The Use of Neighborhood Mapping in Community Evaluation: The Experience of the Baltimore City Healthy Start Evaluation

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Introduction:

The Healthy Start Infant Mortality Prevention Demonstration Program is a federally funded initiative targeting thirteen cities and two rural areas across the United States which began in 1991. The program's goal is to reduce the infant mortality rate in these areas by 50% through the provision of comprehensive community-based services to pregnant women, their infants and their neighborhoods. In Baltimore, Healthy Start efforts are focused at two levels: the Project Area, encompassing ½ of Baltimore City including the highest risk neighborhoods; and two smaller "Target Areas", the Sandtown-Winchester/Harlem Park neighborhood in West Baltimore (Target Area A), and the Middle East neighborhood in East Baltimore (Target Area B) (See Map 1). The target area neighborhoods represent areas of the city with the highest social and reproductive risks. It is in these two target areas where the most intensive infant mortality reduction activities are being undertaken.

A principle feature of Baltimore's Healthy Start Program is the establishment of "Neighborhood Healthy Start Centers" (NHSC's) in each of the target areas. Each NHSC is designed to be a "one stop shop" providing a broad array of social and health educational services ranging from addressing "urgent social needs" (no or substandard housing, addictions, lack of food, etc.) to breastfeeding promotion programs to educational and support groups around such topics as parenting, life planning, wellness and fathers' involvement in pregnancy and parenting. The NHSC operating in the target area to be described in this paper serves more than six hundred women each year (representing approximately 80% of the pregnant and new mothers in the target area). Outreach services of the NHSC send representatives of the program into the neighborhood where they knock on every door in the target areas at least once every eight weeks. Pregnant women and new mothers with infants less than 6 months old are recruited into the program to participate in services offered on site at the NHSC as well as to receive home visits from local residents trained as Neighborhood Health Advocates and professionally trained case managers. The Men's Services component of Healthy Start works with the male partners of Healthy Start clients, and has become a model program not only for the community but also for the nation. Healthy Start's visibility in the target areas is punctuated by the fact that it is the largest employer of neighborhood residents in each of its sites. Through its comprehensive services to women, their children and their male partners, and its strategy of employing community residents, Healthy Start aims to contribute to a process of "neighborhood transformation" that will produce changes in physical, social and behavioral aspects of the neighborhood that increase risk for poor pregnancy outcome and infant mortality.

The Community Evaluation is one component of the local evaluation of Baltimore's Healthy Start Program. Relying on in-depth ethnographic and qualitative research as well as survey methodology, the community evaluation describes the relation between the program and the target neighborhoods, including the role that Healthy Start plays in contributing to a process of positive social and behavioral change conducive to improved rates of infant mortality. In addition to describing longitudinal change in neighborhoods throughout the life of the program, the community evaluation provides on-going feedback regarding issues of community norms, support and acceptance of the program by neighborhood residents to Healthy Start staff to facilitate the success of the program.

Map 1: Baltimore City Healthy Start Target Areas

Target Area A

Control Area C

Target Area B
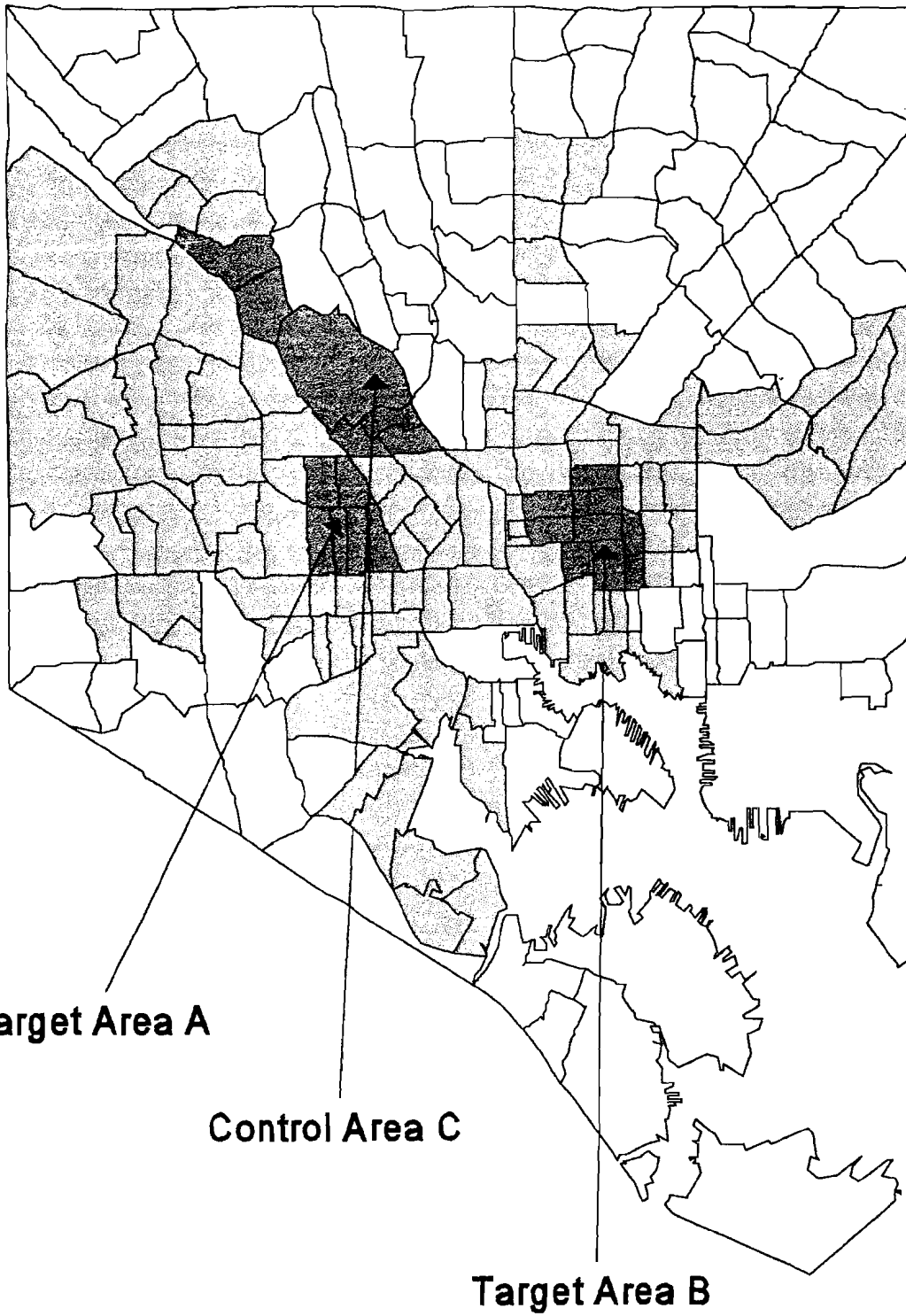
The Use of Neighborhood Mapping in Community Evaluation:

The community evaluation of Baltimore Healthy Start uses a participatory research approach referred to in the literature as "community diagnosis"[2-5] and represents an attempt to triangulate qualitative ethnographic methods and quantitative methods in a systematic research process. Building on the work done by Nichter (1984) in India on "project community diagnosis"[4] we are applying it to a program evaluation context in the U.S.

