SPATIAL PERSPECTIVES OF INFANT HEALTH CARE DELIVERY IN HILLSBOROUGH COUNTY, FLORIDA

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Introduction

The purpose of the study is to explore the causes of Hillsborough County's relatively high infant mortality rate and how the rate might be lowered. Specifically, the purpose is to: 1) examine the location of the infant health care facilities in Hillsborough County; 2) identify the infant mortality rate (deaths under one year of life) and the postneonatal mortality rate (deaths from twenty-eight days through 365 days of life) by census tract; 3) rank the census tracts by socioeconomic level; and 4) compare the relationship between the location of infant health care facilities, infant death rates, and census tract socioeconomic status.

The infant mortality rate has long been considered one of the most reliable indexes of the general health of a population (1). Whenever a change occurs in the standard of living in a nation, that change will be reflected with a change in the number of infant deaths. Infant mortality is also a sensitive barometer of the availability and effectiveness of certain types of social and medical services (2). Insufficient medical and health services, along with under-utilization of existing services, contribute to excessive infant mortality levels (3). Existing medical techniques and knowledge, if applied properly, could prevent most causes of infant deaths in the United States (4).

The infant mortality rate in Hillsborough County from 1971-1973 averaged 20.4 infant deaths per 1,000 live births (5). Meanwhile, over the same period of time, the state of Florida averaged 19.4 infant deaths per 1,000 live births (6). Although Hillsborough County's infant mortality rate may not be cause for alarm, it is above the state average and is considered unnecessary in light of existing medical knowledge.

Infant Health Care Facilities

Infant health care delivery in Hillsborough County is achieved through a combination of public and private infant health care facilities. A variety of local, state, and federal governmental agencies are involved in the implementation of infant health care. The scope of this section will be: 1) the identification of the available types of infant health care facilities; 2) the location of the various infant health care facilities; and 3) the means of transportation servicing the facilities.

Types and Location of Facilities

The location of infant health care facilities is an important factor in determining the patterns and frequency of neonatal and postneonatal care because of people's inclination to obtain medical treatment close to home. Hillsborough County, for the purpose of this study, is served by hospitals, health clinics, and private pediatric physicians.
There are seven hospitals in Hillsborough County that provide medical treatment for infants. Out of the total, four are within the city limits of Tampa; two are in the unincorporated area of the county, just outside the city limits of Tampa; and one is in Plant City, in the eastern part of Hillsborough County (7). Five health clinics provide medical treatment for infants, three within the city limits of Tampa, and one each in both the unincorporated area of Hillsborough County and Plant City (8).

The thirty-nine pediatricians in Hillsborough County are located in clusters with other pediatricians (9). Most notable is their location near large, new hospitals. Pediatricians are found at eleven locations in Tampa. However, five of the offices are groups of four or more pediatric clusters representing 81% of the pediatricians in Tampa, and 33% are clustered around St. Joseph's Hospital. There are four clusters of pediatricians in the unincorporated area, all in groups of four or more. Significantly, 65% are located around the University Community Hospital and the University of South Florida Medical School in the northern part of the county. Eight pediatricians are in Temple Terrace. Since Temple Terrace covers a rather small geographic area, the occurrence of the pediatricians in one location is of little significance. Only one pediatrician is available in Plant City to meet the needs of the city residents as well as those of the residents of eastern Hillsborough County.

Methods of Transportation

The residents of Hillsborough County have limited methods of transportation available for reaching infant health care facilities. The private automobile is the most frequently used form; however, many families in Hillsborough County are without automobiles because of financial reasons. The only bus service available is provided by the City of Tampa. Bus service is not available at all hours, but it is possible to reach five of the seven hospitals during the regular operating times. Of the five health clinics, only one is located adjacent to public bus transportation. Fifty percent of the county pediatricians can be reached by bus, but the remainder are not situated on bus routes. Commercial taxicab service is available throughout all areas of the county.

A small number of infant patients are transported to health care facilities, mostly hospitals, by means of the county ambulance service. However, the number is quite insignificant and probably has very little influence on the county's infant death rate (10).

