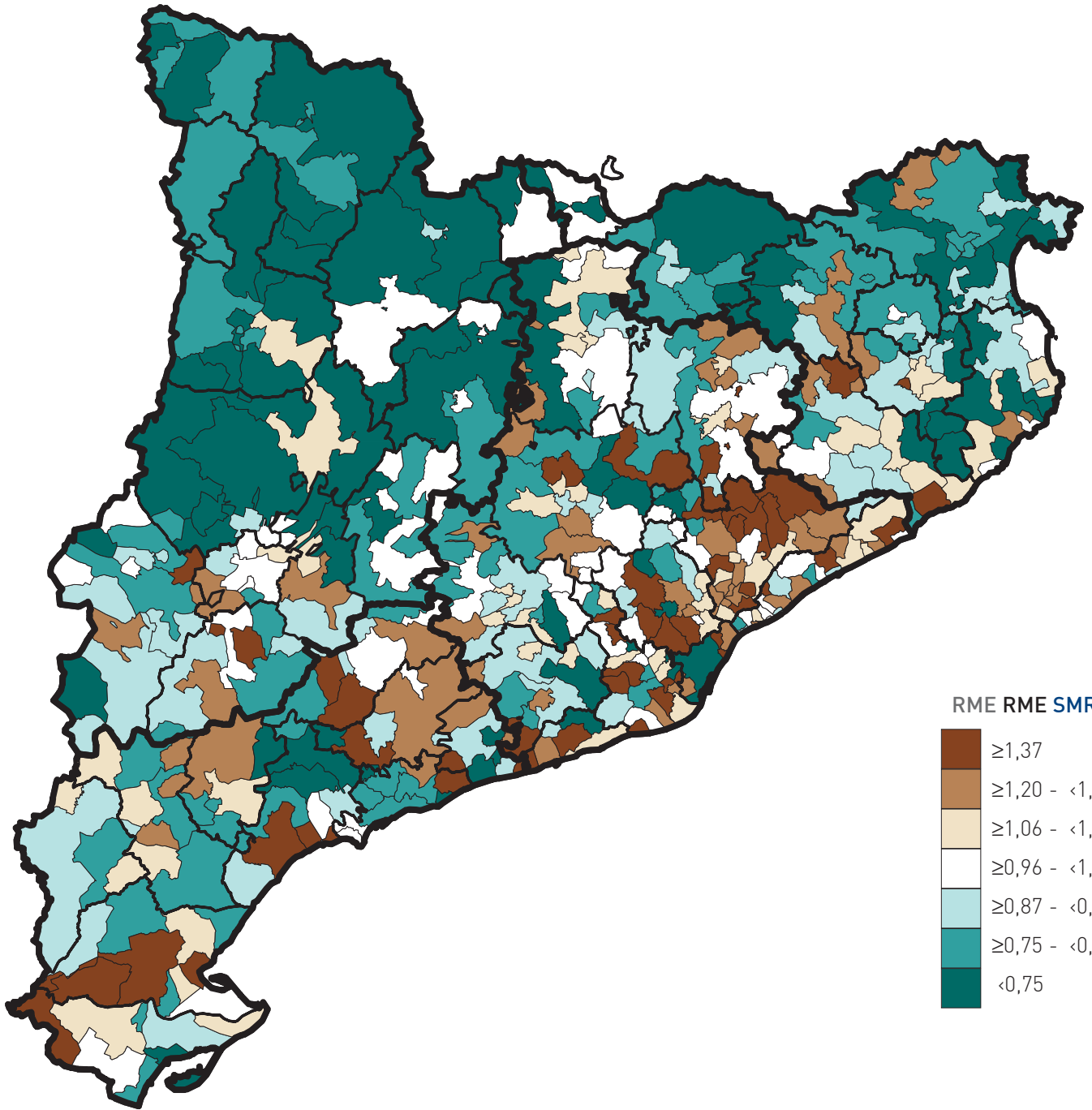
José Miguel Martínez Martínez
PhD Student

Joan Benach de Rovira
Universitat Pompeu Fabra
PhD Advisor

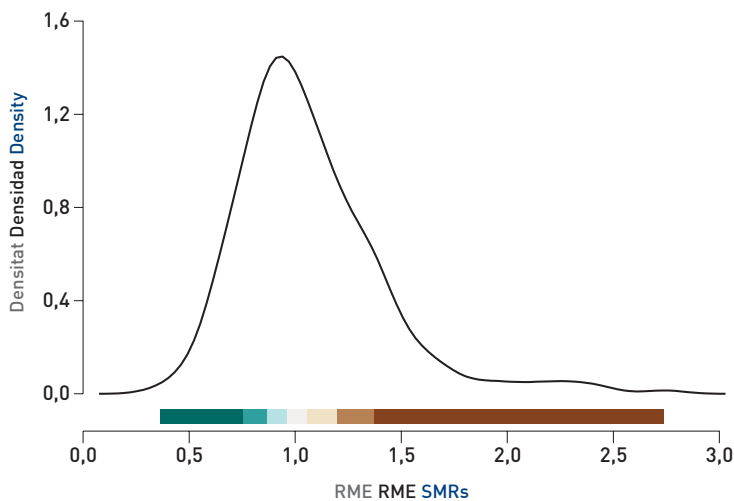
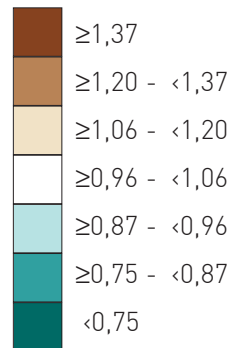
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Universitat Politècnica de Catalunya
PhD Tutor

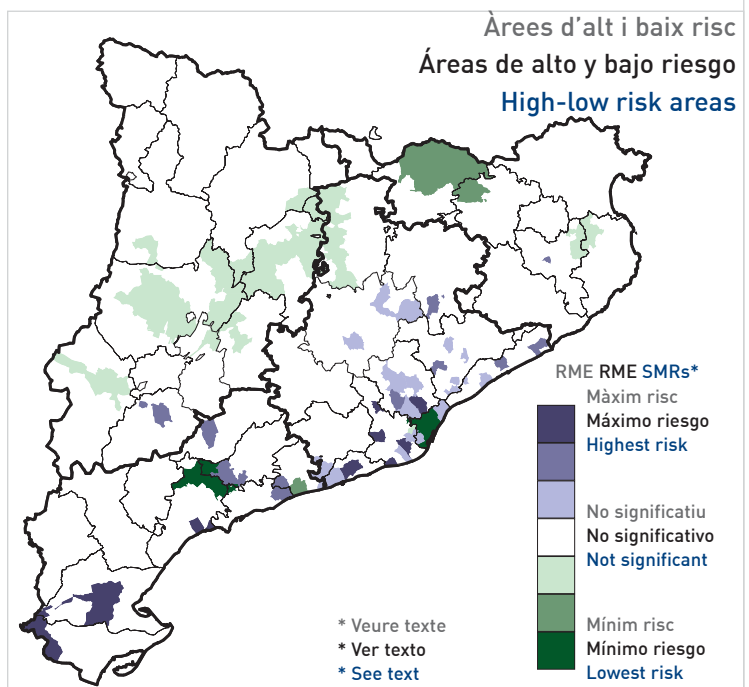
Doctorate in Technical and Computer Applications of Statistics,
Operational Research and Optimization.
Universitat Politècnica de Catalunya
Barcelona, 8/05/2006



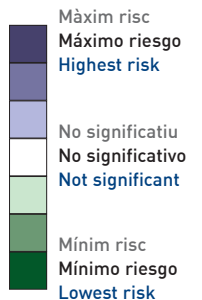
RME RME SMRs



Àrees d'alt i baix risc
 Áreas de alto y bajo riesgo
 High-low risk areas

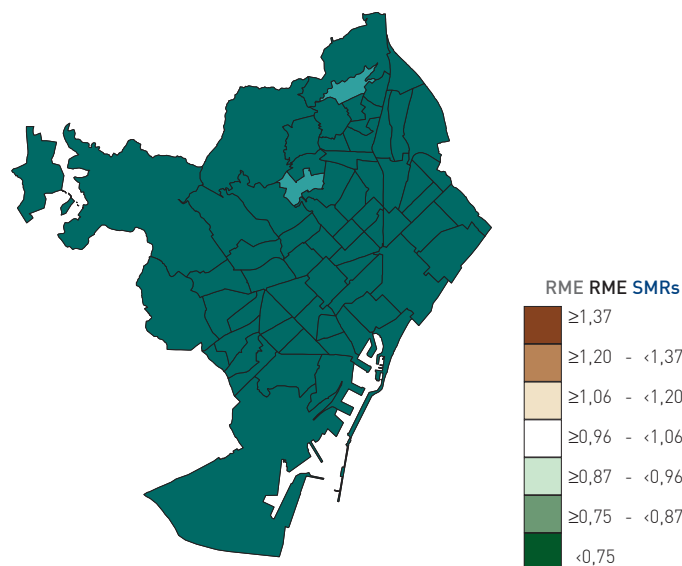


RME RME SMRs*

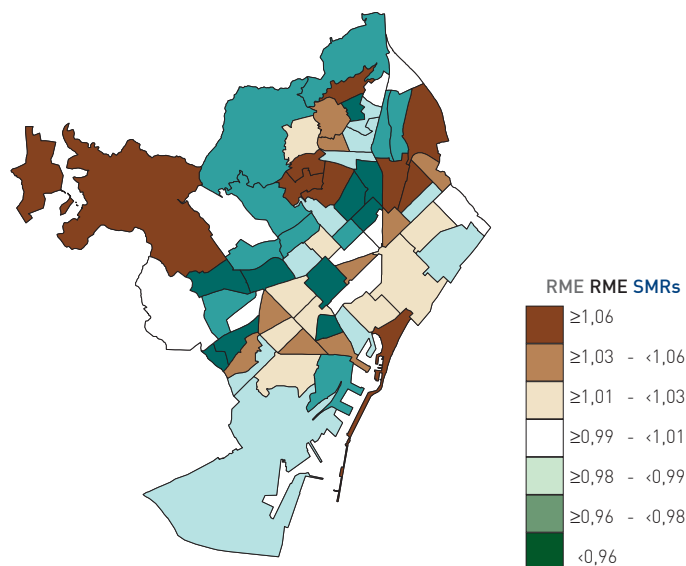


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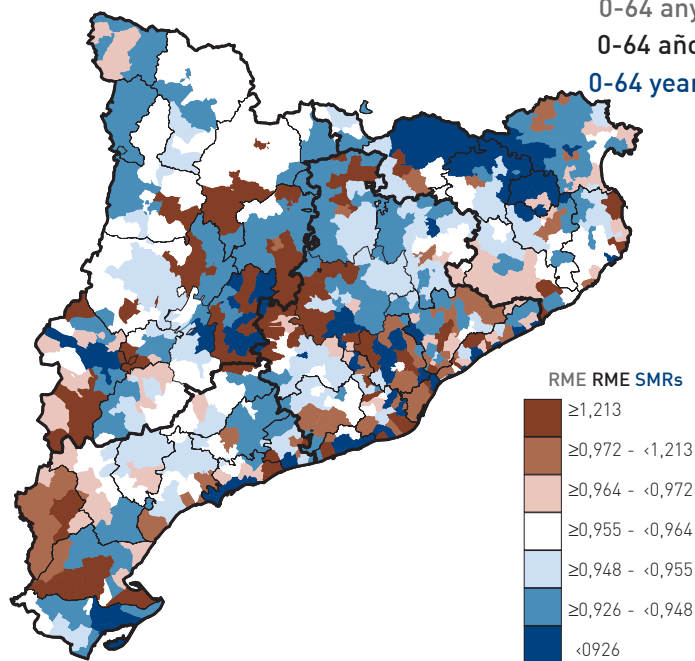
Àrees de Barcelona en comparació amb Catalunya
 Áreas de Barcelona en comparación con Cataluña
 Barcelona areas vs Catalonia



