Chapter X

Spatial Cluster Analysis for Etiological Research and Identification of Socio-Environmental Risk Factors

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This chapter describes the use of disease clustering methods using diarrheal disease data from a rural area of Bangladesh for which the authors created a household-level GIS database. Understanding distributions of diseases in space and time can be useful for etiologic research and socio-environmental risk factor identification. Disease clustering techniques are not only useful as etiologic research tools for chronic diseases but also for infectious diseases. The magnitude of clustering in different areas can assist with the generation of hypotheses about the underlying socio-environmental causes of the clusters. Once clusters are identified, studies can then focus on the socio-environmental characteristics of the areas where clusters are found.
INTRODUCTION

Understanding distributions of diseases in space and time can be useful for etiologic research and socio-environmental risk factor identification. Disease clustering studies can help detect and monitor potential public health hazards. Investigators must adjust for the spatial variation of the population at risk for a disease when identifying disease clusters. If a population distribution is not controlled for, apparent disease clusters might simply reflect the distribution of the population. The goal of spatial clustering techniques is to distinguish between clusters that are due to chance alone and clusters that are associated with some underlying risk factor. Hjalmars et al. (1996), for example, used a geographic information system (GIS) and a spatial clustering algorithm to identify clusters of childhood leukemia in Sweden. In that country, there is public concern that environmental factors, such as high voltage power lines and nuclear power plants, are responsible for the disease. While anecdotal information might suggest that there is a relationship between environmental factors and childhood leukemia, the investigators found no significant spatial clusters associated with nuclear power plants in Sweden.

Disease clustering techniques are not only useful as etiological research tools for chronic diseases but also for infectious diseases. There will usually be more spatial clustering in infectious diseases than in chronic diseases. The magnitude of clustering in different areas can assist with the generation of hypotheses about the underlying socio-environmental causes of the clusters. Once clusters are identified, studies can then focus on the socio-environmental characteristics of the areas where clusters are found. This chapter describes the use of disease clustering methods using diarrheal disease data from a rural area of Bangladesh for which we created a household-level GIS database.

Several different methodologies have been developed for detecting geographical clusters of health events that are represented as points in space. Most methodologies test for global clustering of events (Alt & Vach, 1991; Besag & Newell, 1991; Cuzick & Edwards, 1990; Diggle & Chetwynd, 1991; Grimson, 1991; Moran, 1950; Ranta et al., 1996; Tango, 1995; Walter, 1994; Whittemore et al., 1987). Global cluster analysis is descriptive in nature, i.e., it (a) either detects the location of clusters but cannot be used for inference or (b) can be used inferentially but cannot be used to identify the location of specific clusters (Kulldorff, 1997). This chapter uses the spatial scan statistic proposed by Kulldorff (1997), which can detect spatial clusters of health events and be used inferentially. Clusters of two types of health events, cholera and cholera-like diarrhea, were identified in Matlab, Bangladesh. Once the clusters were identified using several different local cluster analysis techniques, we developed hypotheses concerning whether or not the ecological niches of the two diseases are the same.
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