Data are collected using "rapid assessment procedures" (RAP) as described by Scrimshaw and Hurtado[6], and includes such research methods as neighborhood mapping, key informant and ethnographic interviewing, as well as focus groups and the use of primary and secondary sources of data on neighborhood and residents characteristics. The inclusion of community residents as part of the evaluation team is a key feature of this evaluation. The framing of evaluation questions, data collection and data interpretation are conducted with the participation of the neighborhood residents serving on the community evaluation team.

Neighborhood mapping has been used extensively in developing countries as well as industrialized countries in a process of needs assessment for program planning. Experience in India[7] using participatory mapping methods have shown that even maps crudely drawn on the ground can depict detailed information from villagers on locations of homes, locations of pregnant women, persons with handicaps, malnourished children as well as social information such as household caste. In developed countries, such as the U.K., desktop mapping combined with geographic information systems containing census data has enabled community nursing professionals to identify high risk areas where their attention is most needed[8].

Little has been done to incorporate neighborhood mapping in the evaluation of public health program activities. Perhaps this is due in part to the emphasis in programs on change at the individual level. For programs that seek to bring about social and physical change within a locale, such as recent efforts toward "neighborhood transformation", the same methods used in baseline needs assessment can be used to document and describe change over time. In addition, context related factors depicted in neighborhood mapping can be useful in showing how individual level change of program participants may vary with characteristics of the residential environment. The community evaluation of Healthy Start hypothesizes that women living in high risk neighborhoods (defined as census block groups with high rates of poor physical conditions such as vacant or boarded houses, liquor stores, etc.) will experience (1) poorer pregnancy outcomes and (2) lower rates of recruitment into and participation in Healthy Start activities. This paper will report on the process and results of the mapping of the physical characteristics of Baltimore Healthy Start's Target Area A.

Conceptual Framework:

The community diagnosis approach provides a useful process for exploring the physical, social and cultural context of community-based programs and the problems they address. What it does not provide is a conceptual framework for determining what aspects of the context are relevant to the program or the problem. Relying on Whitehead's (1984) "Cultural Systems Paradigm" (CSP)[9] the community evaluation examined a myriad of factors that may directly or indirectly affect infant mortality and pregnancy outcome. The categories of the CSP of interest to the community diagnosis were adapted into a conceptual framework depicted in **Figure 1**.

Figure1: Conceptual Framework: "The Neighborhood Milieu"
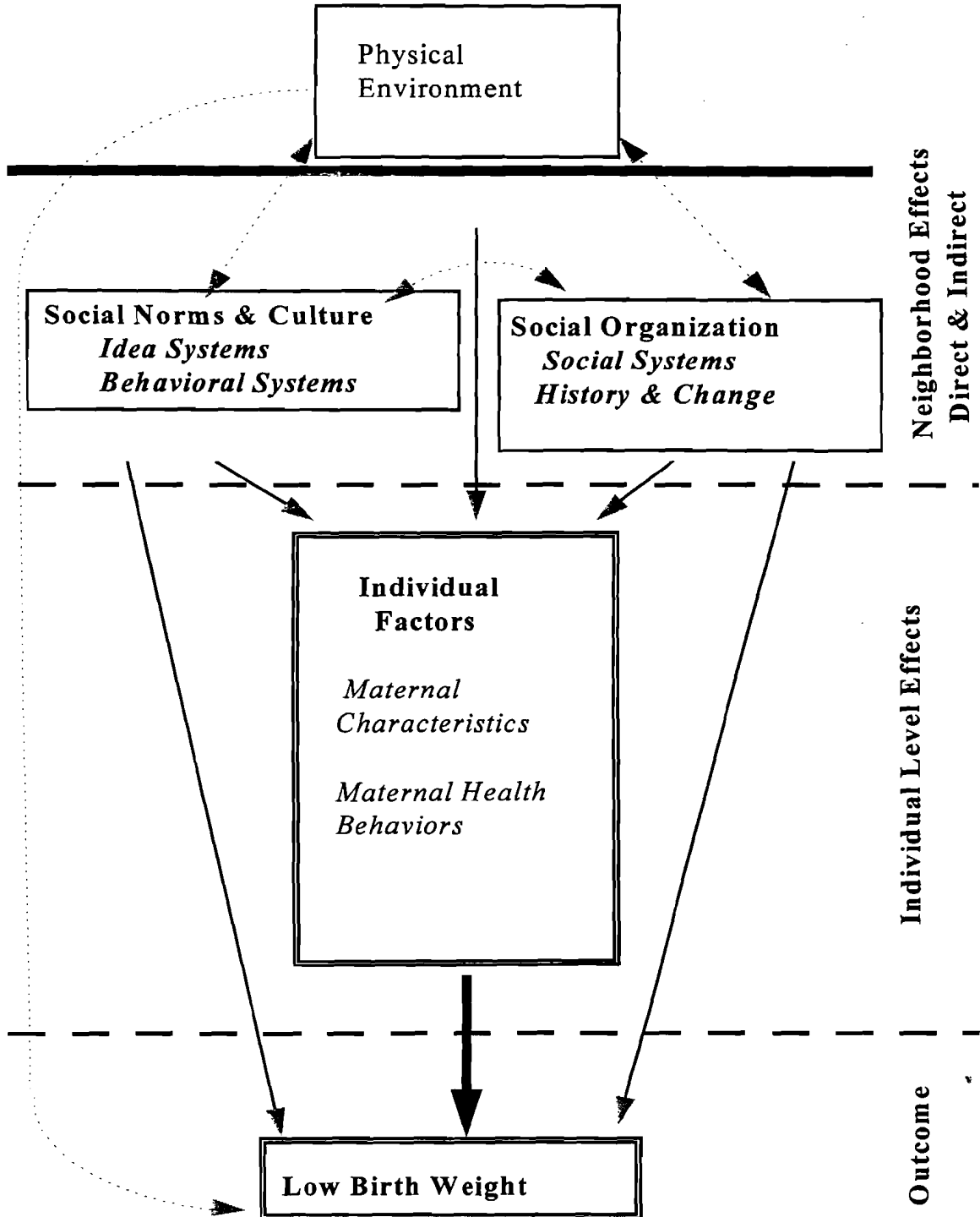
The conceptual framework defines broad domains of individual and neighborhood level factors that can contribute to such adverse pregnancy outcomes as low and very low birth weight, preterm delivery and late or no entry into prenatal care. At the neighborhood level, the three broad domains include 1) neighborhood physical characteristics, 2) social norms and cultural features, and 3) the social organization of the neighborhood including local manifestations of wider socio-economic and political trends. Of particular concern in this paper are the physical characteristics of the neighborhood and their relevance to pregnancy related health and behavioral outcomes and to issues of program implementation (such as recruitment and participation rates). This domain is assessed through a process of physical mapping of the target areas. The purpose of the neighborhood mapping component is as follows:

- to provide more in-depth description of the target area than can be obtained through survey, census or statistical data;

- to identify neighborhood physical, social, economic and political features that may contribute to poor pregnancy outcomes and collect baseline measures of these features so that appropriate interventions can be designed both in the current program and in future efforts;

- to identify high risk neighborhoods within the target area and to link information on environmental conditions to program participants; and

- to document changes in target neighborhood conditions over time as part of the overall community evaluation.