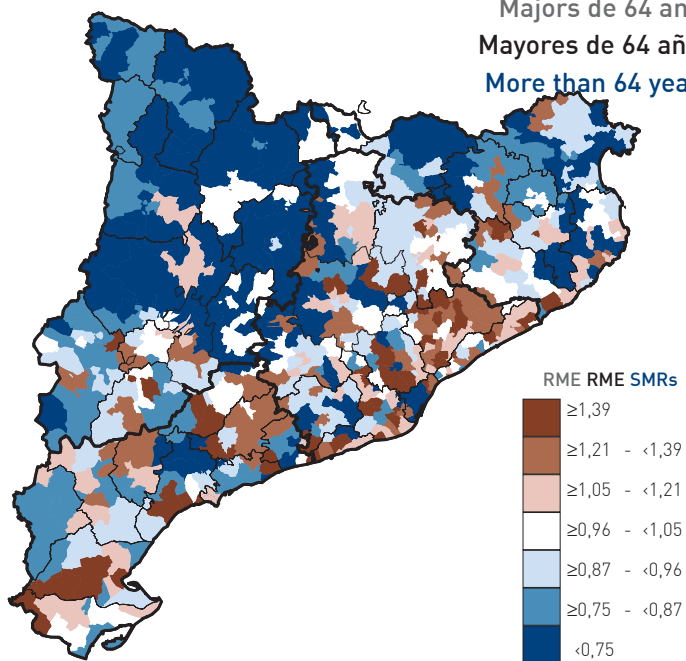
Àrees de Barcelona
 Áreas de Barcelona
 Barcelona areas



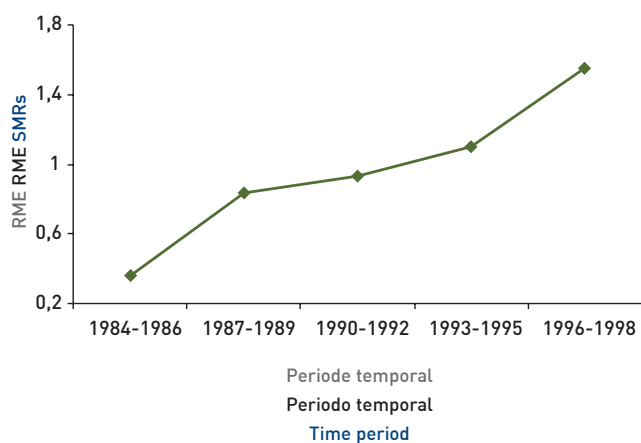
0-64 anys
 0-64 años
 0-64 years



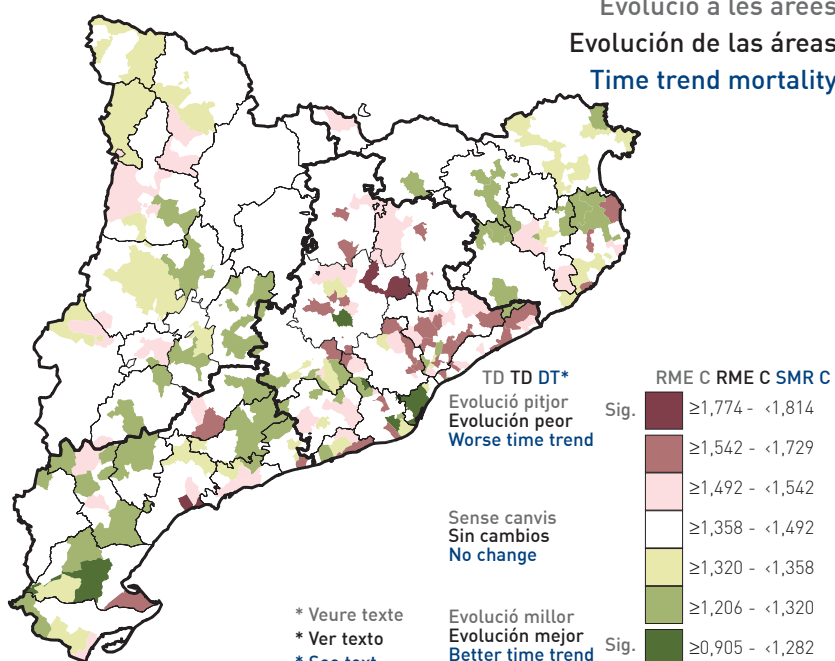
Majors de 64 anys
 Mayores de 64 años
 More than 64 years

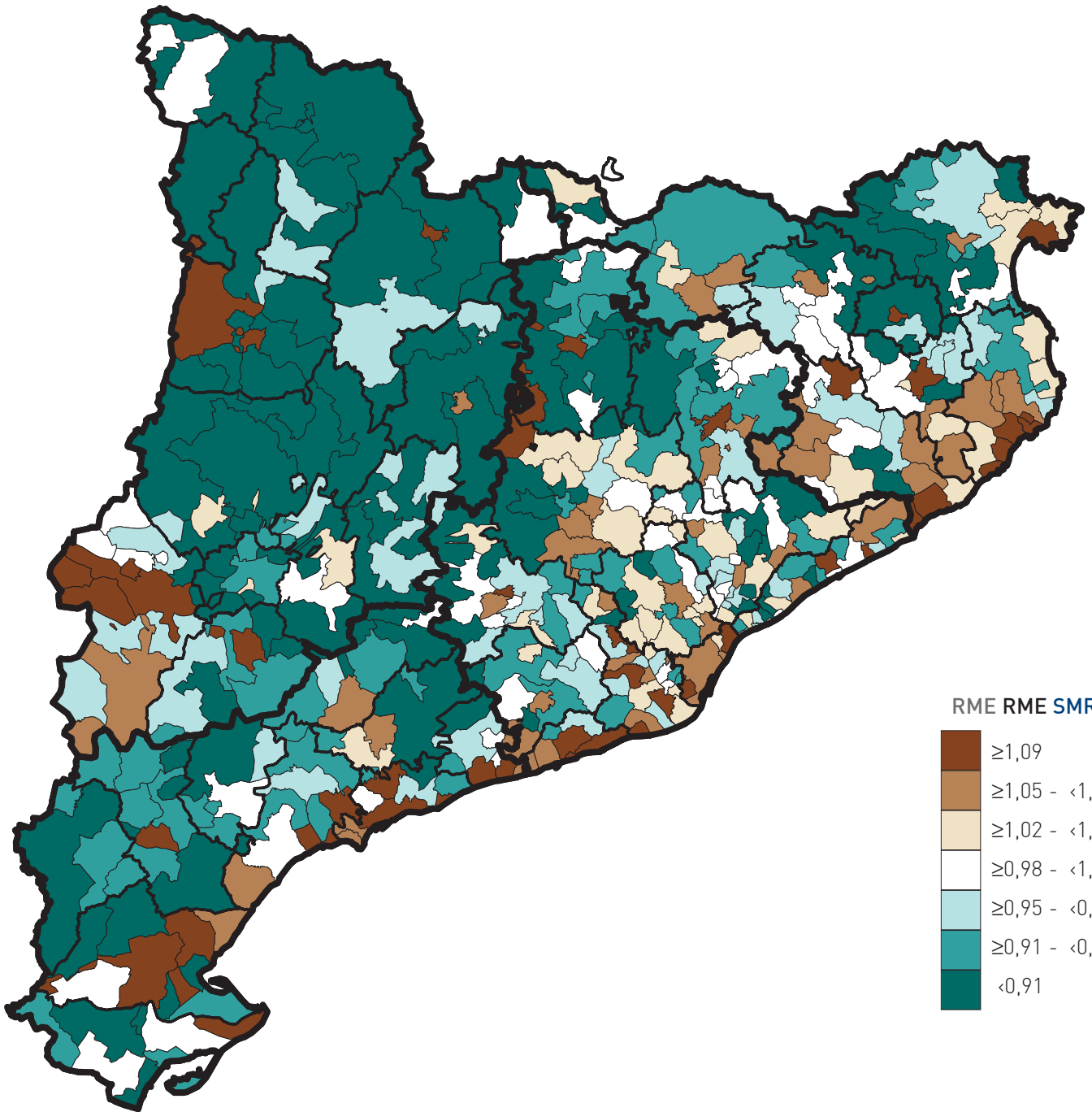


Evolució de la mortalitat a Catalunya (1984 -1998)
 Evolución de la mortalidad en Cataluña (1984-1998)
 Catalonia time trend mortality (1984-1998)

