Geospatial Modeling of Asthma Population in Relation to Air Pollution
A Decision Support for Health Administration

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Abstract

Current observations indicate that asthma is growing every year in the United States, specific reasons for this are not well understood. The duty demands increasing research effort to investigate the spatio-temporal behavior of asthma and its relation to air pollution. The association between environmental pollutants such as particulate matter and residential health outcome in Mississippi is explored using Geographic Information Systems (GIS) tools and applications. Health data concerning asthma obtained from Mississippi Department of Health (MSDH) for a 6-year period of 2003-2009, and data of air pollutant concentrations collected from USEPA web resources, are analyzed and assessed to establish the impact of air pollution on human health specifically related to asthma. Disease mapping using geospatial techniques provides valuable insight into the spatial nature, variability, and association of asthma to air pollution. Asthma patient hospitalization data of Mississippi has been analyzed and assessed using quantitative Choropleth techniques in ArcGIS. Potential air pollutants sources like interstate highways, industries, and land use data have been integrated with common geospatial platform to understand their adverse contribution on human health. Existing hospitals and emergency clinics are being injected into analysis to further understand their proximity and easy access to patient locations. At the current level of analysis and understanding, spatial distribution of Asthma is observed in the populations of Zip code regions in gulf coast, along the interstates of south, and in counties of Northeast Mississippi. It is also found that asthma is prevalent in most of the urban population. The GIS-based project would be useful to make health risk assessment and provide information support to the administrators and decision makers for establishing satellite clinics in future.

Introduction

1. Asthma is an economic and health problem, it’s an expensive disease. According to the United States $65 billion each year (CDC, 2009).
2. It is a chronic respiratory disease that affects more than 25 million people in the United States.
3. A GIS-based research conducted by Rob., 2003 has found that there is a good correlation between Asthma and poverty, they also found that the region with higher prevalence of Asthma than those in rural regions.
4. Foody, 2006 has published that the long term pollution of disease is still prevalent, which is significant to plan and provide health care needs to a cluster of diseases population, also find that time and place are important dimensions for health GIS studies.
5. Relationships between Disease and Environmental Factors A critical review on pollution and health GIS, 2003 concludes that establishing associations between disease rates and exposure to environmental hazards is a new emphasis in GIS and spatial analysis of health data.
6. Al-Hamdani et al., 2009 has estimated daily PM₂.₅ levels combining both Moderate Resolution Imaging Spectroradiometer (MODIS) and Environmental Protection Agency (EPA) ground data.

Main objectives for this research were: (1) Identify the Asthma disease spatial clusters, (2) Geographically pinpoint areas of high risk, (3) Comparison of number of patients are over served or underserved, (4) Investigate the composition between poverty and population health, where each percent increase in air pollution lead to what percent increase in hospitalization.

Future Work

1. Identify seasonal patterns in pollution and hospital admissions.
2. Establish a quantitative relationship between PM₂.₅ and Asthma related hospitalizations.
3. Find the underserved and over served clusters of diseased population.
4. Use remotely sensed data (MODIS AOD) to fill the gaps between ground monitors, and estimate the accurate levels of pollutant over study region.
5. Relationships between Disease and Environmental Factors: A critical review on public health and GIS, Rushton, 2003 concludes that establishing relationships between disease rates and exposures to environmental factors is an area of increased interest in GIS and spatial analysis of health data.
6. Al-Hamdani et al., 2009 Methods for characterizing fine particulate matter using ground observations and remotely sensed data.

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