Physical characteristics of the neighborhood to be mapped were selected based upon issues and themes generated by residents in focus group discussions and plausible mechanisms by which they might be related to infant mortality and other poor pregnancy outcomes. In addition, local institutions, services and resources which may be of relevance to program implementation were mapped to assist in program development activities[10].

The research conducted in the neighborhood mapping portion of the community diagnosis attempts to explore characteristics of the neighborhood environment that may be related to infant mortality and/or poor pregnancy outcomes such as low birth weight and pre-term delivery, and/or related to participation in Healthy Start's programs and services. Each of the variables to be included in the neighborhood mapping process relates to infant mortality and poor pregnancy outcome in one of three ways: 1) indicates a direct health hazard to the mother or infant; 2) indicates an indirect health hazard mediated by stress; 3) affects behavior which increases risk of poor pregnancy outcome. **Table 2** shows some of the physical characteristics of neighborhoods studied in the community diagnosis and neighborhood mapping along with the possible mechanisms by which they are related to infant mortality and poor pregnancy outcome, or to Healthy Start participation.

TABLE 2:
PHYSICAL CONDITIONS OF HEALTHY START NEIGHBORHOODS AND POSSIBLE MECHANISMS BY WHICH THEY DIRECTLY OR INDIRECTLY AFFECT PREGNANCY OUTCOMES

PHYSICAL CONDITIONS	POSSIBLE MECHANISMS
Vacant Houses	Living in an area with a high concentration of vacant houses can expose individuals to direct health risks (rodents, fires, crime and violence), and indirect health risks (stress and lack of social support[12,13]) which may effect pregnancy, birth weight and infant mortality. High concentrations of vacanct houses may also decrease the likelihood that women leave their homes to go to the NHSC for activities.
Churches	Churches have been shown to serve as buffers to the stress of living in poverty, in that they provide much needed social support to members.[14] Churches may also be actively involved in addressing local social concerns. Alternatively, their presence may just mean that rents are cheap and codes are not enforced, making it easier to locate in the area. The constituency of the church is another factor, in that many urban churches have members from outside the community or outside the city who may have little commitment to the neighborhood of the church.
Businesses	Availability of employment opportunities can serve as a supportive mechanism in the environment, depending on the number and types of jobs available to local residents. Lax requirements for zoning may place more businesses in poor residential neighborhoods.
Liquor Licenses	Presence of businesses with liquor licenses may affect the availability and use of alcohol. Alcohol and other substance use that interferes with proper nutrition is a risk factor for poor pregnancy outcome. Excessive prenatal exposure to alcohol can lead to fetal alcohol syndrome. Lax requirements for zoning may place more liquor in poor residential neighborhoods. Liquor stores may also be hangouts for people that can be threatening to the neighbors, affecting their ability to leave their homes and interact with their neighbors. These conditions may also effect the likelihood that women leave their homes to go to the NHSC for activities. Contexts that are perceived as threatening may also influence the extent to which recruitment staff and outreach staff provide services to women in these areas.

Data Collection and Geocoding:

Primary data collection:

Data for the neighborhood mapping were collected during neighborhood walk-throughs using community residents who recorded detailed observational data on every block, street and alley in the target area. Simple data collection forms were created that provided space for the observers to record addresses and descriptions for each category of interest. In addition to documenting the overall condition of the blocks, attention was given to the following specific categories of data: vacant/boarded housing, businesses, churches, schools, recreational centers and parks, service providers, clubs, and descriptive data on sanitation conditions.

Data were also obtained on clients in the Healthy Start program including the addresses of clients recruited into the program, their degree of participation, and those lost to follow-up. These data were used to examine the geographic distribution of clients enrolled, and clients lost to follow-up and to link client participation to the physical characteristics of the environment that were observed in the neighborhood walk-through.

Routinely available secondary data:

Other data were obtained from state, city and U.S. Census sources. Housing inspection data (including violations) were obtained from the Baltimore City Department of Housing and Community Development. Liquor license data were obtained from the Baltimore City Board of Liquor License Commissioners. Birth certificate data containing information on pregnancy outcome were obtained from Maryland Vital Records.

Geocoding of data:

All of the data collected for the physical mapping of the Healthy Start Target Areas were geocoded using the desktop mapping software MapInfo 3.0. Geocoding refers to the assigning of geographic indicators to each record of a data file. In most cases, physical features of a neighborhood were given a street address which could be geocoded as a precise latitude and longitude, permitting their representation as a point on a map (e.g. playground at 1650 N. Carey Street). In addition, census tracts and census block groups were assigned to each entry, so data could be aggregated at these geographic levels. Maps generated for the neighborhood mapping are of two basic types, point data maps and thematic maps. Point data maps show the locations of specific neighborhood features such as vacant houses, licensed liquor stores, businesses and churches. Point data maps are helpful in describing the specific context in which program participants live, including detailed descriptions of the street and block. Thematic maps aggregate and present data in the form of counts, rates, percentages, etc. across a geographic space such as census tracts or census block groups. Thematic mapping permits the displaying of data that are only available in aggregate form based upon geographic region (such as census data). It also permits visual comparison of smaller geographic units within the target area. Point data can also be presented on top of thematic maps, such as when program participants are presented on a map depicting level of neighborhood physical risks.

Factor analysis of neighborhood physical features:

Rates of physical conditions by census block groups were factor analyzed to determine if the characteristics "hang together" in a single factor. Using SPSS for Windows, the physical characteristics for each census block groups were analyzed using principal components factor analysis and a varimax rotation. Factor scores for each census block group were saved as variables to permit the creation of thematic maps representing different levels of scoring of the physical risk conditions in the neighborhood.