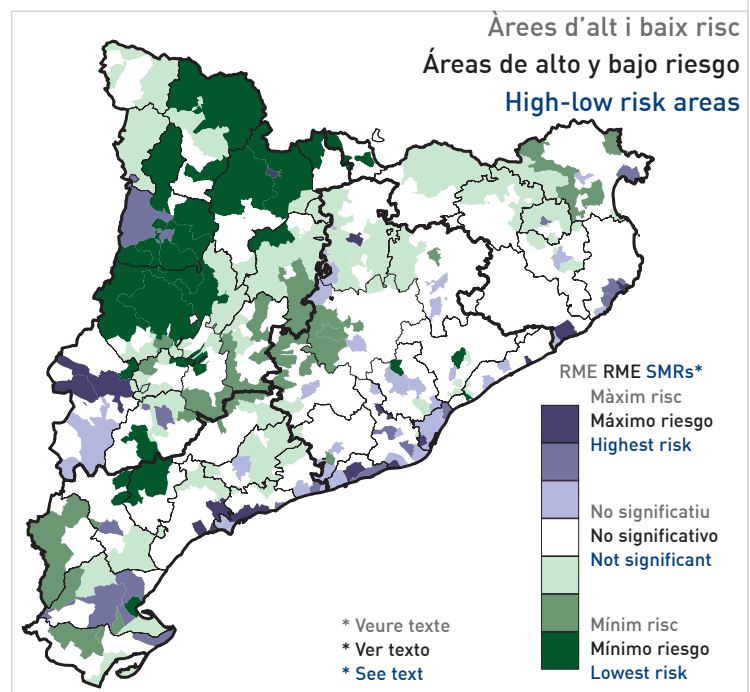
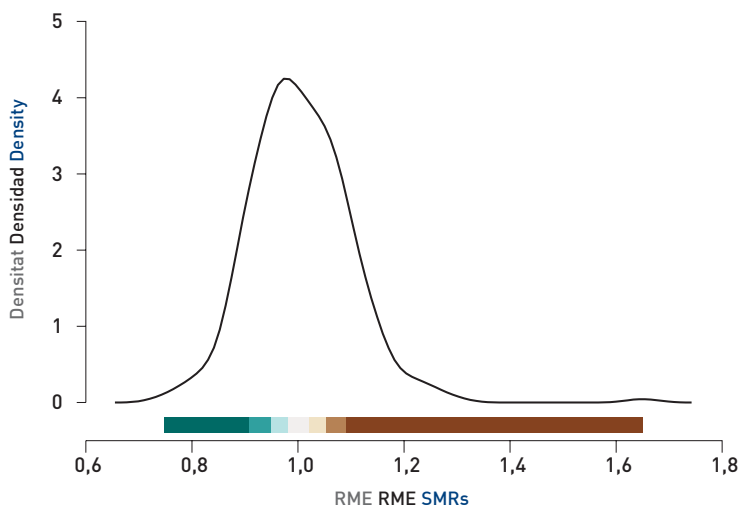
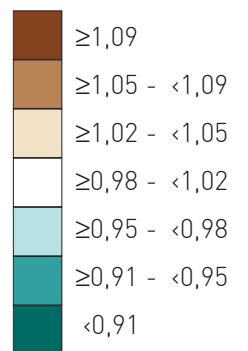


Evolució a les àrees
 Evolución de las áreas
 Time trend mortality

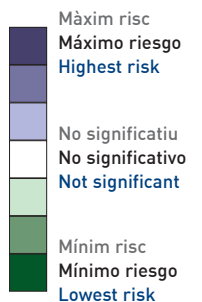




RME RME SMRs

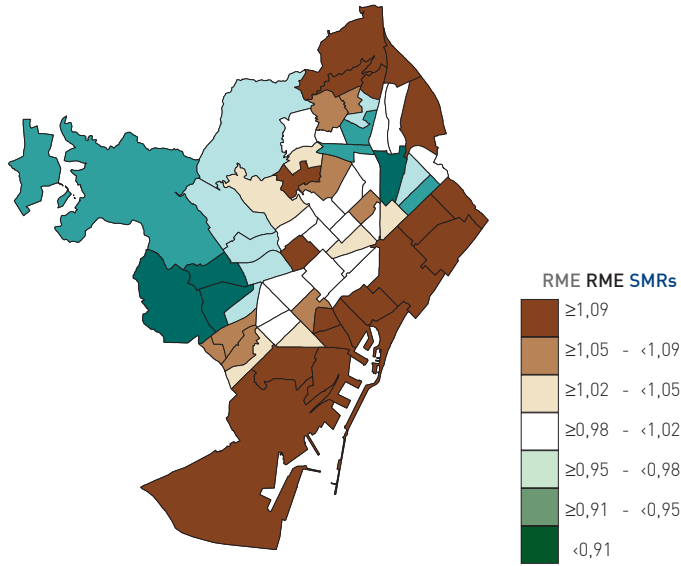


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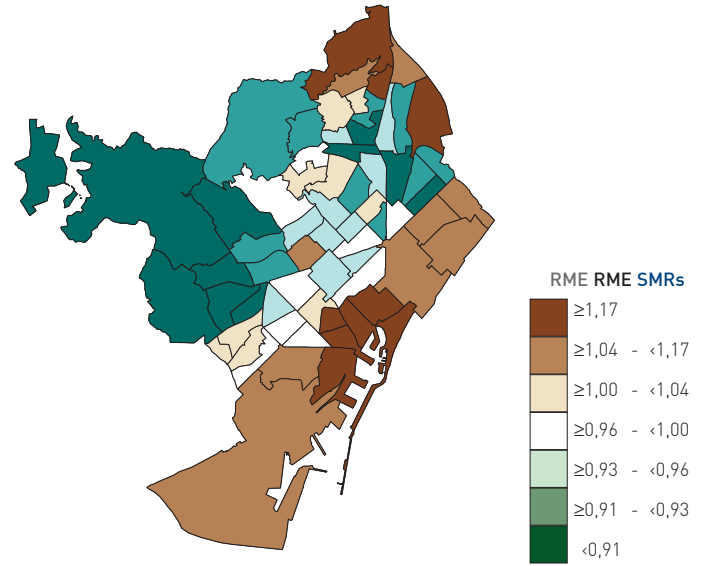


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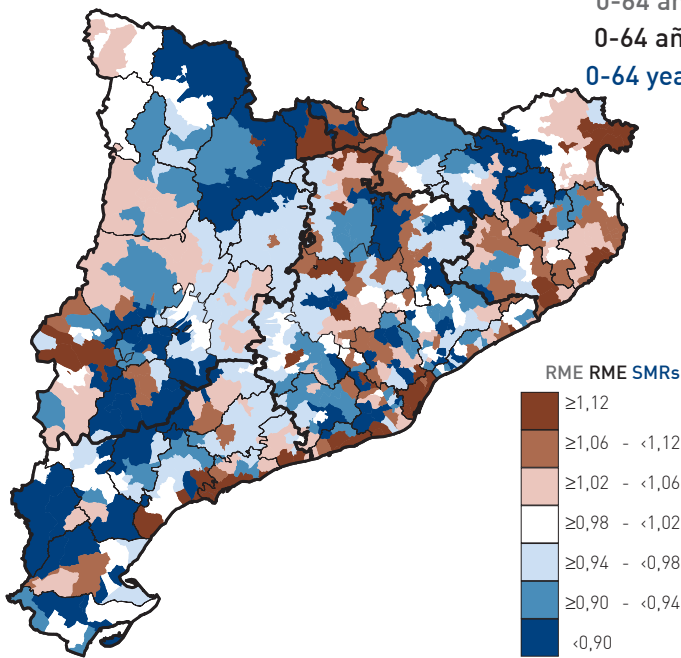
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 Áreas de Barcelona en comparación con Cataluña
 Barcelona areas vs Catalonia



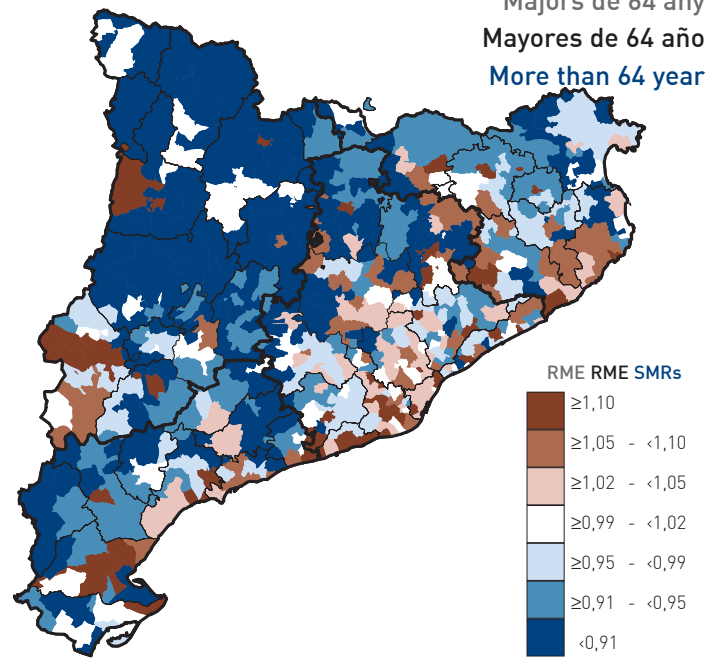
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 Áreas de Barcelona
 Barcelona areas



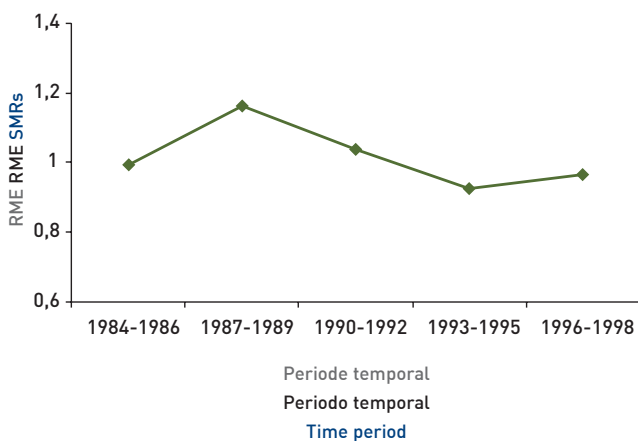
0-64 anys
 0-64 años
 0-64 years



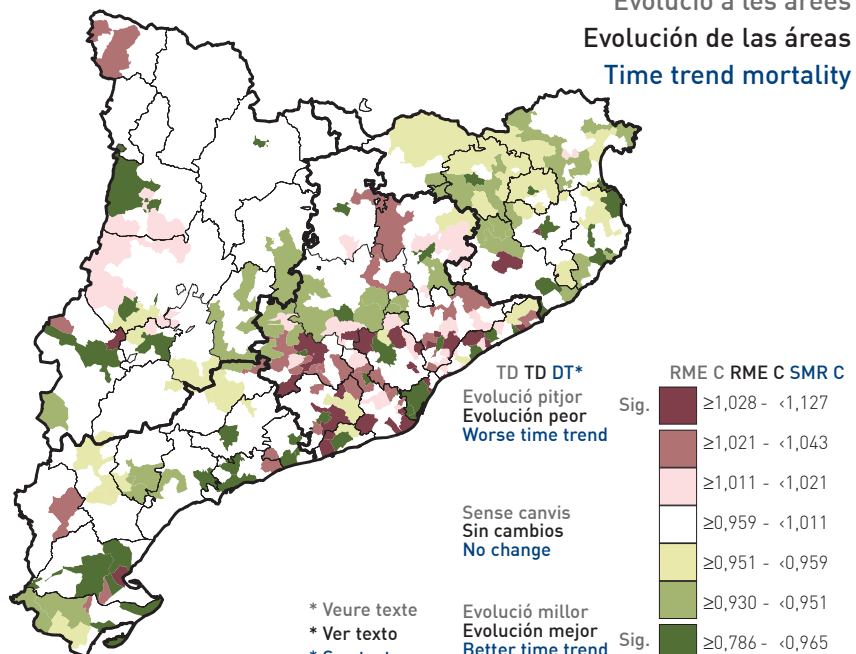
Majors de 64 anys
 Mayores de 64 años
 More than 64 years