Infant Death Rates

Many methods are employed for calculating infant mortality rate. Usually it is based on the number of infant deaths (under one year of age) per number of recorded live births. Infant mortality rates, calculated in this manner, are an accepted method of measurement of the health care facilities in a community (11). Two types of infant death rates are used in this section. The infant mortality rate is the number of infant deaths under one year of life, by place of residence, per 1,000 of live births. The postneonatal mortality rate is the number of infant deaths from twenty-eight days through 365 days of life, by place of residence, per 1,000 of live births.
Fig. 1. Spatial Distribution of Infant Health Care Facilities and Tampa Census Tracts Ranked by Socioeconomic and Infant Death Rate.
Fig. 2. Spatial Distribution of Infant Health Care Facilities and Hillsborough County Census Tracts Ranked by Socioeconomic Score and Infant Death Rate.

- Low Socioeconomic Score, High Infant and Postneonatal Mortality Rate.
- Low Socioeconomic Score, Low Infant and Postneonatal Mortality Rate.
- High Socioeconomic Score, Low Infant and Postneonatal Mortality Rate.
- High Socioeconomic Score, High Infant and Postneonatal Mortality Rate.
Infant Mortality Rates

The average infant mortality rate for Hillsborough County during the years 1971-1973 was 20.4 deaths per 1,000 live births. While this figure is slightly higher than the Florida average of 19.4 during the same time period, there is no cause for immediate alarm. However, when the infant mortality rate for each individual census tract in Hillsborough County is examined, it is evident that in some areas the rates are exceptionally high (12). It must be noted, however, that if an infant mortality rate is calculated on less than 100 live births, the results are of limited significance (13). Of the 114 census tracts in Hillsborough County, only fifteen had over 100 live births for each of the three years from 1971-1973. Using the three-year county average infant mortality rate (20.4) as a standard of measurement, it was concluded that ten of the census tracts had an infant death rate higher than the county as a whole.

The spatial distribution of infant mortality rates in Hillsborough County reveals a significant pattern. A cluster of census tracts with above average infant mortality rates is located in the center of the county. Other tracts with above average infant mortality rates are located in the western, eastern, and southern sections of Hillsborough County. There are no tracts in northern Hillsborough County with above average infant mortality rates, and no census tracts with below average infant mortality rates are located within the city of Tampa. The five tracts with infant mortality rates below the average are all located in the unincorporated areas of the county.

Postneonatal Mortality Rates

The average postneonatal mortality rate in Hillsborough County during the years 1971-1973 was 5.4 deaths per 1,000 live births. This figure is slightly above the Florida average of 5.3 for the same time period. A closer look at the figures by census tract reveals that the postneonatal mortality rate in some areas is unusually high (14). Again, it must be noted that in all cases where the postneonatal mortality rates were extraordinarily high, there were less than 100 live births on which to base the rates, so they are of limited significance.

Only the fifteen census tracts which recorded a live birth rate in excess of 100 from 1971-1973 were considered for analysis. The measurement used in this case was the three-year county average postneonatal mortality rate (5.4). Only five census tracts displayed postneonatal death rates higher than the county average using this criterion.

The cluster of census tracts in the center of the county with above average infant mortality rates is reduced substantially when only the post-neonatal mortality rates are considered. Tracts with high postneonatal mortality rates are found mostly in the eastern and southern section of Hillsborough County. There are no tracts in northern or western Hillsborough County with above average postneonatal mortality rates. All of the tracts with below average postneonatal mortality rates are found in the center and in the western portion of the county.
Socioeconomic Factors

The social, economic, and cultural status of the family has a direct influence on infant death rates. In general, there is an inverse relationship between socioeconomic status and infant mortality rate. The postneonatal period is greatly influenced, however, by environmental conditions. Many distinct socioeconomic factors in the environment influence the rate of infant death. Therefore, the scope of this section is to establish a hierarchy of Hillsborough County's census tracts based upon socioeconomic status.

Census tracts were assigned a standardized socioeconomic score based upon the method described by Donabedian, Rosenfeld, and Southern (15). Using data from the 1970 census (16), calculations were made based upon: 1) the median income of families and unrelated persons; 2) the percentage of persons twenty-five years of age or older who graduated from high school; and 3) the percentage of persons employed in the workforce sixteen years of age or older who were professionals, technicians, managers, officials, administrators, or proprietors.

