

An Analysis of Population Health and Urban Proximity in Colombia

Introduction



The foundations of a healthy population are rooted in its public health infrastructure. The upkeep of effective sanitation and water distribution systems are primary examples of how a central government can positively impact the determinants of health of its citizens. Public health infrastructure takes into consideration the role the environment plays in determining the health of the individual. For this reason, urban areas with basic public health infrastructure (water and sewerage) provide an incredibly important service to its constituents. Colombia is an optimal case study for analyzing how proximity to urban centers can impact the health of the public because of its significant socio-economic inequality and stratified development between major cities and rural areas. The internal conflict has left many rural areas isolated from the central government and with limited access to resources. Their vulnerability to health complications is compounded

by a tropical climate that provides the ideal breeding grounds for vector borne diseases, particularly malaria and dengue. Tourism provides an incentive for major cities to continue construction and maintenance of infrastructure while rural areas do not receive the same pressure nor resources from the central government. This analysis aims to evaluate the relationship between public health indicators and proximity to cities and consequently, better understand the impact the built environment has in determining a population's health.

Spatial questions:

How do health outcomes vary across geographic space as seen in the case of Colombia?

What role does proximity to major cities play in determining a population's health?

Methodology

In order to analyze the relationship between population health and urban proximity, various layers representing different indicators of population health were joined to create one raster with classified health scores. Subsequently, a proximity analysis took place using the Spider Web tool.

1. Data Preparation

Data layers were downloaded and projected to the coordinate system, Colombia_Bogota_Zone.

Selected polygon layers displaying health data include Sewerage system coverage, Water system coverage, Hepatitis B vaccination rate, and Infant mortality rate.

2. Conversion of Polygons to Raster Data

Each polygon dataset was classified into 9 classes whose ranges differed per dataset depending upon the values. Polygons were then converted to raster data by using the Polygon to Raster Conversion tool.

3. Creation of Health Score Raster

The resulting raster layers were reclassified using the Reclassify tool and each class was designated a value from 1 to 9 (1 being the worst and represented by yellow and 9 being the best, represented by dark blue). Infant mortality ratings had to be flipped because high infant mortality is an indication of poor health. Using the Raster Calculator, a singular raster was created from overlaying the four existing ones. The values of the new raster ranged from 4 (the lowest, worst potential health value) to 36 (the highest, best potential health outcome).

4. Aggregation of Mean Health Scores by Municipality

Using Zonal Statistics, a mean health score was calculated for each municipality by defining the feature zone data as the municipalities layer and the input raster as the previously generated Health Score raster. The resulting table with mean health scores was joined to the municipalities layer and the resulting aggregation was displayed as the base map for the spider web analysis.

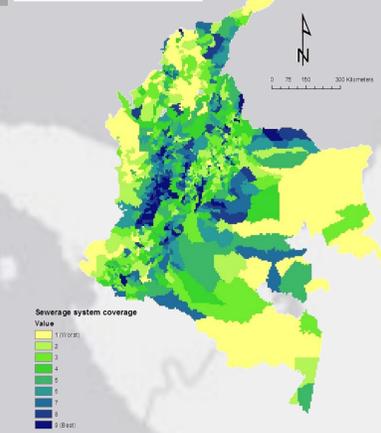
5. Application of Spider Web tool

Centroids were drawn for each municipality using the Feature to Point tool. Caribbean Islands were excluded using Select by Attribute. Using the Near Table, distances were calculated from the municipality centroids to the nearest major city out of five possibilities (the five most populated cities in Colombia). The results of the Near Table were then joined with the municipality centroids and mean health scores so the information was organized and easily accessible. The Spider Web tool was then applied 5 times, connecting each of the five major cities to their nearest municipality centers.