Evolució de la mortalitat a Catalunya (1984 -1998)
 Evolución de la mortalidad en Cataluña (1984-1998)
 Catalonia time trend mortality (1984-1998)



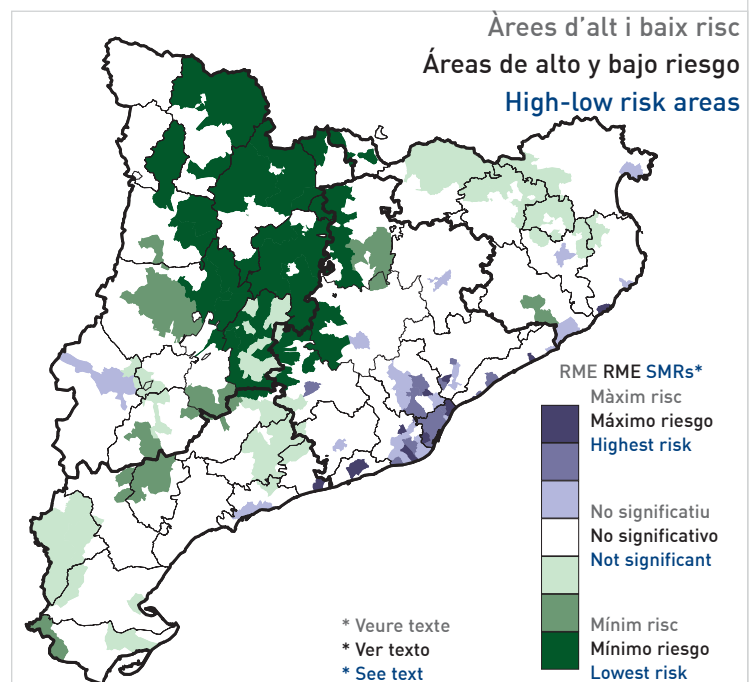
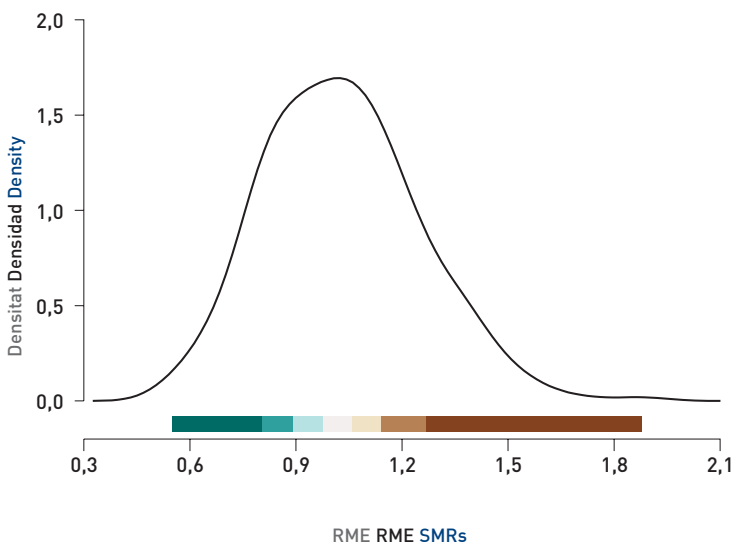
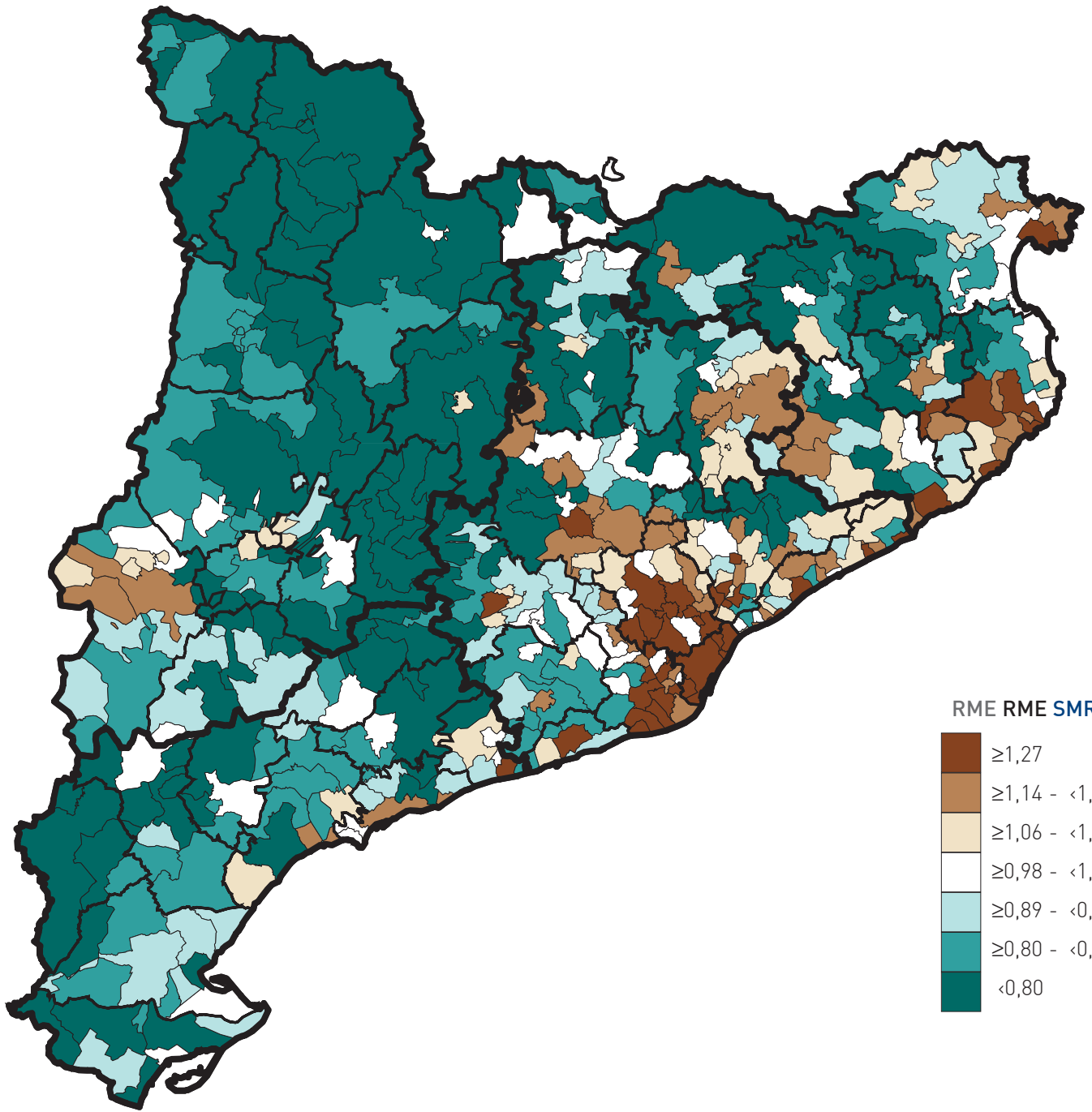
Evolució a les àrees
 Evolución de las áreas
 Time trend mortality



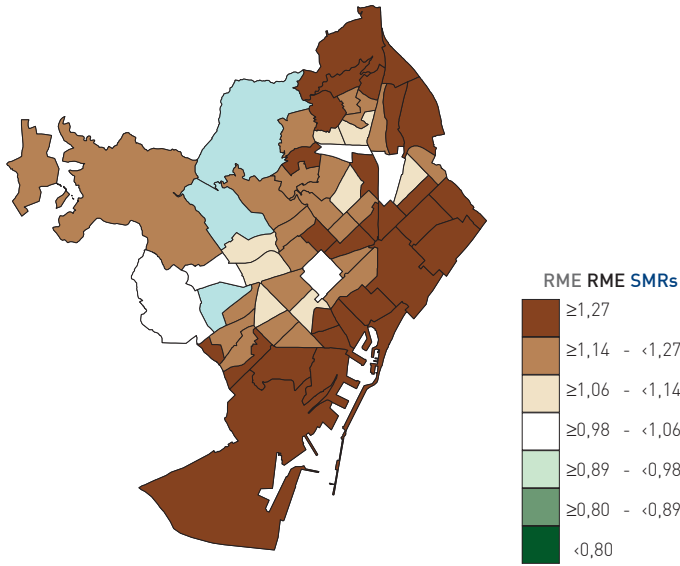
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Evolution better
 Evolución mejor
 Better time trend