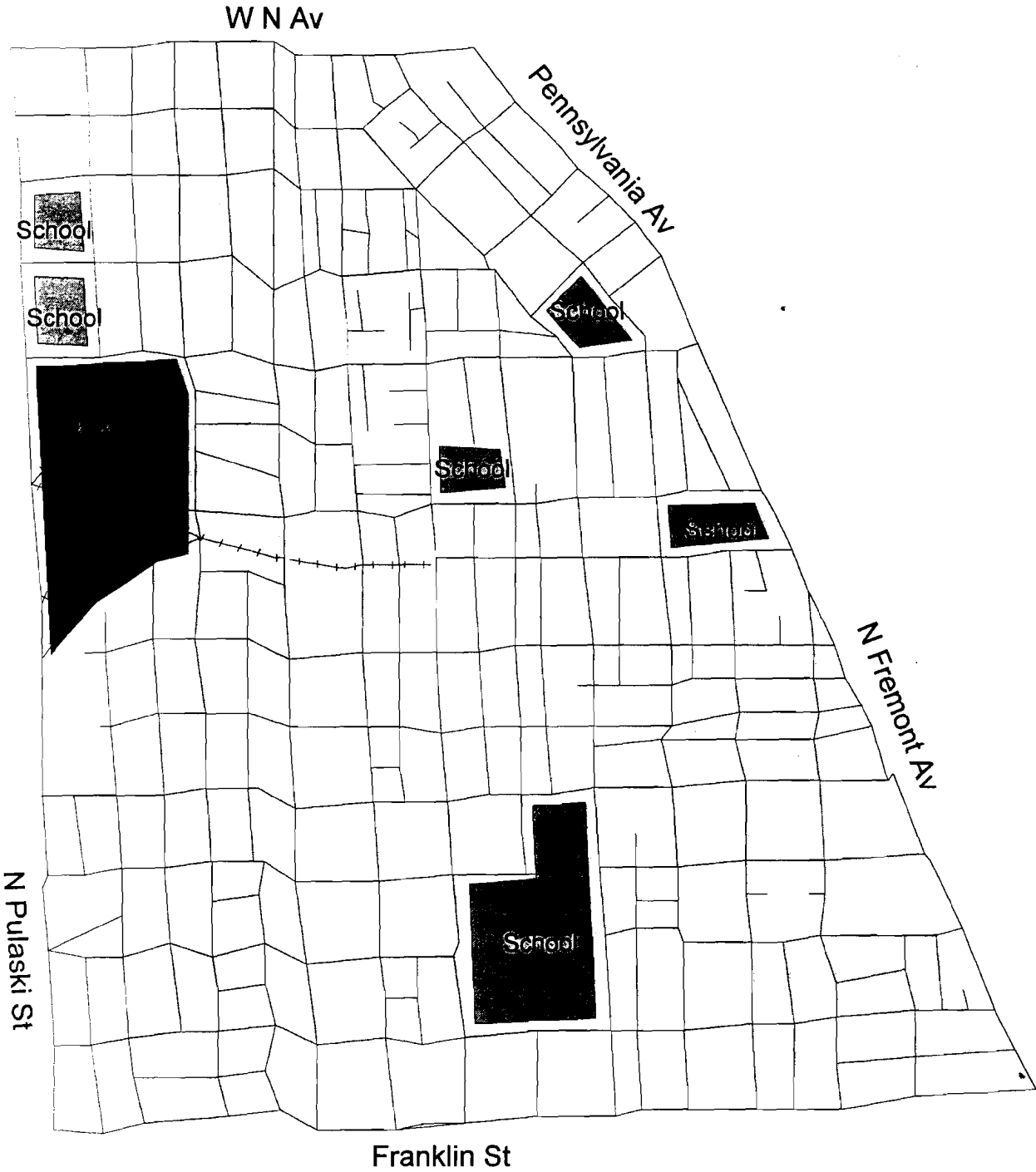## The Neighborhood Physical Context of Baltimore Healthy Start:

Target Area A of Baltimore's Healthy Start Program is located in the heart of West Baltimore. The area is bounded by North Avenue, Pennsylvania Avenue, Fremont Avenue, Franklin Street and Pulaski Street (see Map 2). Map 3 presents combined data on vacant/boarded houses, churches and businesses. During the time frame when data on vacant houses were collected, a total of 947 vacant/boarded houses were identified. Houses were identified as vacant if they were boarded or obviously unoccupied and not advertised as for sale or rent. The data were collected in the summer and fall of 1993 and are subject to continual change. With new funding available for renovation and demolition, many of the identified houses are either no longer vacant or have been demolished. Other houses have become vacant since the time of the data collection. Nevertheless, these data will serve as the best baseline indicator of vacant housing in the target area that is available.
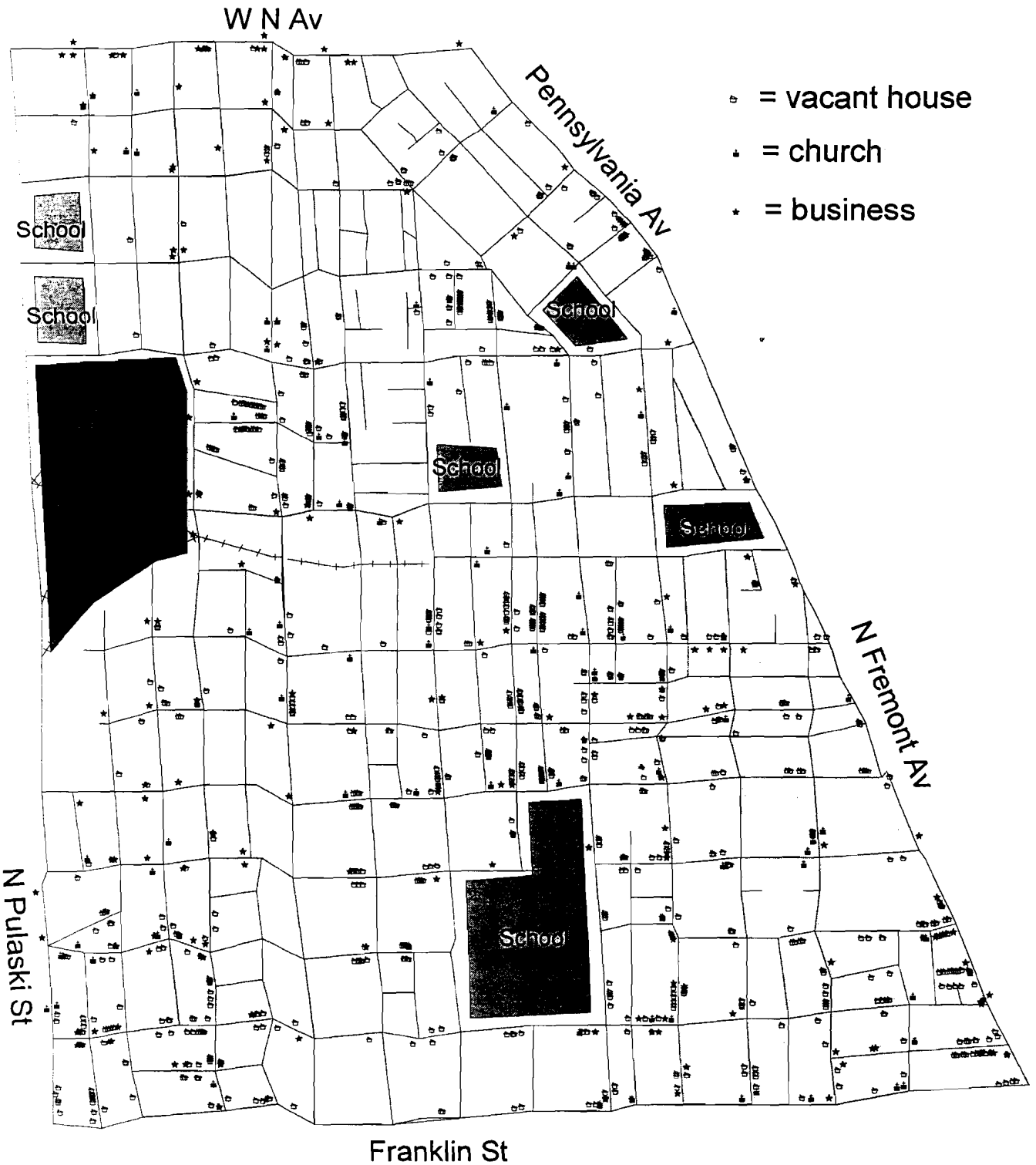
Vacant housing:

Residents complained of the vacant houses during focus groups[15,16] because they are targets for illegal dumping, rodent infestation and illegal drug activities ("stash houses"). They also pose a hazard for children who may venture in to play. The presence of vacant houses in a neighborhood poses both a direct and indirect effect on the health of residents by exposing residents to hazards and by contributing to the stress of urban living.[17] Vacant and boarded homes are distributed throughout the target area but not in a uniform manner. Pockets of most densely concentrated vacant houses are apparent on Map 3. A band of streets near the middle and southern sections of the target area seems to be the most concentrated areas for vacant housing. Some areas are free of vacant housing because they contain newly developed housing units or public housing units managed by the Baltimore City Housing Authority. The area in the northwest section of the target area has the fewest vacant and boarded houses.

Map 4 shows the density of vacant houses by census block group. Density was calculated by dividing the total number of vacant houses within each block group by the total number of housing units within the block group. This method of calculation actually dilutes the density of the most concentrated areas, because these areas also have the greatest number of rental units. Since the denominator is total housing units (rather than total number of houses/buildings), areas in which houses are more likely to be broken into several rental units will have inflated denominators and reduced overall densities. Map 4 shows a strong west to east gradient in density of vacant houses, with density increasing as we move east toward downtown.
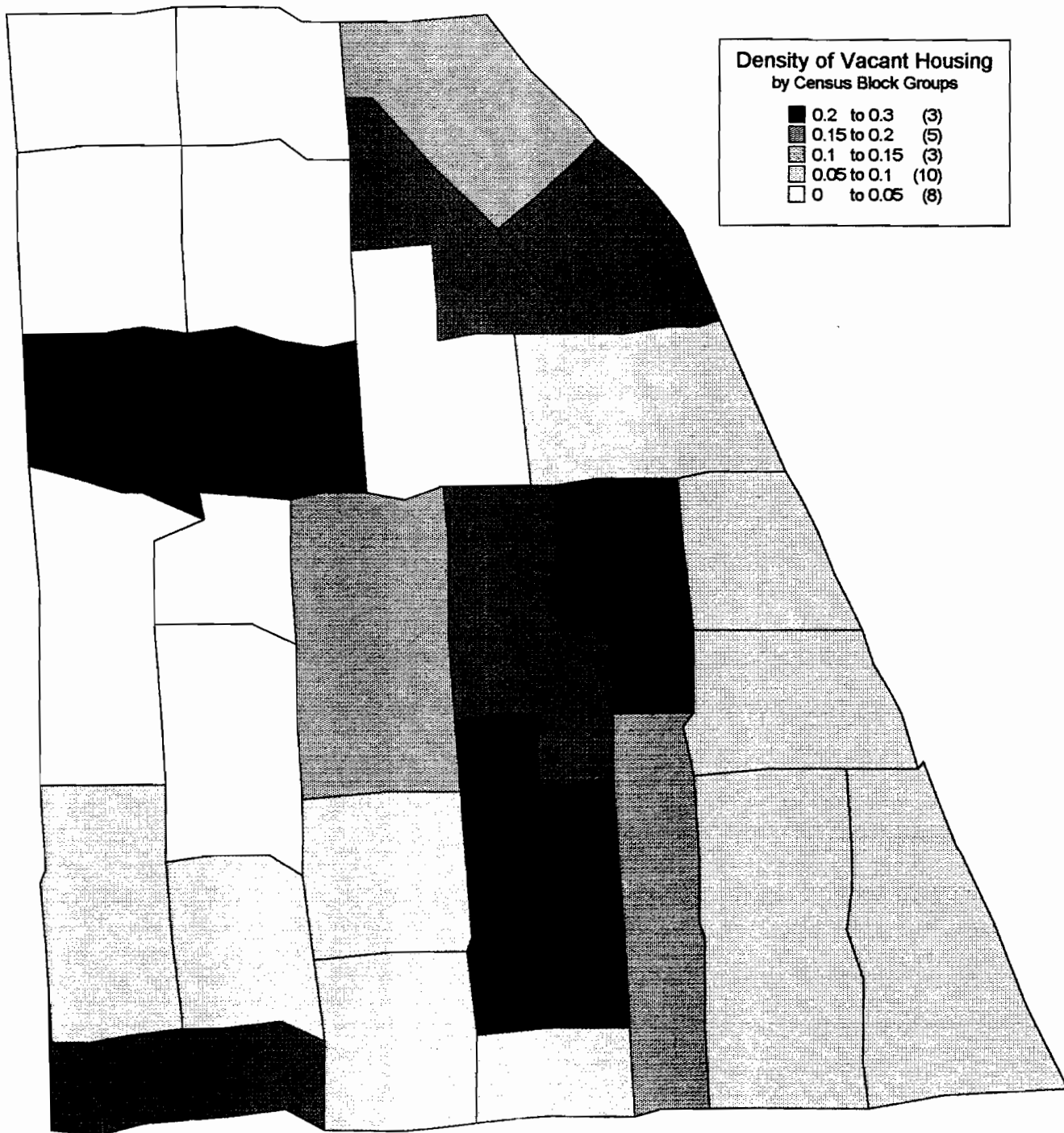
Map 2: Healthy Start Target Area A

W N Av

Pennsylvania Av

School

School

School

School

School

School

N Fremont Av

N Pulaski St

Franklin St

Map 3: Vacant houses, churches and businesses

W N Av

Pennsylvania Av

N Fremont Av

N Pulaski St

Franklin St

School
School
School
School
School
School

c = vacant house

d = church

★ = business

Map 4: Density of Vacant Housing

Density of Vacant Housing
by Census Block Groups

■	0.2 to 0.3	(3)
▓	0.15 to 0.2	(5)
▒	0.1 to 0.15	(3)
░	0.05 to 0.1	(10)
□	0 to 0.05	(8)

Churches, temples and mosques:

The target area contains 95 churches, temples and mosques representing various Christian and Islamic denominations. Congregations vary in size, and members frequently live outside of the community. Map 3 shows the locations of all of these churches/temples/mosques. In many cases these are the strongest institutions to which local residents may belong. They have a tradition of providing support and assistance during times of need. At the same time, the role of these congregations in the neighborhood has diminished as many members have fled the neighborhood to more secure locations in the city's fringes or suburban counties. The result can be an urban congregation composed of commuters from the suburbs. Commitment to the neighborhood may then suffer. Churches/temples/mosques may continue to rent in a particular area because of the low cost to lease or the absence of zoning regulations. Also, they may own their building and land in a particular area and be simply unable to sell so they could move to a suburban location. Simply looking at the locations of churches/temples/mosques will not allow us to say anything definitive about the effect on the local surroundings. For this reason, a comprehensive church/temple/mosque survey was designed to examine the role of each congregation in the local neighborhood. Identifying important congregations can be an important aspect of neighborhood assessment for program planning purposes.