The census tracts' standardized scores were calculated using the following formula:

\[ \text{STANDARDIZED SCORE} = \frac{Cv - Lv}{Hv - Lv} \times 100 \]

with \( Cv \) representing the median value of the tract and \( Hv \) and \( Lv \) representing the highest and lowest median values among 113 of the 114 census tracts in Hillsborough County. (The University of South Florida is represented by its own census tract; this tract is clearly atypical in all regards, and was omitted from the analysis.) The income, education, and occupational scores were calculated by this method, and the scores for each of the three variables were averaged to obtain a combined socioeconomic status score for each tract in the county. These scores ranged from a low of 2.62 for tract 40 and a high of 96.52 for tract 59. The average score was 38.18; some 56.6% of the tracts in Hillsborough County fell below the average.

In terms of location, census tracts with above average socioeconomic scores are found in the northwestern section of Hillsborough County, in the southwestern section of Tampa, and in the central part of the county where middle and higher income housing developments are found. The census tracts which rank below the county average are in two sections. Most noticeable is eastern Hillsborough County where, except for tract 128 in Plant City, all the tracts are below average. The other significant area is in east Tampa, extending southeast into the unincorporated area of Hillsborough County. These areas are mostly rural with lower income housing.

Relationship of Infant Health Care Facilities, Infant Death Rates, and Socioeconomic Status

The fifteen census tracts which recorded 100 or more live births for each of the years between 1971-1973 were ranked according to their socioeconomic standardized score (Table 1). Of these, the six lowest and the six highest were selected for comparison with infant death rates. The results show that infant death rate decreases as socioeconomic level increases.
Table 1

Comparison of Infant and Postneonatal Mortality Rates in Census Tracts (Registering over 100 Live Births) with Six Lowest and Six Highest Socioeconomic Scores: Hillsborough County, 1971-1973

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>Standardized Socioeconomic Score</th>
<th>Infant Mortality Rate (1971-73)</th>
<th>Postneonatal Mortality Rate (1971-73)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>15.32</td>
<td>26.436</td>
<td>8.743</td>
</tr>
<tr>
<td>124</td>
<td>24.63</td>
<td>10.340</td>
<td>0.000</td>
</tr>
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<td>10</td>
<td>29.62</td>
<td>26.816</td>
<td>3.420</td>
</tr>
<tr>
<td>141</td>
<td>30.33</td>
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<td>12.543</td>
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<td>130</td>
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<td>29.920</td>
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</tr>
<tr>
<td>116</td>
<td>57.75</td>
<td>19.313</td>
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</tr>
<tr>
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<td>63.01</td>
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</tr>
<tr>
<td>123</td>
<td>64.51</td>
<td>10.910</td>
<td>4.406</td>
</tr>
<tr>
<td>113</td>
<td>95.46</td>
<td>12.860</td>
<td>2.506</td>
</tr>
</tbody>
</table>

Census tract 34, with the lowest socioeconomic score (59.8% below the county average), records an infant mortality rate which is 29% above the average. The postneonatal mortality rate, a factor which is extremely sensitive to the socioeconomic condition, is 8.7, or 61% above the average of 5.4 for Hillsborough County.

By comparison, census tract 113 which has the highest socioeconomic score (150% above the county average), records an infant mortality rate 36.8% below the average. The postneonatal mortality rate is 53.9% below the postneonatal mortality rate of 5.4 for the county.

It is important to note that even though the socioeconomic score of tract 113 is 150% above the average score for the county, the infant and postneonatal mortality rates do not reflect a comparable percentage of decrease. There is a point at which the socioeconomic level of the family overcomes the disadvantages connected with low socioeconomic status, and above which, an increase in socioeconomic status does not result in a further decrease in the infant death rate. However, as the socioeconomic level decreases the infant death rate generally increases substantially.

Similar results obtain using the averages of the six highest and lowest tracts. The average socioeconomic score of the lowest six is 27.88 (26.9% below the county average); the mean infant mortality rate of this group is 23.75 (16.3% above the county average), and the mean postneonatal mortality
rate is 6.72 (23.9% above the county average). The six highest tracks show a mean socioeconomic score of 63.5 (66.4% above the county average), and the mean infant and postneonatal mortality scores are respectively 15.99 (21.6% below) and 3.17 (41.5% below the county average).