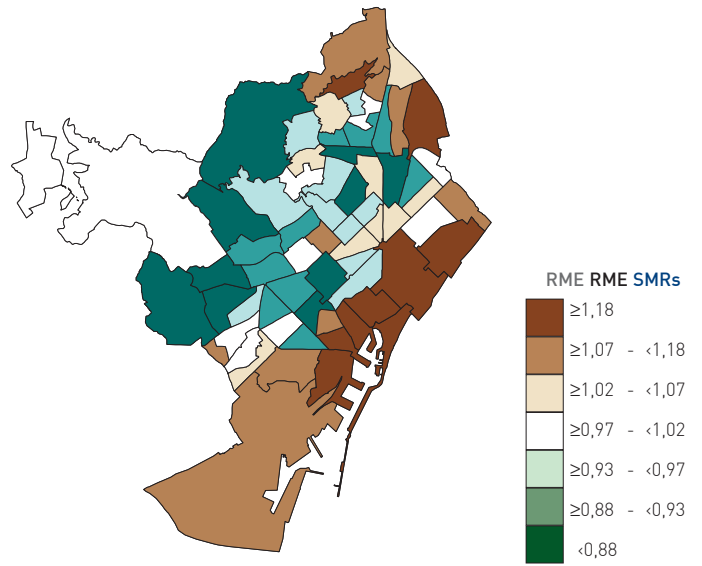
Sig. ≥0,786 - <0,965



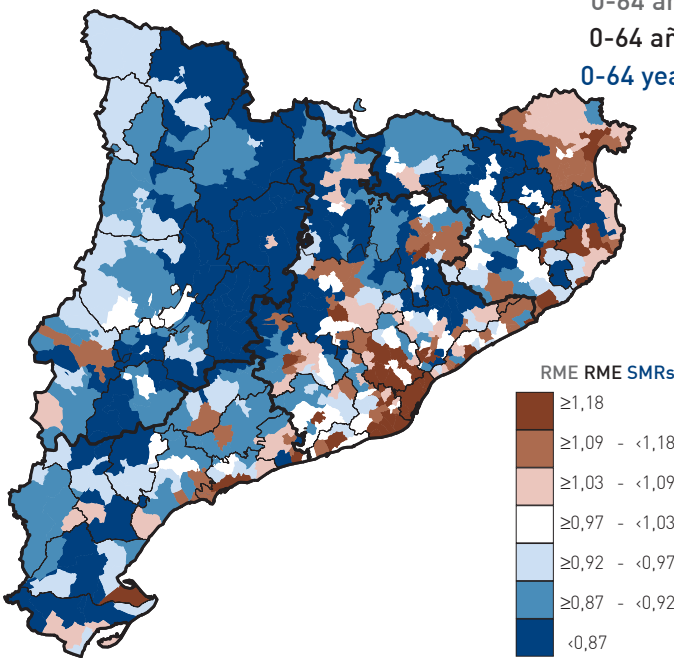
Àrees de Barcelona en comparació amb Catalunya
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 Barcelona areas vs Catalonia



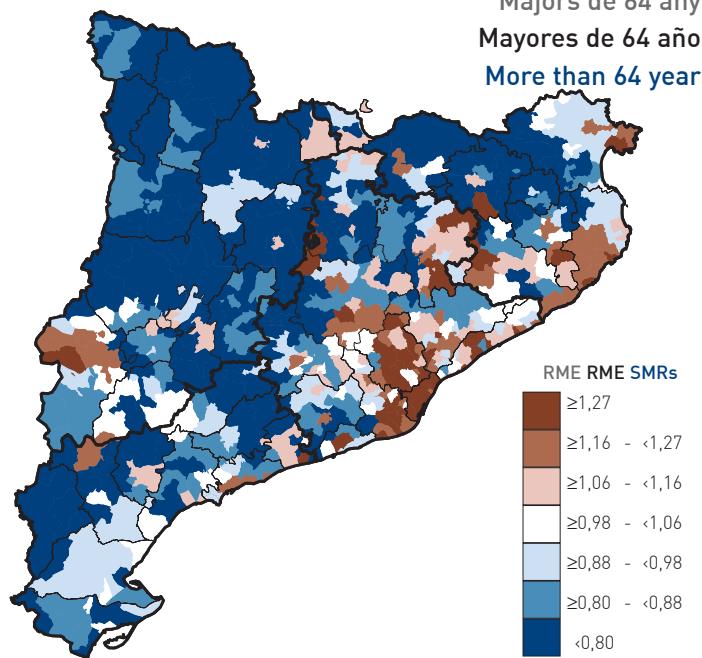
Àrees de Barcelona
 Áreas de Barcelona
 Barcelona areas



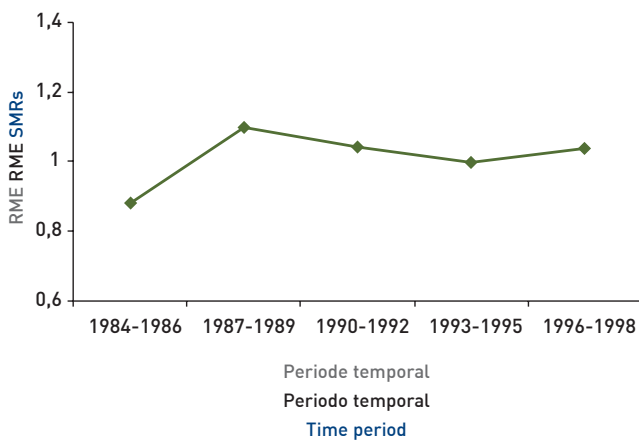
0-64 anys
 0-64 años
 0-64 years



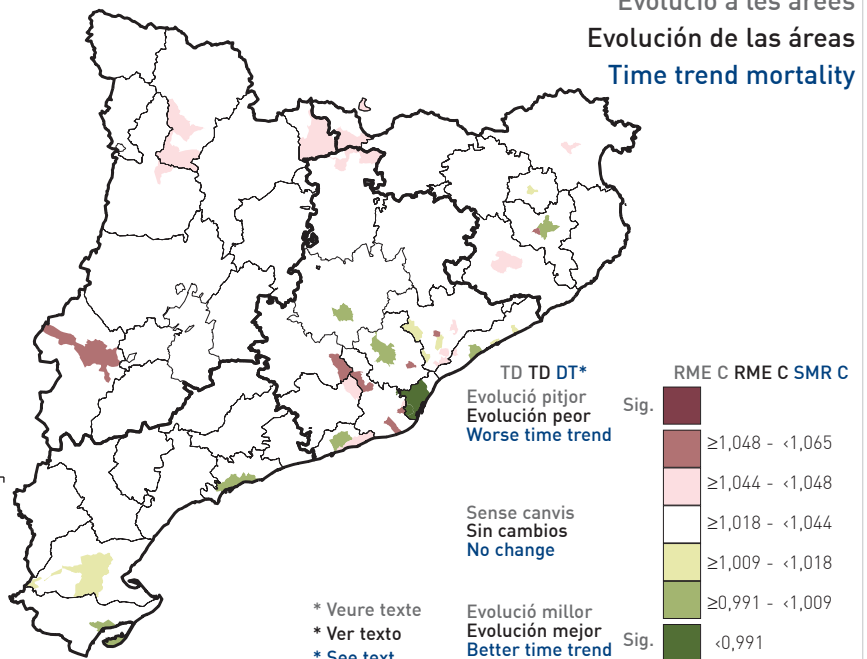
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 Mayores de 64 años
 More than 64 years



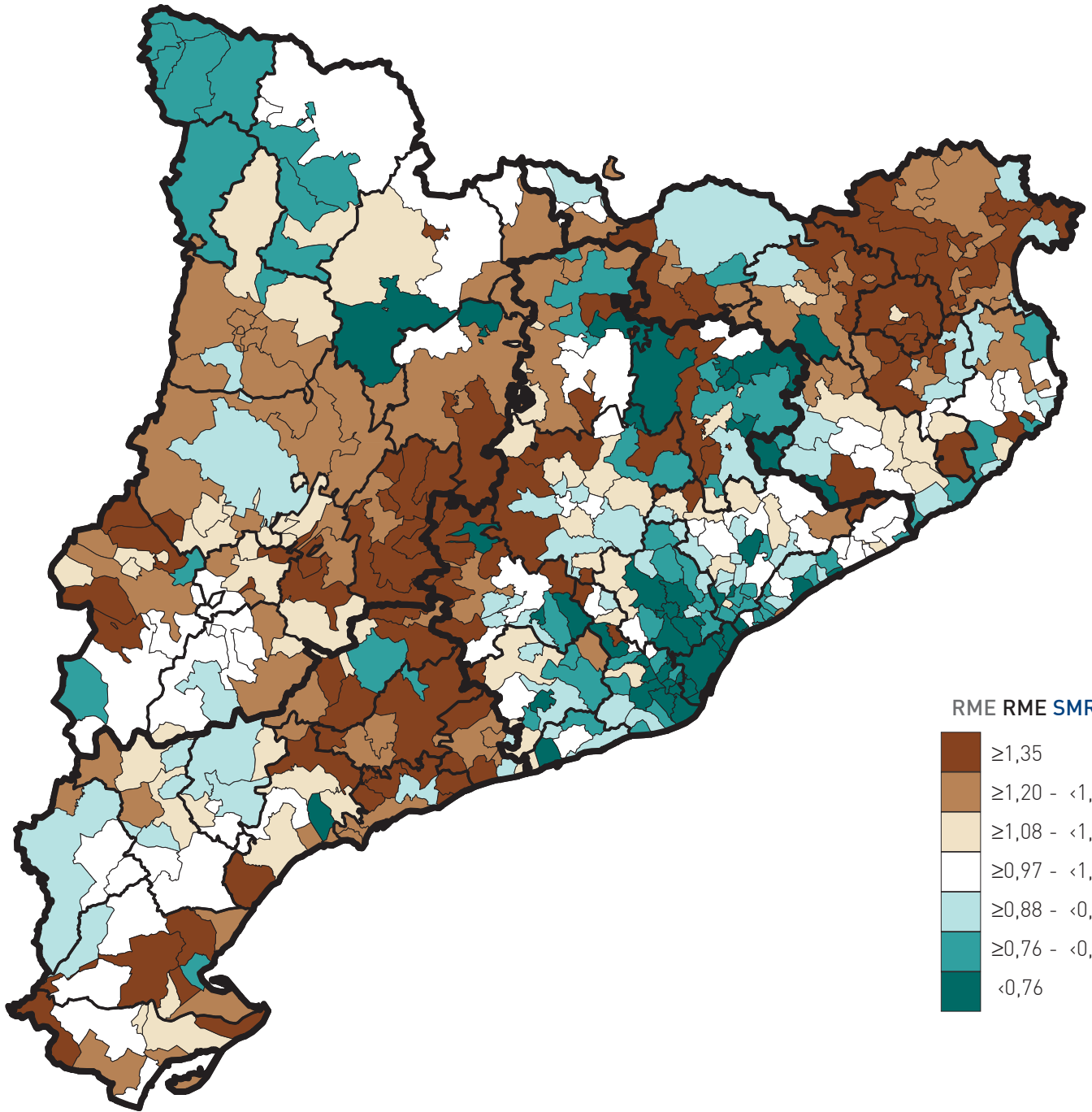
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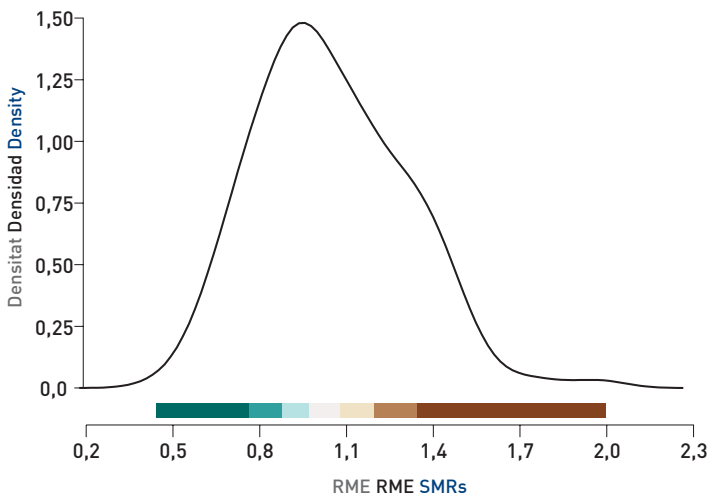
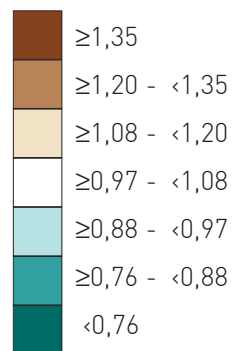
Evolució a les àrees
 Evolución de las áreas
 Time trend mortality



