A spatially explicit analysis of chronic diseases in small areas: A case study of diabetes in Santiago, Chile

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Abstract

Background There is a strong spatial correlation between demographics and chronic diseases in urban areas. Thus, most of the public policies aimed at improving prevention plans and optimizing the allocation of resources in health networks should be designed specifically for socioeconomic reality of the population. One way to tackle this challenge is by exploring the spatial patterns that link the sociodemographic attributes that characterize a community, its risk of suffering chronic diseases, and its accessibility to treatment at a small area geographical level. Due the inherent complexity of cities, advanced clustering methods are needed to find significant spatial patterns. Our main motivation is to provide stakeholders with valuable information to optimize the spatial distributions of health services and the provision of human resources. For the case study, we chose to investigate diabetes in Santiago, Chile.

Methods To deal with spatiality, we used two advanced statistical techniques: spatial microsimulation and a self-organizing map (SOM). Spatial microsimulation allows spatial disaggregation of health indicators data to a small area level. In turn, SOM unlike classical clustering methods, incorporate a learning component through neural networks, which makes it more appropriate to model complex adaptive systems, such as cities. Thus, while spatial microsimulation generates the data for the analysis, the SOM method finds the relevant socio-economic clusters. As socioeconomic attributes for the clustering we selected age, sex, educational level and per capita income. We used public surveys as input data.

Results Significant spatial patterns of people with low income, low educational level and high diabetes prevalence exhibit a lower density of public health services. This group of people comprises approximately the 62 percent of the whole population of the city and is located toward the periphery of the city.

Conclusions Our approach allowed us to understand that the current criteria for locating the health network would be based primarily on population density and/or the number of people reported with diabetes and only, to a lower extent, on the ability of patients to cope with the disease from a sociodemographic perspective. We recommend that allocation of future health services and
optimization of the current supply chain should take into account the location of the most vulnerable people. Keywords Chronic diseases, spatial microsimulation, self-organizing maps, supply chain optimization

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

SOM map structure (with permission of authors [31]).
Figure 2

Spatial distribution of diabetes auto report.
Figure 3

Spatial distribution of per capita income (with permission of authors [27]).
Figure 4

2D grid output of the SOM method.
Figure 5

Geographical representation of the SOM results.