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Comparing spatial distributions of infant mortality over time: Investigating the urban environment of Baltimore, Maryland in 1880 and 1920

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ABSTRACT

Infant mortality is a sensitive indicator of urban environmental conditions, and investigating the geography of such an indicator provides insight into variables affecting public health in urban North America in 1880 and 1920. Geographic information systems (GIS) and spatial analysis now provide a means by which to view past infant mortality distributions from a new perspective, one not available at the time. This study makes use of data collected from the 1880 and 1920 Vital Statistics Death Records for Baltimore, Maryland - mapping each infant death to his or her place of residence. Previous work with the 1880 data indicates an uneven distribution of infant deaths with some degree of spatial clustering. The current study takes these findings a step further through the use of the local spatial autocorrelation statistic, Gi*, to identify the locations of clusters in one or both years. The aim of the comparison is to determine whether the location of infant mortality clusters remained the same over time indicating persistent environmental, and possibly demographic, challenges in certain neighborhoods. The data indicated hotspots of infant mortality in both years with persistence in the Fells Point area of Baltimore. The significant clusters appeared in neighborhoods with large African American and/or immigrant populations in both years. The hotspots in the primarily African American neighborhood were only significant in 1880 despite presenting some intriguing questions about what caused such a change, particular when the population in that part of the city did not change. This work offers insights into the spatial distribution of infant mortality in the past and clues regarding which parts of the city need additional investigation to better understand their social and environmental characteristics.

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1. Introduction

Whether considering the past or the present, infant mortality provides a sensitive indicator of urban environmental conditions. While it is difficult to identify the precise variable(s) that sustained late nineteenth century rates around 25 percent of live births, examining the geography of infant deaths provides an opportunity to explore those urban neighborhoods that might have experienced particularly high infant mortality rates and poor environmental conditions. Between 1880 and 1920 North American cities went through the epidemiological transition resulting in the majority of deaths coming from chronic ailments rather than infectious diseases like typhoid fever (Elman & Myers, 1999). While the entire population benefitted from a reduction in mortality rates, infant mortality rates declined dramatically during this time period. In Baltimore, Maryland, the infant mortality rate in 1880 was 250 infant deaths per 1000 live births. This rate decreased to 90 deaths per 1000 live births by 1920. While a single trigger of declining rates may never fully be teased apart from other related variables, or the causes may have varied from place to place, it is possible to compare the locations of infant deaths as a means of identifying places with potentially less salubrious conditions as a means of peeking into past environmental conditions. This is particularly true if there are statistically significant clusters of infant mortality providing a focal point or points rather than an entire city to investigate. Even more intriguing would be if clusters in 1880 persist in 1920.

Knowledge gained about the correlations between infant mortality and local conditions has implications for how to investigate modern spaces for interventions relating to infant mortality and infant health. Frequently there is a lack of public health data,

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particularly local level geographic data, in the urban Global South. While current data and data specific to locations in the developing world would be best for understanding the ongoing high rates of infant mortality, historical datasets marking the beginning and end of the North American epidemiological transition provide an opportunity to explore a potentially comparable scenario with a complete dataset. Scholars of urban public health in the developing world highlight the need for consistent data collection in order to begin to resolve negative health outcomes (Konteh 2009). Additionally, Harpham (2009) emphasizes the need to better define "community" in low-income urban settings. One approach to identifying communities in need can be to work with individual level data, such as the infant mortality data in this paper, in combination with spatial statistics in order to locate areas facing a specific public health problem. The challenge of consistent and reliable collection of data relating to vital events such as births and deaths is raised by both Harpham (2009) and Konteh (2009). Therefore, the current study seeks not only to better understand the geography of infant mortality in a 19th century American city, but also to begin to explore what aspects of vital event data for infants is most useful for understanding drivers behind geographic patterns of infant deaths and finally to suggest an alternative means of defining a community or neighborhood that is neither dependent on official boundaries nor local qualitative information.