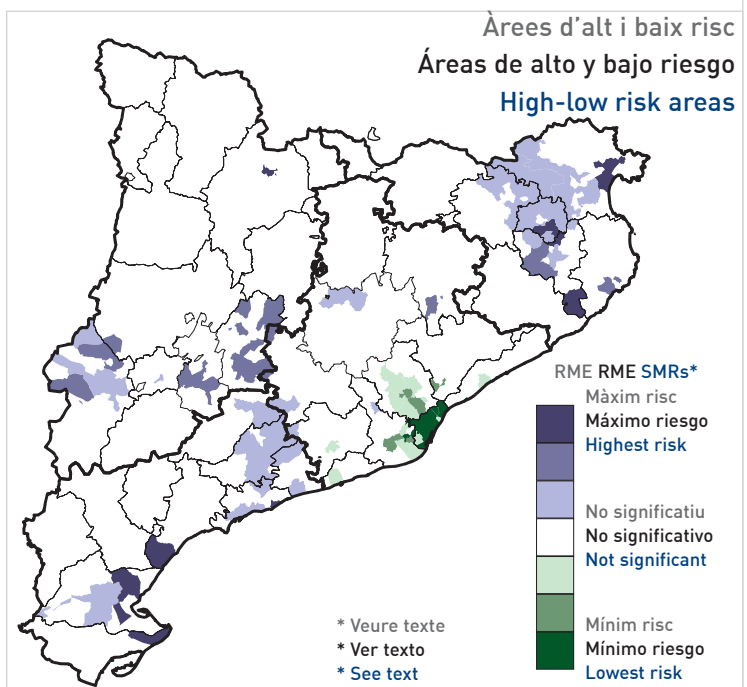
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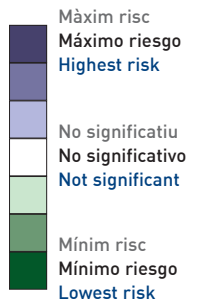
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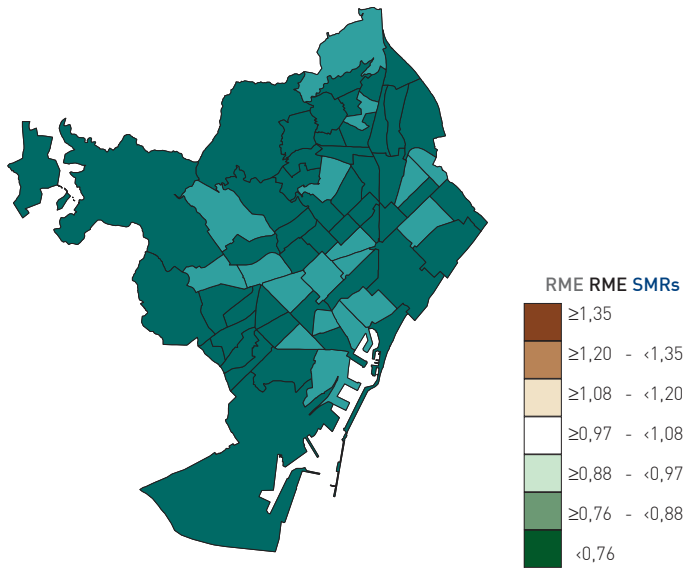


RME RME SMRs*

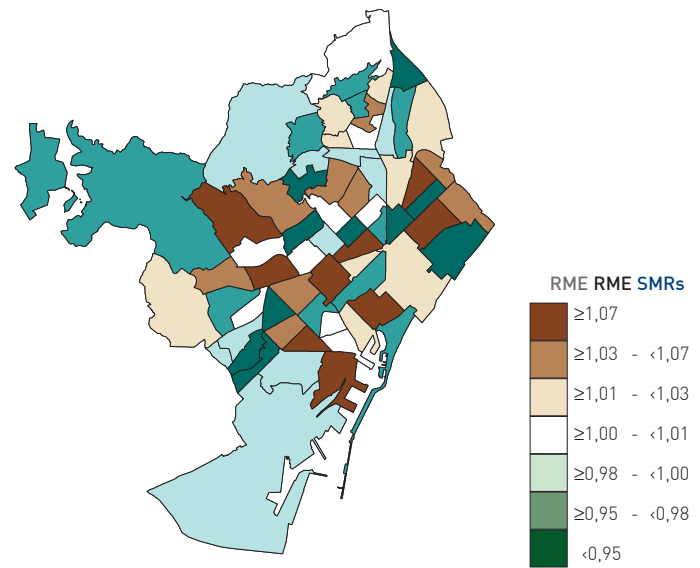


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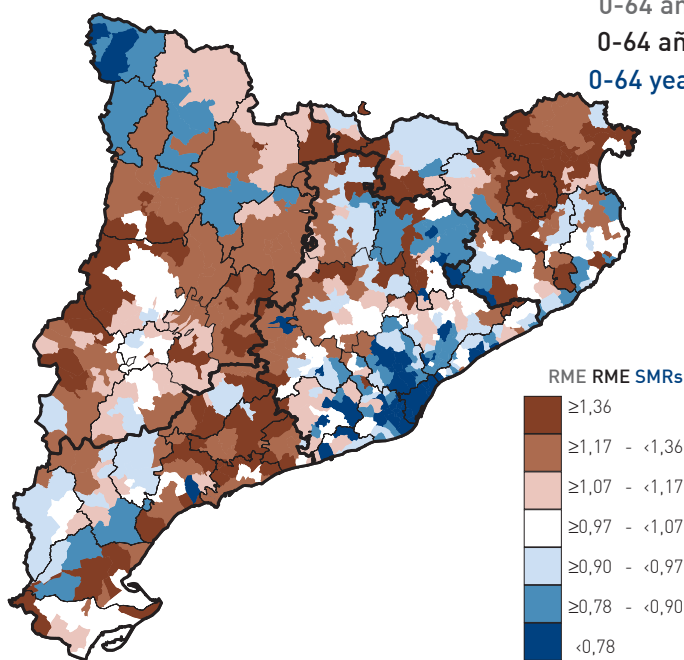
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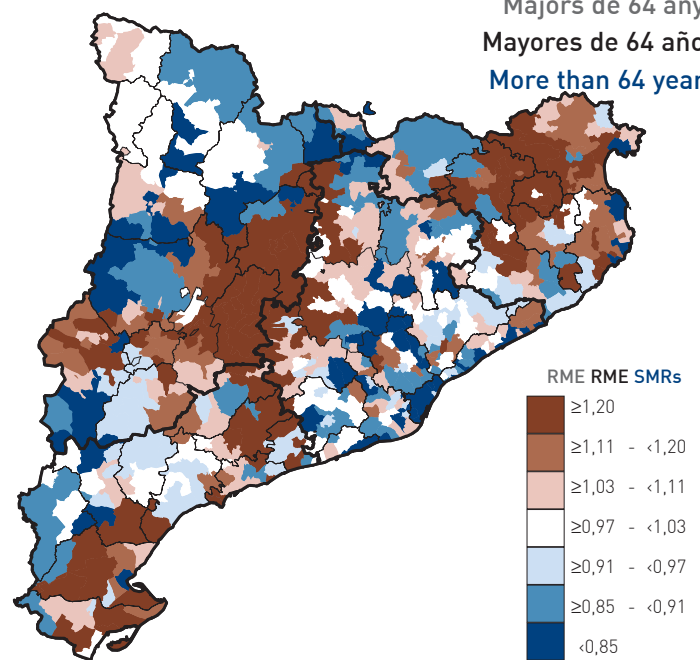
Àrees de Barcelona
 Áreas de Barcelona
 Barcelona areas