Businesses:

A total of 175 businesses are located in the target area. The locations of these businesses are shown on Map 3. Most of the businesses in the target area are small grocers or carry-outs and businesses employing very few people. Large employers that hire directly from the community are virtually non-existent with the exception of Healthy Start. Given such a situation, residents who are employed must work outside the neighborhood. The only large grocery stores are Farm Fresh and Super Pride, both located in the western-most parts of the target area.

Liquor licenses:

Using 1993 data from the Liquor Board of Baltimore City, Map 5 shows the count of carry-out liquor licenses per census block group. Forty-eight licenses were renewed or awarded in the target area for the year 1993. Forty-two of those were of type A, which are package goods and carry out liquor stores, and which are disproportionately present in poorer African American communities as compared with other areas of the city. Focus group participants repeatedly spoke of the problem with liquor stores and the people that hang out around them. Living near liquor stores is seen as undesirable as it adds to the stress of living in a poor neighborhood because of the potential for trouble in the area.
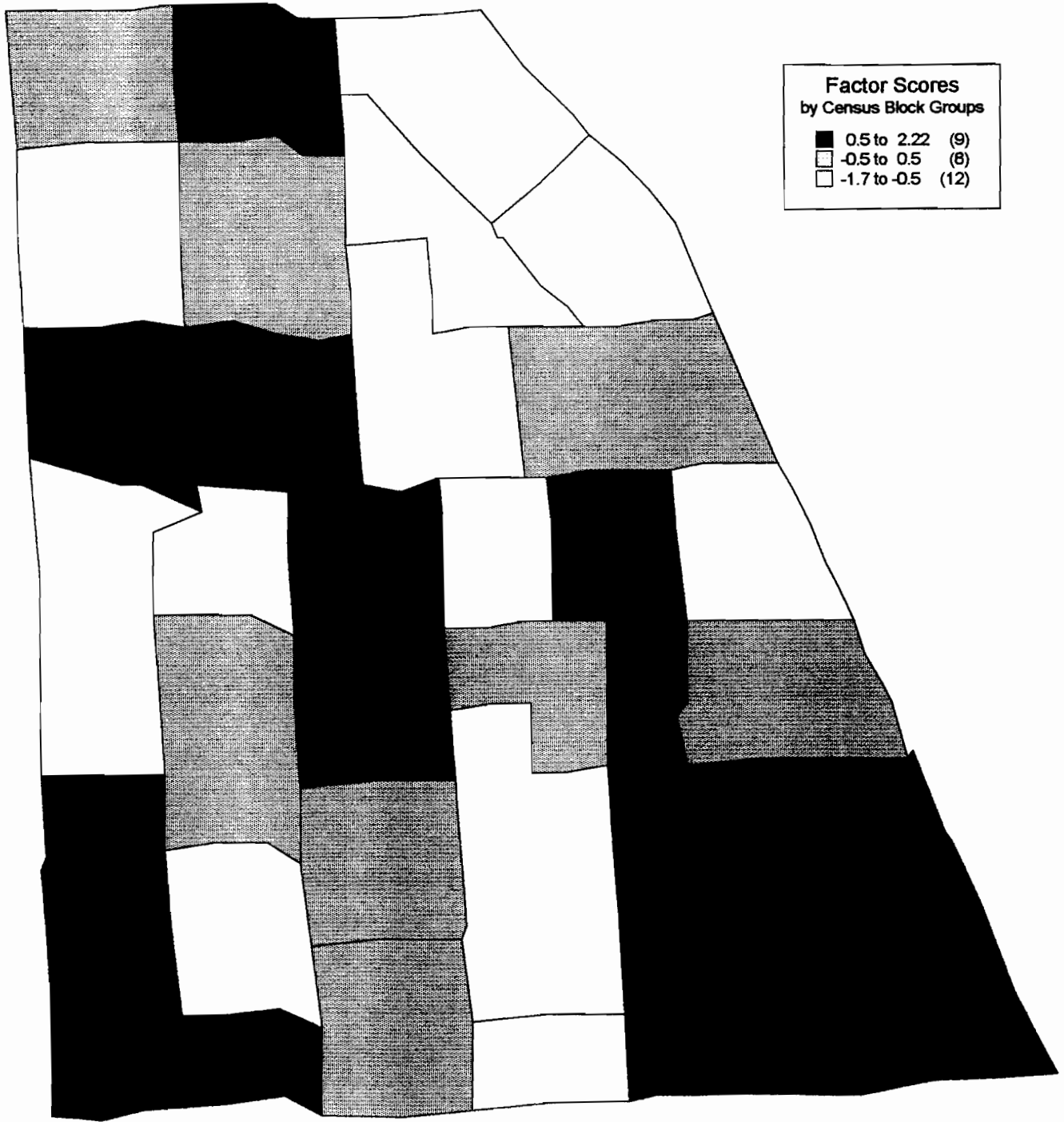
Combining data on neighborhood physical characteristics:

Factor analysis of the physical features of the neighborhood (including vacant housing, churches, businesses and liquor stores) produced only one factor. Bivariate correlations also demonstrated that these variables were strongly correlated with one another. Based upon these findings factor scores were assigned to each census block group and the block groups were then categorized into three levels (strong presence of identified neighborhood risk features, strong absence of identified neighborhood risk features, and a mid level). The presence of vacant houses as

