Statistical analyses

Empirical Bayes estimation

To describe age-adjusted relative risk of mortality, standardised mortality ratios (SMRs) are often used. In small area studies, however, the statistical stability of SMRs is an issue of special concern. That is, the SMR for an area with a small population size is subject to a large variability and such highly variable SMRs tend to dominate spatial patterns in disease maps. Therefore, we used a Bayesian estimation method to obtain the relative risk of mortality for each small area and its evolution over the study period (21) (22). In the context of disease mapping, the idea of the bayes method is to "weight" the information in the specific small area of interest; i.e., balancing the mortality data for a given area together with the distribution of mortality data from the rest of the areas and/or a combination of them (areas called neighbor areas). If the area of interest has a small-size population, then the estimation would "borrow strengths" from the information provided by other areas and give a smaller weight to the unstable information of that specific area in estimating the relative risk. On the other hand, if the area of interest has a large-size population, then the estimation would not need to "borrow strengths" and use the stable information of that specific area with a large weight in the estimation. By this weighting of area-specific vs. allarea information, the Bayes method alleviates the aforementioned problem associated with the stability of SMRs and their temporal evolution in small areas.

In order to obtain estimates of the indicators of mortality in the 2,218 small areas of Spain we considered a spacetime model (23) using an empirical Bayesian approach. On the other hand, estimates of the relative risks of mortality in the census units of the cities examined were obtained through the Bayesian hierarchical model proposed by Besag, York and Mollie (24), estimated using Monte Carlo methods based on Markov chains.