These figures clearly indicate that socioeconomic status has a greater impact on postneonatal mortality rates than on overall infant mortality rates. Among the six census tracts with the highest socioeconomic scores, the reduction in postneonatal mortality rates are nearly double that of the infant mortality rates.

An examination of spatial distribution of the six lowest and six highest socioeconomic scoring census tracts with the corresponding infant and postneonatal mortality rates reveals several distinct patterns (Figs. 1 and 2). The census tracts with low socioeconomic scores, and high infant and postneonatal mortality rates, are located in the eastern part of Hillsborough County. The only exception is census tract 34, which is located in east Tampa. The census tracts with above average socioeconomic scores, and below average infant and postneonatal mortality rates, are located in the northwest section of Hillsborough County. The one exception is tract 125 located in the center of the county. There are no census tracts with above average socioeconomic scores, and below average infant death rates located within the city limits of Tampa; although such tracts were located just outside the city limits.

The influence of infant health care facilities on the infant death rate is dependent upon complex socioeconomic influences. The presence or absence of a hospital, health clinic, or pediatrician in a census tract does not automatically increase or decrease the infant mortality rate in that tract. However, the access to those infant health care facilities, as influenced by family socioeconomic level, does seem to have an impact on postneonatal mortality rates.

The spatial distribution of infant health care facilities exhibits several patterns (Figs. 1 and 2). Notable is the complete lack of hospitals in the six census tracts with below average socioeconomic status, and above average infant death rates. The average distance, as measured from the center of the census tract, is 5.5 miles. Another noticeable feature is the absence of a pediatrician in any of these tracts. The average distance to the nearest pediatrician is 4.9 miles. Neither of these distances seems particularly great, but without adequate transportation available, the problem of access to the infant care facilities becomes insurmountable.

There is a lack of health clinics in fifty percent of the census tracts with below average socioeconomic scores. The infant mortality rate remains above average in all three tracts which did have a health clinic located within their boundaries. However, since the health clinic provides treatment mostly during the postneonatal period, it could have been responsible for the below average postneonatal mortality rate in tract 10.

Other patterns can be found in the relationship of infant health care facilities with the six census tracts of above average socioeconomic status and mostly below average infant death rates. There are no hospitals, health clinics, or pediatricians in any of these six census tracts. The average
distance to a hospital is 6.6 miles, slightly greater than the average distance to a hospital in the tracts with below average socioeconomic scores. The average distance to a health clinic is 7.3 miles, or about 2½ times greater than the distance to a health clinic in the census tracts with below average socioeconomic scores. However, the difficulties in gaining access caused by greater distance from the infant health care facilities are more easily overcome due to the higher socioeconomic level of the residents. Pediatricians are located closer to the above average socioeconomic status tracts, the average distance being 3.5 miles. Some reductions in the postneonatal mortality rates for these six tracts are probably attributable to the proximity of the pediatricians.

Conclusion

The assumption of an inverse relationship between socioeconomic status and infant death rates is clearly supported by the data from Hillsborough County. Postneonatal mortality rates are particularly sensitive to socioeconomic conditions. During this period death occurs largely from accidents or infectious, digestive and respiratory diseases.

Less clearly established is any significant relationship between high infant death rates and distance to health care facilities. This study has shown that distances are greater to some such services in those tracts scoring low on death rates than tracts which score high. The population of the high-ranking tracts apparently are financially able to overcome the friction of distance between home and health care. The converse is also evident: proximity to health care services by itself does little to ameliorate the depressed socioeconomic conditions which undoubtedly contribute to a high rate of infant mortality.

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(7) Hillsborough-Manatee Health Planning Council, "Hospital Locations in Tampa-Hillsborough County" (Tampa, 1975).


(9) Hillsborough County Medical Association, "Membership Roster" (Tampa, 1975).


(13) Andy Fernandez, Department of Health and Rehabilitative Services, Division of Health, Hillsborough County Health Department. Tampa, 1975.