Map 5: Liquor Licenses

Count of Liquor Licenses 1993
by Census Block Groups

- ■ 4 to 4 (4)
- ■ 3 to 4 (2)
- ▨ 2 to 3 (6)
- ☐ 1 to 2 (8)
- ☐ 0 to 1 (9)
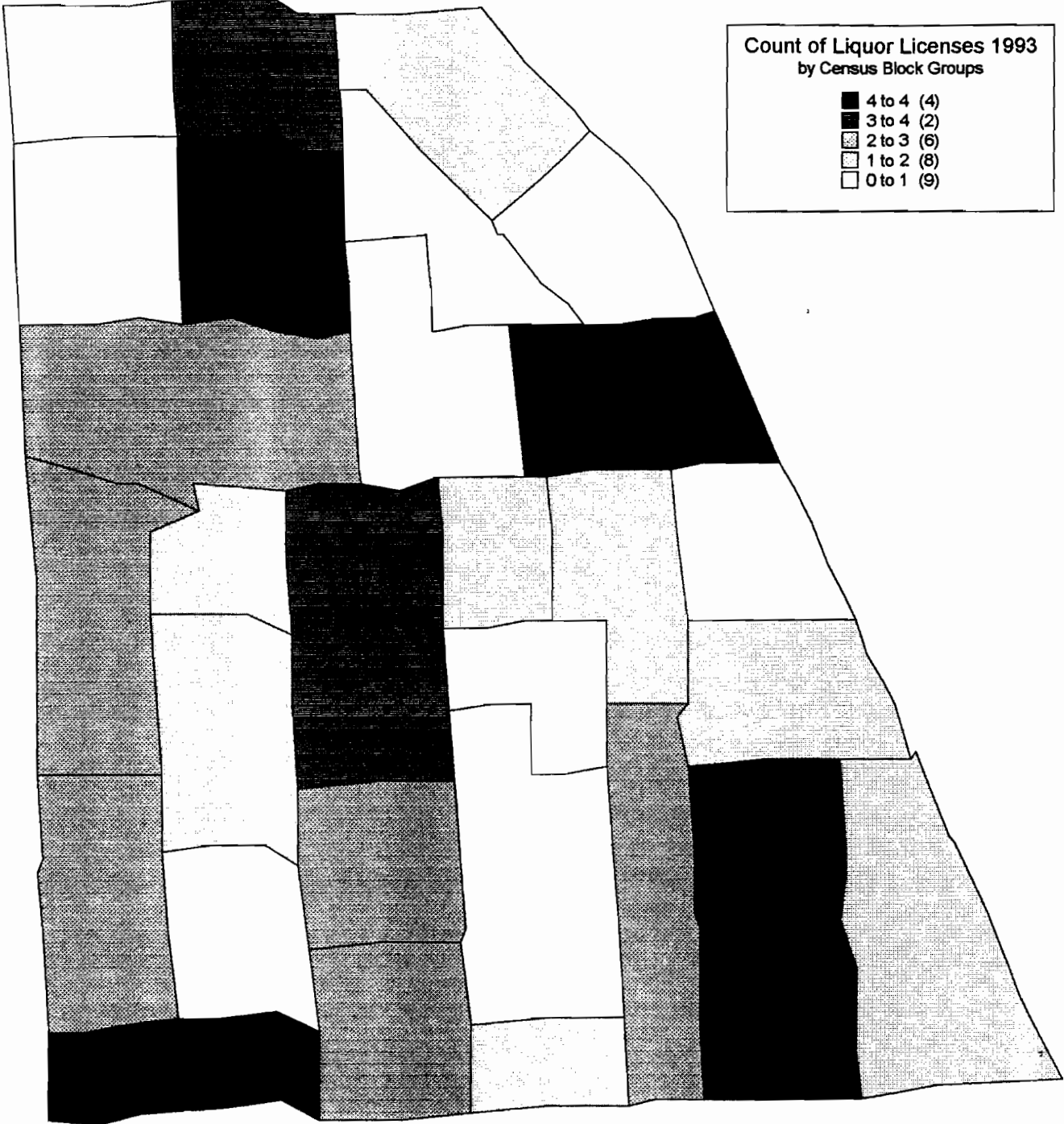
Map 6: Factor Scores for Neighborhood Risks

Factor Scores
by Census Block Groups

- ■ 0.5 to 2.22 (9)
- ☐ -0.5 to 0.5 (8)
- ☐ -1.7 to -0.5 (12)

well as businesses, churches and liquor stores have been described as risk conditions for such problems as crime or fear of crime.[11]   Map 6 is a thematic map with different degrees of shading for the three categories of the factor scores. The darkest regions represent the census block groups with the highest factor scores of observed neighborhood features (or highest risk census block groups). The white regions represent the lowest factor scores of observed neighborhood features (or lowest risk census block groups).

Pregnancy outcomes:

Vital records provided data on all of the live births for 1993 in Target Area A. Using mothers' address of residency, all records were geocoded and census tract/census block group indicators were assigned. A total of 498 singleton births were recorded for Target Area A in 1993. Each of these births were then categorized as normal birth weight (greater than or equal to 2500 grams), low birth weight (less than 2500 grams) or very low birth weight (less than 1500 grams). In addition, entry into prenatal care was recoded into trimester of entry or no prenatal care at all. Map 7 shows the births for 1993 with different symbols representing either normal, low or very low birth weight. Aggregation of data at the census tract or census block group level permits the display of rates of these pregnancy outcomes at these geographic levels.

Participation in Neighborhood Healthy Start Center activities:

The Baltimore Healthy Start Office of Management Information Systems provided data on all program participants in the target area. These data were also geocoded and mapped to display the distribution of Healthy Start clients across the target area (see Map 8). This map presents the clients on top of a map depicting the level of physical risk in the census block group as determined by the factor analysis of physical features described earlier. Data regarding levels of participation for each client were used to create a map showing the location of residence for each client, with five different size icons representing different three five of participation. Once again these data were presented on top of the map depicting the level of physical risk in the census block group (see Map 9).