The study of historical infant mortality patterns, decline, and the variables contributing to increased risk of early death present a fascinating puzzle. As with all areas of study the answers produced are dependent upon the particular the study framing (Gregory, 2008; Woods, Watterson, & Woodward, 1988). The current study draws on two related and connected lines of inquiry, both of which relate to our understanding of infant mortality in the late nineteenth and early twentieth centuries. The first are those scholars considering the macro scale trends of where within a country did infant mortality rates decline first and/or at what speed (Gregory, 2008; Preston & Haines, 1991; Woods et al., 1988). The second line of inquiry looks within a localized area at which variables played the most important role in reducing an infant's chances of survival (Williams, 1992; Haines, 1995; Thornton & Olson, 2001, 2011). Within the latter group the findings can be organized into socio-economic drivers, cultural group/ethnic identity, or environmental conditions. Where these three sets of variables become problematic is that they are intertwined. Socio-economic status will have an impact on the housing quality and thus access to clean drinking water, for example (Rochester, 1923; Williams, 1992). In the most conclusive studies of the role of culture in infant mortality, the socio-economic status of certain cultural groups was somewhat determined by other societal attitudes of the time in terms of types of employment (Thornton & Olson, 2001, 2011). Thornton and Olson (2001) discuss ideas along these lines in Montreal for the same time period. They found a distinct improvement or detriment, depending, in survival of infants regardless of ethnic group depending upon which ethnic group dominated a given street. For example, while French Canadian infants in Montreal regardless of the family's socio-economic status had reduced chances of survival. Yet, if the family lived in an area of mostly Irish Catholics the French Canadian infant had an increased chance of surviving the first year.

Previous work with the Baltimore, Maryland data from 1880 presented here sought to further investigate the connection between infant mortality and the environment by exploring relationships with proximity to of industrial land use. While the results indicated no correlation between land use and infant mortality, there did appear to be some connections between residential location and proximity to the waterfront. Additionally, questions related to housing density (rather than population density) surfaced (Author).

It should be noted that as health overall improved during this period and both the improvement for infant health as well as the rest of the population was at least partly connected to infrastructure/environmental changes as well as changes in medical knowledge. As the body of literature specific to historical infant mortality is small and some reference to general mortality literature where appropriate broadens the foundation of this work. First and most importantly is the role of city-wide infrastructure improvements, particularly that of clean drinking water producing a reduction in infant and child mortality from water-borne diseases. What is interesting according to Ferrie and Troesken (2008) though is that the overall impact of a clean water supply had variable results depending upon city. The implication is that within a city a variable geography of improvement could also have existed. Environmental conditions and their relationship with historical infant mortality are difficult to illustrate, particularly in a detailed way that may shed light on nuances of causality. When working with aggregated data, correlations tend to be weak (Condran & Crimmins-Gardner, 1978). Alternatively, it is laborious to work with individual level data. The difficulties of using infant death data pale when faced with finding detailed and specific environmental data at the same scale. For example, a city might build and complete a sewerage system, but this does not mean all households acquire connections to the service and records of these connections tend to be limited (Colten, 2002).

Therefore, the purpose of this study is first to determine if there is a spatial clustering pattern among infant deaths in Baltimore in 1880 and in 1920. Second, to identify if there are areas of the city in which infant mortality clustered in both 1880 and 1920 which could indicate persistent environmental disamenities and persistent poverty. By identifying such areas it is easier to then investigate the particular characteristics of those parts of the city rather than the entire city. Finally, as Baltimore was a border city between the north and south there are opportunities to examine racial differences in infant mortality patterns between the two years. The two years investigated represent, in general, the beginning and end of the epidemiological transition in North American cities and they are also census years so that future research could utilize data from the enumeration schedules.

2. Study area: Baltimore, Maryland

Baltimore, Maryland (39.2904° N, 76.6122° W) is just one example of a North American city undergoing the typical processes of urbanization and industrialization in the late nineteenth and early twentieth centuries. Yet there are a number of features in the city's history that lend this location to being particularly good for a geographic study of infant mortality at the individual level. First, as a border city between the north and south, Baltimore has a long history of African Americans and whites living in close proximity to each other. Following the Civil War, the implications of this history and the subsequent northward migration of blacks from the rural south resulted in 16 percent of the city's residents bring black in 1880 (Groves & Muller, 1975). In the study of infant mortality the racial differences in the city along with the socio-economic implications could result in identification particular of geographies.

Not only does Baltimore have a particular historical story of African American migration that predates the Great Migration of southern blacks to northern cities following World War I, but it is also a destination port city for migrants from Europe in a process that began to increase in numbers with the Irish Famine of the 1840s along with German immigration in the same decades. While not the same degree of destination for immigrants as New York or Boston, Baltimore played a notable role in this part of American history. Spatially the result of immigration to Baltimore was the

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