Lead poisoning is one of the top environmental health threats to children. Despite conclusive evidence regarding the harmful health effects of childhood lead exposure, lead poisoning remains a significant public health problem. The “Healthy People 2020” goal includes the elimination of blood levels > 10µg/dL.

Over time, exposure to even low levels of lead can affect a child's growth, behavior, and learning ability. Children under five years of age are particularly vulnerable to lead poisoning. Due to the tremendous social costs lead exposure poses to society, it is of prime importance to accurately identify high risk regions to focus testing and cleanup efforts. Boston has been identified as a high-risk area for lead exposure combined with low income and high density of children with lead exposure risk. Thus, it is of prime importance to accurately identify high risk regions to focus testing and cleanup efforts.

Lead is a persistent, bioaccumulative, and toxic metal. Predominantly, the primary sources of lead pollution were: lead paint in homes and through automobile emissions. Children who live in pre-1979 housing (the law banning the use of lead paint was passed in 1978) are more likely to be exposed to lead. Moreover, children living at or below the poverty line are at a significantly elevated risk of lead exposure. This project focuses on identifying high risk areas of lead exposure in Boston city. In this analysis, I estimated cumulative lead exposure in Boston. Additionally, I compared median income and density of children with the lead exposure risk to identify vulnerable areas in Boston.

Spatial Questions

- What is the collective risk of old paint lead, gasoline-lead deposits from gas stations and major roadways in Boston?
- How does high risk areas for lead exposure rank across density of children per square mile?
- How do the collective lead exposure coincides with the income disparities in Boston?
- Which Boston census tracts are highly vulnerable because of high lead exposure combined with low income and high density of children?

Methodology

I used age of home, proximity to major roads and high density of gas station as the risk variables. Parcel information was obtained from City of Boston to analyze the year the house was built and remodeled. The year the house was built is important to the risk analysis as lead was allowed in household paint until 1978 and 78% of Massachusetts homes were built before 1978. House built, and remodeled year was reclassified by three categories: before 1950, 1950-1978, after 1978. As lead used to be allowed in gasoline, density of gas stations was analyzed using the kernel density tool, where areas of high gas station density were considered high risk. As leaded gasoline was only phased out in the 1970s and still remains in the soil near the roads. Therefore, the proximity to major roadways was analyzed using Euclidean distance. All factors were reclassified into three classes. By using the raster calculator, these measures were combined to create a “high risk to lead exposure” map. The risk analysis was completed with the variables weighted at 50% for housing year, 25% for proximity to major roads, and 25% for gas station density. A child density raster was created based on census block data using zonal statics as study shows that children from poor household are more exposed to lead. Finally the child density with risk exposure map were compared with the house hold median income map (census tract) by using zonal statistics as study shows that children from poor household are more exposed to lead. This map showed the highly vulnerable areas of high lead exposure combined with low income and high density of children.

Result and Discussion

The study demonstrated how the risk factors contribute to a holistic risk analysis of lead exposure in Boston. The results suggest that a moderate percentage of Boston is at high risk to lead exposure. The matrix raster highlighted areas of high risk to lead exposure in relation to child density. High child density and high lead exposure areas included parts of Dorchester, Hyde Park, West Roxbury, Mattapan, and East Boston. Furthermore, I found the regions with highest risk of lead exposure were commonly low income neighborhoods. No high density-high risk zones were present in the highest income areas.

Constraints on this project rose from no public access to lead incidence data and very limited lead exposure data.

Source and References