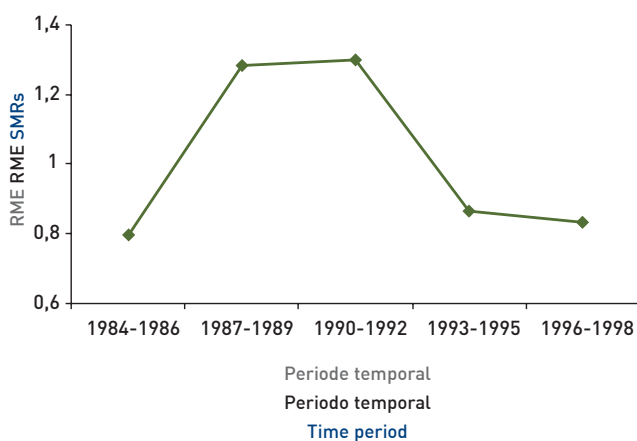
0-64 anys
 0-64 años
 0-64 years



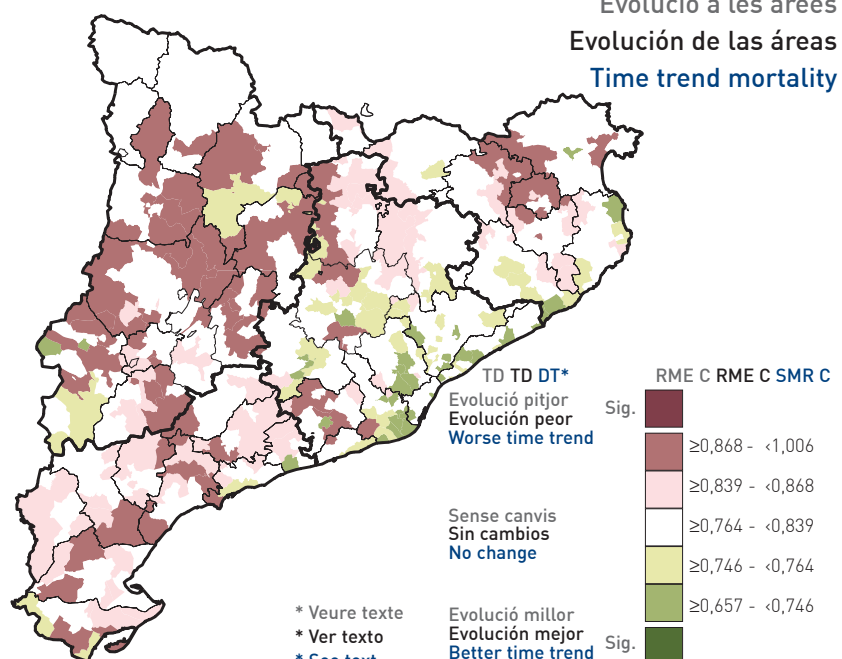
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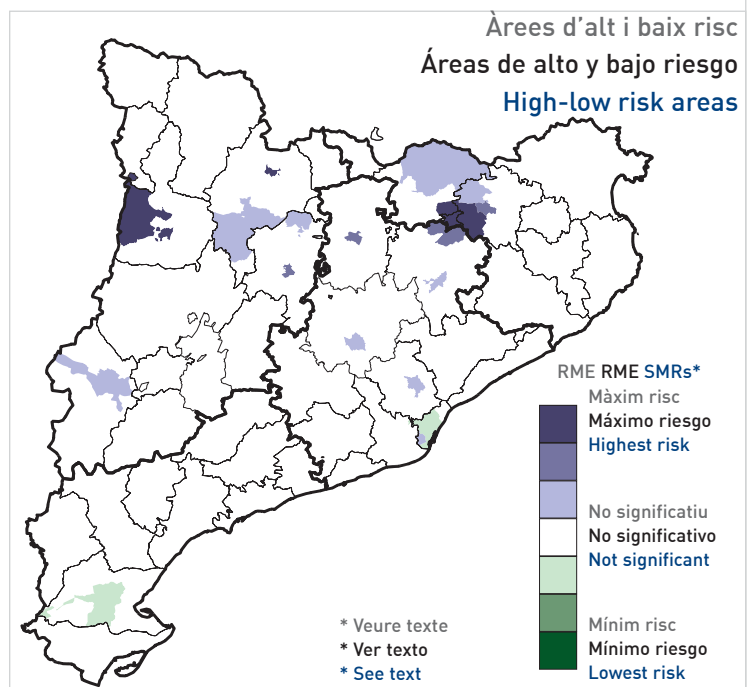
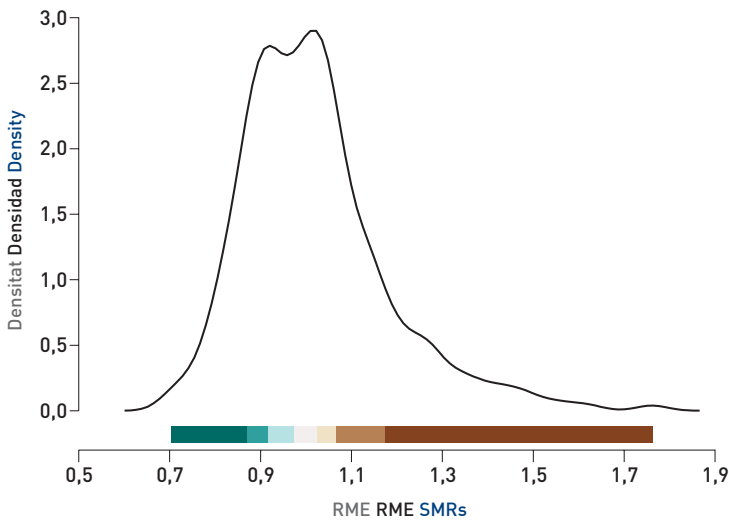
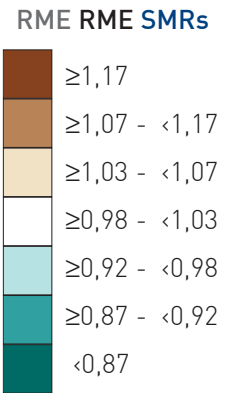
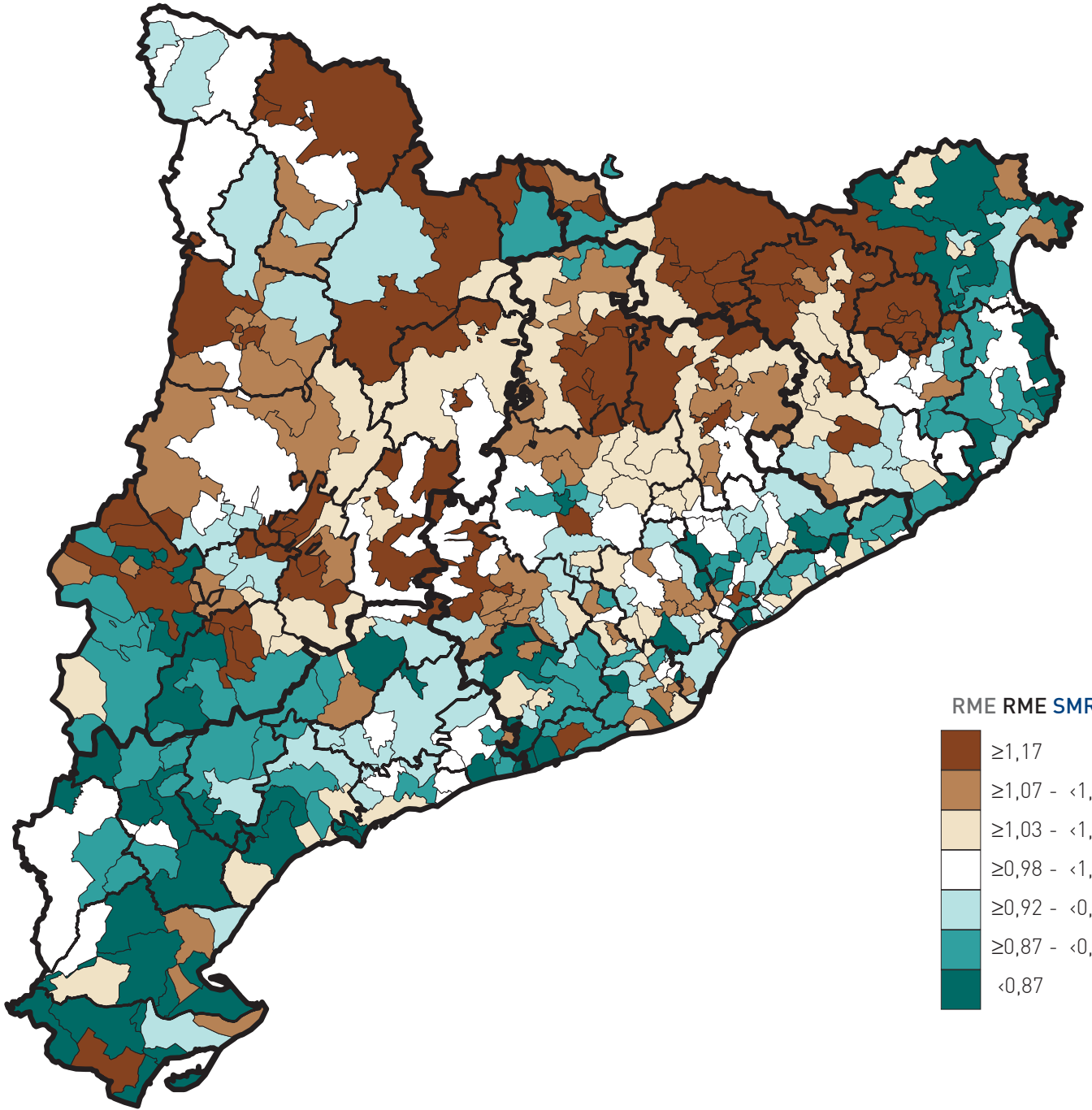


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 Catalonia time trend mortality (1984-1998)