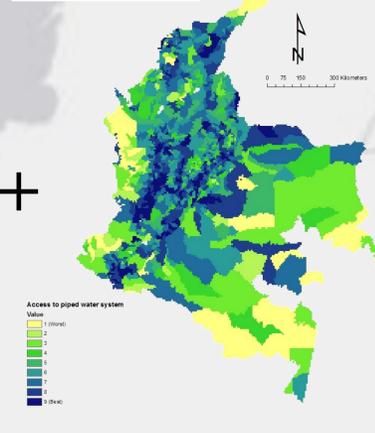
6. Creation of Scatter plot

Using the Merge tool, the 5 spider webs were joined. The resulting layer with distances from each centroid to their nearest city was joined with the mean health scores based on Origin ID and were exported to Excel. A scatter plot was created with the X axis as Distance in meters from the nearest city and the Y axis as Average health score.

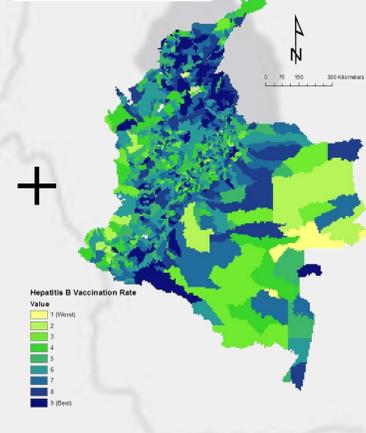
Sewerage System Coverage
Based on percent of population per municipality with home connection to sewerage system



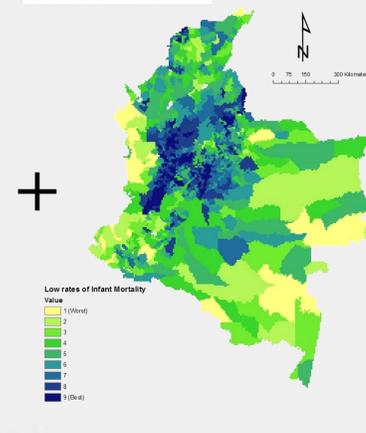
Water System Coverage
Based on percent of population per municipality with direct access to water tap



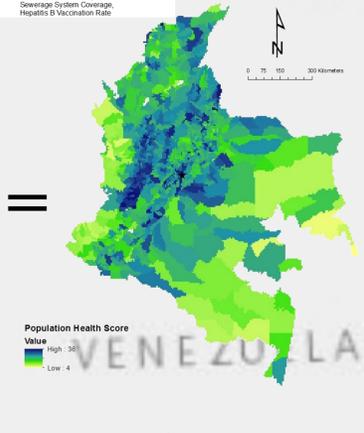
Hepatitis B Vaccination Rate
Based on number of people vaccinated per 1,000 people



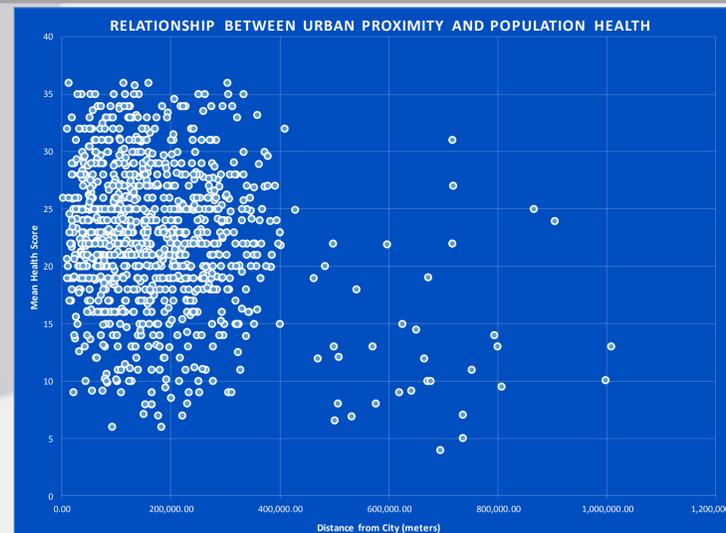
Infant Mortality Rate
Based on number of infant deaths per 1,000 births (Low mortality rate represented by Blue)