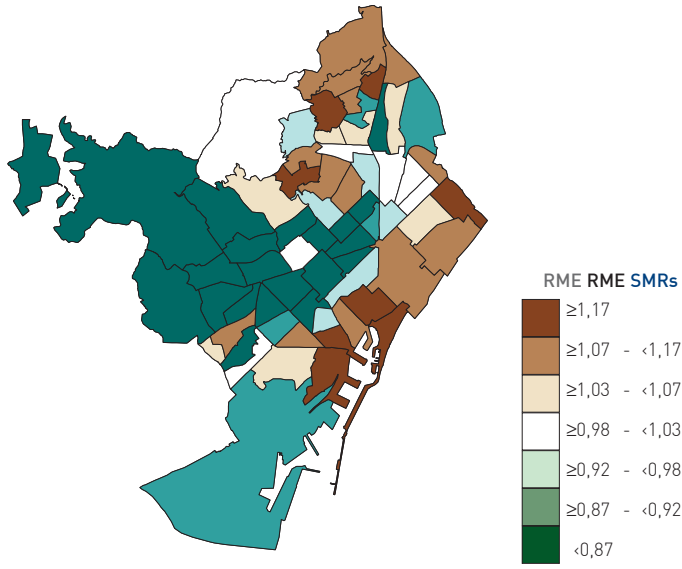


Evolució a les àrees
 Evolución de las áreas
 Time trend mortality

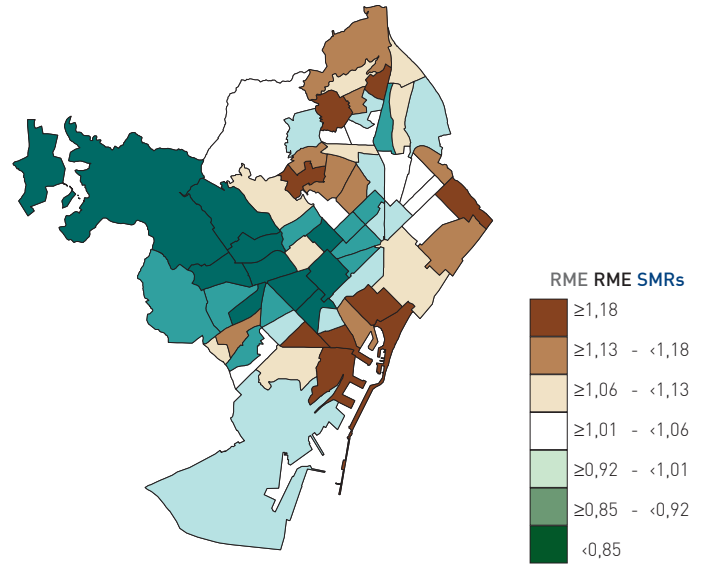




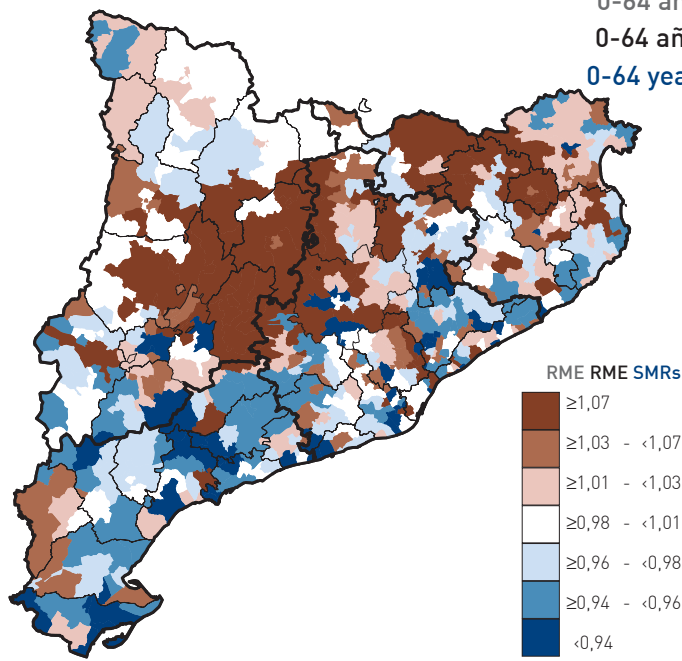
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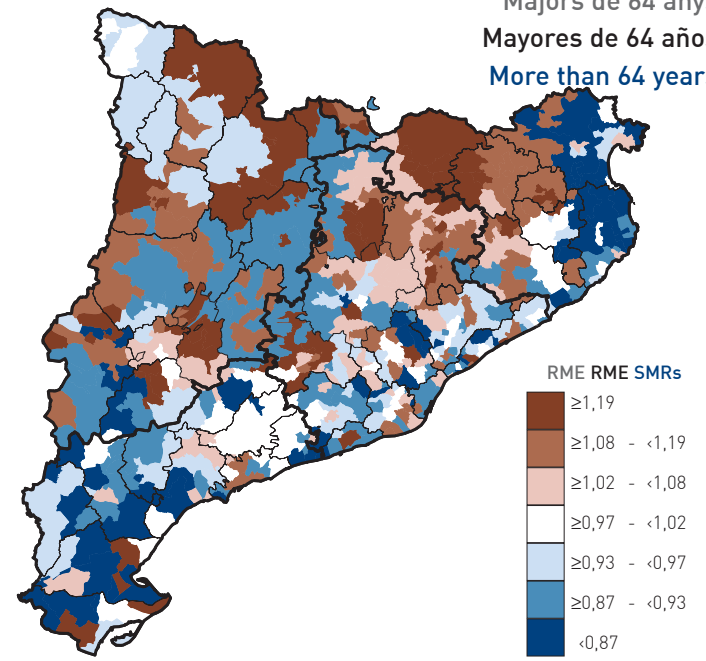
Àrees de Barcelona
 Áreas de Barcelona
 Barcelona areas



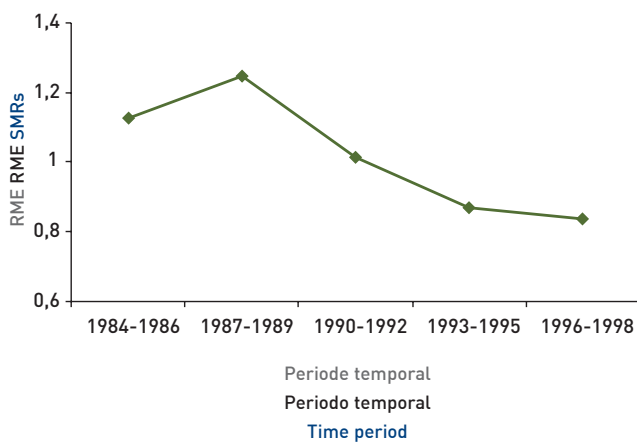
0-64 anys
 0-64 años
 0-64 years



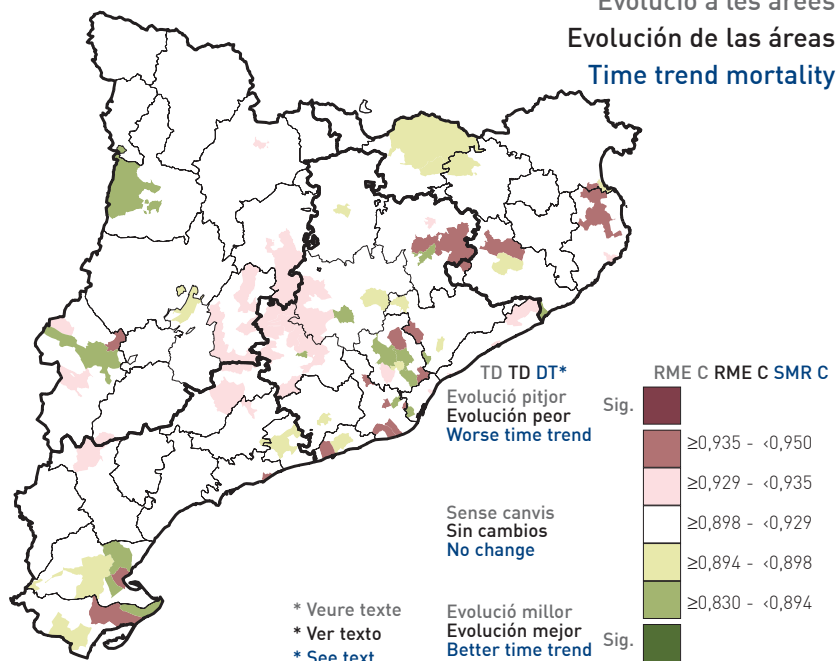
Majors de 64 anys
 Mayores de 64 años
 More than 64 years



Evolució de la mortalitat a Catalunya (1984 -1998)
 Evolución de la mortalidad en Cataluña (1984-1998)
 Catalonia time trend mortality (1984-1998)



Evolució a les àrees
 Evolución de las áreas
 Time trend mortality



6.4 Discussion.

The summarizing of time trends, in a single map, for age adjusted relative risk combining two types of information, is a useful and straightforward tool when there are many periods and causes of death, as is the case for mortality or incidence in Atlases of small areas. This approach may identify more clearly which specific small areas are increasing or decreasing their relative risk during the time period analyzed instead of using several maps corresponding to different instants of time. In addition, the approach based on instants, useful in other settings²²; in general only provides information about the absolute evolution of each area and not about their relative evolution with respect to the global trend of all the areas. Comparison with the global trend is useful for studies of inequalities in health between areas. For example, although all the areas may follow the same evolution of the global trend (decrease or increase) certain areas may decrease or increase at a rate different from that of the global trend of all the areas (see for example Dementia, Alzheimer's disease in women). In addition to the map of mortality time trend in each area, we add a graphic with the trend for Catalonia as a whole. This graphic makes clear the time trend with respect to which we are comparing the evolution of each area.

The proposed design for displaying the different maps on a double-page close to each other; facilitates the comparison between the various maps for time trend, relative risk geographical distribution, and high/low risk maps. This comparison is useful, for example, to detect if the areas where risk increases over the study period are also areas with high risk of mortality.

It should be noted that for breast cancer in women and traffic injuries in men we observed a great change in the evolution of the general trend in Catalonia. These two causes of death both had a trend which was increasing from 1984-1986 up to 1990-1992 and decreasing from 1990-1992 up to 1996-1998. In these cases we only analyzed the evolution of relative risk in each area for the three last time points, i.e. from 1990-1992 up to 1996-1998.

On the other hand, the results obtained have shown the existence of geographical inequalities in age-adjusted relative mortality risk distribution in Barcelona city, a result that emphasizes the importance and utility of including information about small areas with large population in the Atlases. In this Atlas we included this information making two types of comparisons. The first comparison describes the relative risk classification of the 66 PHA of Barcelona city with respect to Catalonia small areas. The second comparison, describes the PHA internally in Barcelona.

The atlas also includes maps of social and demographic factors (not showed). In addition, maps of life expectancy are presented for women and men in two time periods, using an approach consisting of obtaining age-specific mortality rates in each area with a Bayesian perspective as proposed by Congdom¹¹⁹. In our case the age-specific mortality rates in each area were obtained using an empirical Bayes approach.

The use of mortality as a health indicator is justified by its availability and good quality in Spain and Catalonia (see chapter 1). Currently, Catalonia has population based cancer incidence registers in two of the four provinces: Girona and Tarragona. Perhaps in the future, Catalonia may be in a position to produce incidence data for several causes of deaths in all its small areas, something which would permit publication of an incidence Atlas, as has already been done in certain other countries¹²³.

The construction in our previous research^{6,115} of well-defined contiguous small-areas with an appropriate population size and the maximum level of social homogeneity can yield several gains (see appendix A.5). On one hand, it lends stability to health indicators and especially to time trend parameters in each area. On other the hand, it can reduce the potential spatial relation between contiguous small areas, thus more simple or parsimonious statistical models to be fitted, which are more easily interpreted and enjoy faster computational convergence. The model that we proposed can be easily fit using the empirical Bayes approach. Although the empirical Bayes and the fully Bayes approaches provide good approximations to study the geographical distribution of health indicators in small areas, it may be possible that some more difficult models, for example models that allows spatial and temporal correlation, can be fitted more easily through the fully Bayes approach using MCMC methods

Finally, the small areas mortality Atlas of Catalonia and health Atlases in general, are high utility tools that can lead to detection of health inequalities in the distribution and evolution of relative risk between small areas. These results must be used in the planning of public health policies, to establish priority interventions in the areas with worse health indicators and to generate hypotheses about the causes of observed geographical inequalities in order to conduct more accurate studies.