Population Health Raster
Infant Mortality Rate, Water System Coverage, Sewerage System Coverage, Hepatitis B Vaccination Rate



Results and Limitations

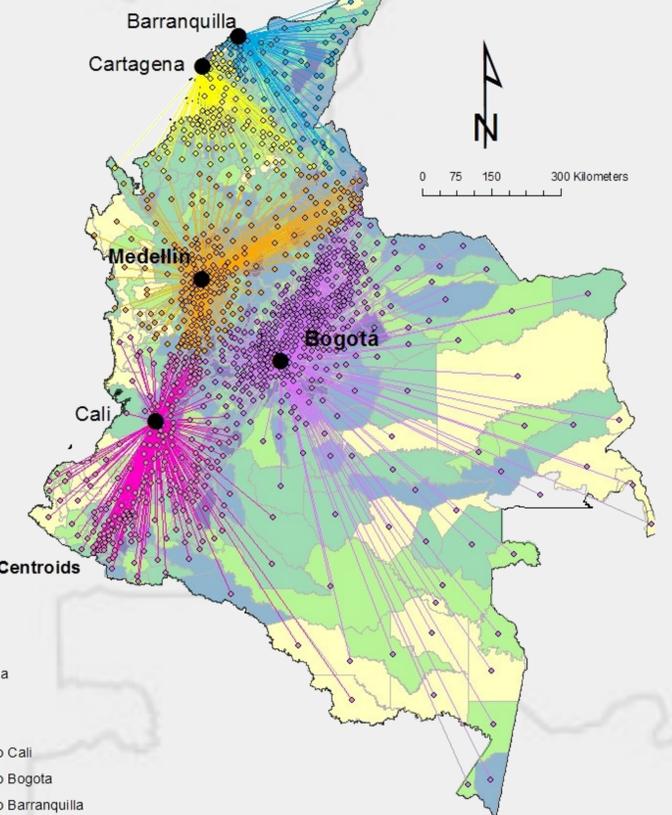


The resulting scatter plot indicates no obvious correlation between distance from nearest city and mean health score, especially amongst municipality centroids that are located within 400,000 meters from a major city. At a distance of 400,000 meters and farther, the majority of the points have a mean health score under 20 (with the highest possible score being 36 and the lowest being 4). The findings may indicate that close proximity to a major city does not have a sizable impact on the population's health outcomes, but a lack of urban proximity corresponds to worse health outcomes.

This analysis has multiple limitations and is particularly restricted by the availability of data. Municipalities were chosen as the basis for distance measurements because it provided the largest quantity of districts for the analysis. Unfortunately, they are not uniform in size, so the larger municipalities which often happened to correspond with greater distance from major cities and low mean health score were underrepresented in the scatter plot. Of the original 1,128 municipalities, only 1,025 were included in the analysis because some of the municipalities were smaller than the resolution of the raster. To give a more holistic representation of health across the country, the Health Score raster would be more complete if it was composed of more than four indicators. The four chosen layers were picked based on their significance as indicators of public health as well as data completeness and type of aggregation. Keeping these factors in mind, the options were limited for complete, current data that was aggregated per municipalities. It would have been ideal to show malaria or dengue incidence per municipality but the data was not aggregated to that level. This analysis is also limited by an inability to control for other confounding factors that influence health, for example climate. The drier and colder climate that occupies Bogota's mountainous surrounding area is less conducive to the spread of tropical diseases and could subsequently reduce the Infant mortality rate of that area. In conclusion, the analysis is limited by multiple factors, but the results indicate that there may be a correlation between lack of urban proximity and poor population health.

Spider Web Proximity Analysis

Municipality Centroid to Nearest City



Sources

Cartographer: Christine Gregory

GIS 102

May 5th, 2015

Projection: Colombia_Bogota_Zone (Meters)

Data collected from M drive: ESRI DataMaps93 and Sistema de Información Geográfica para la Planeación y El Ordenamiento Territorial (SIG-OT), Instituto Geográfico Agustín Codazzi (IGAC),

sigotn.igac.gov.co/sigotn/