A goal of the program's recruitment strategy is to recruit and enroll 80% of the eligible women into the program (pregnant women and women with children less than six months old). Using vital records data to determine the total number of births, recruitment rates can be determined for each census block group within the target areas. Block groups failing to meet the goal can be targeted for more intensive recruitment. Further, as physical conditions in each block group are known, clients can be linked to data about their residential environment to permit analysis of how environment may mitigate the effects of the program activities, and may give direction to program staff about specific needs that should be addressed for women living in different block groups.
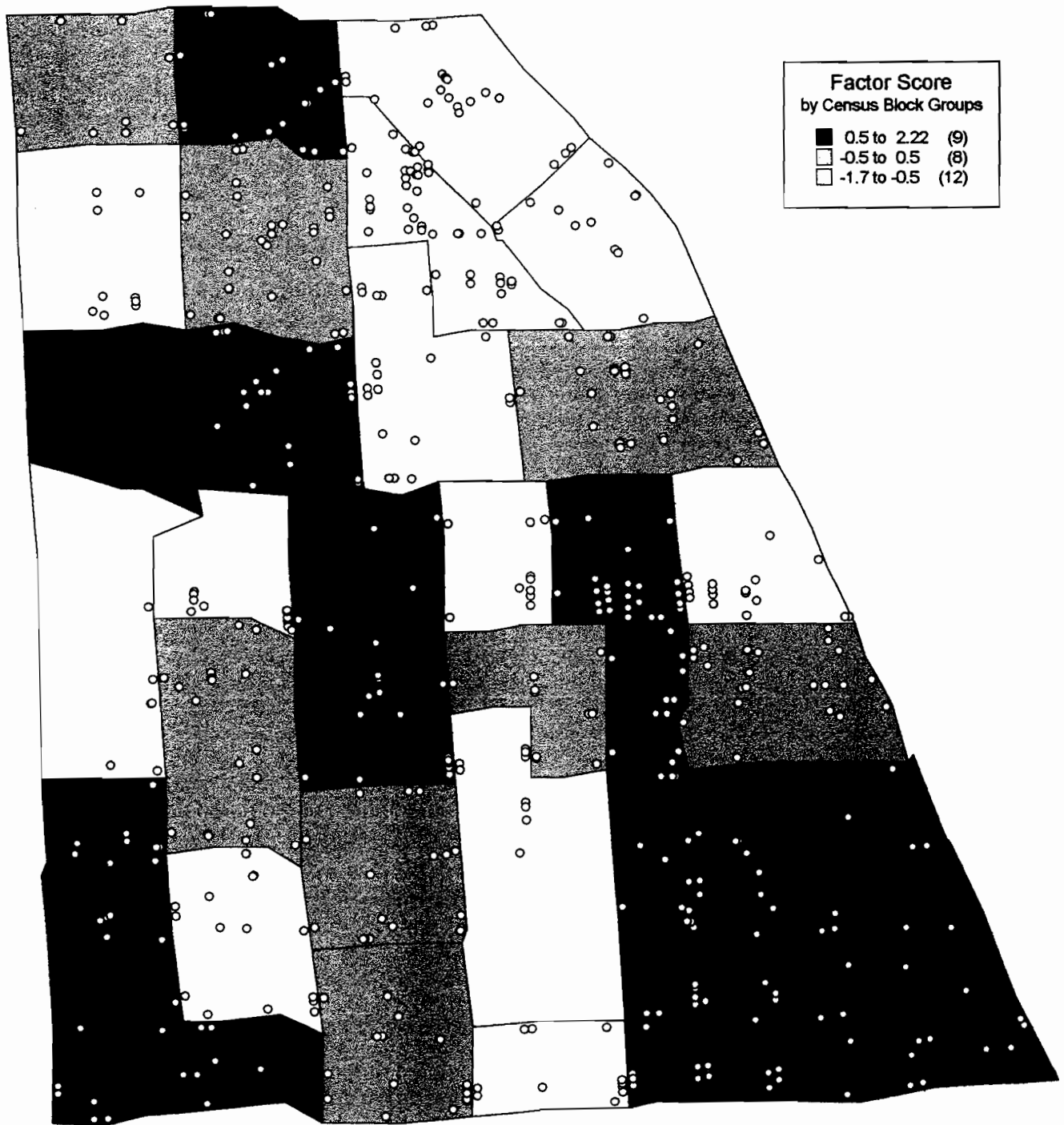
Use of mapping data in evaluation and relevance to research on neighborhood risk factors:

The data collected in the neighborhood mapping component of the community evaluation enable us to identify prevailing neighborhood conditions of concern to residents which may be associated with poor pregnancy outcomes or low rates of program recruitment and participation. In addition to the usual way of summarizing the demographic characteristics of communities, the visual
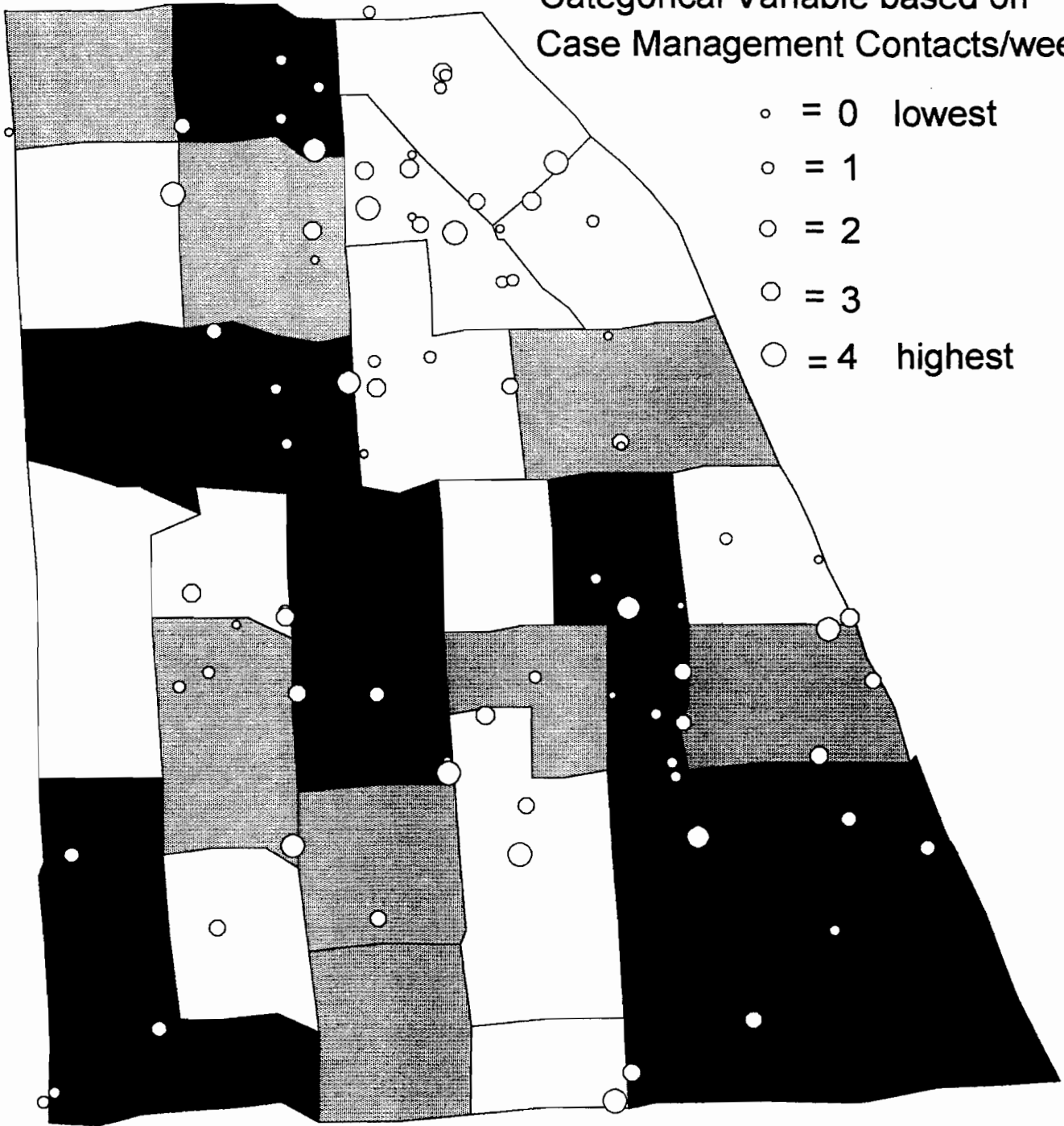
Map 7: Births in 1993

= normal birthweight

★ = low birthweight

◆ = very low birthweight
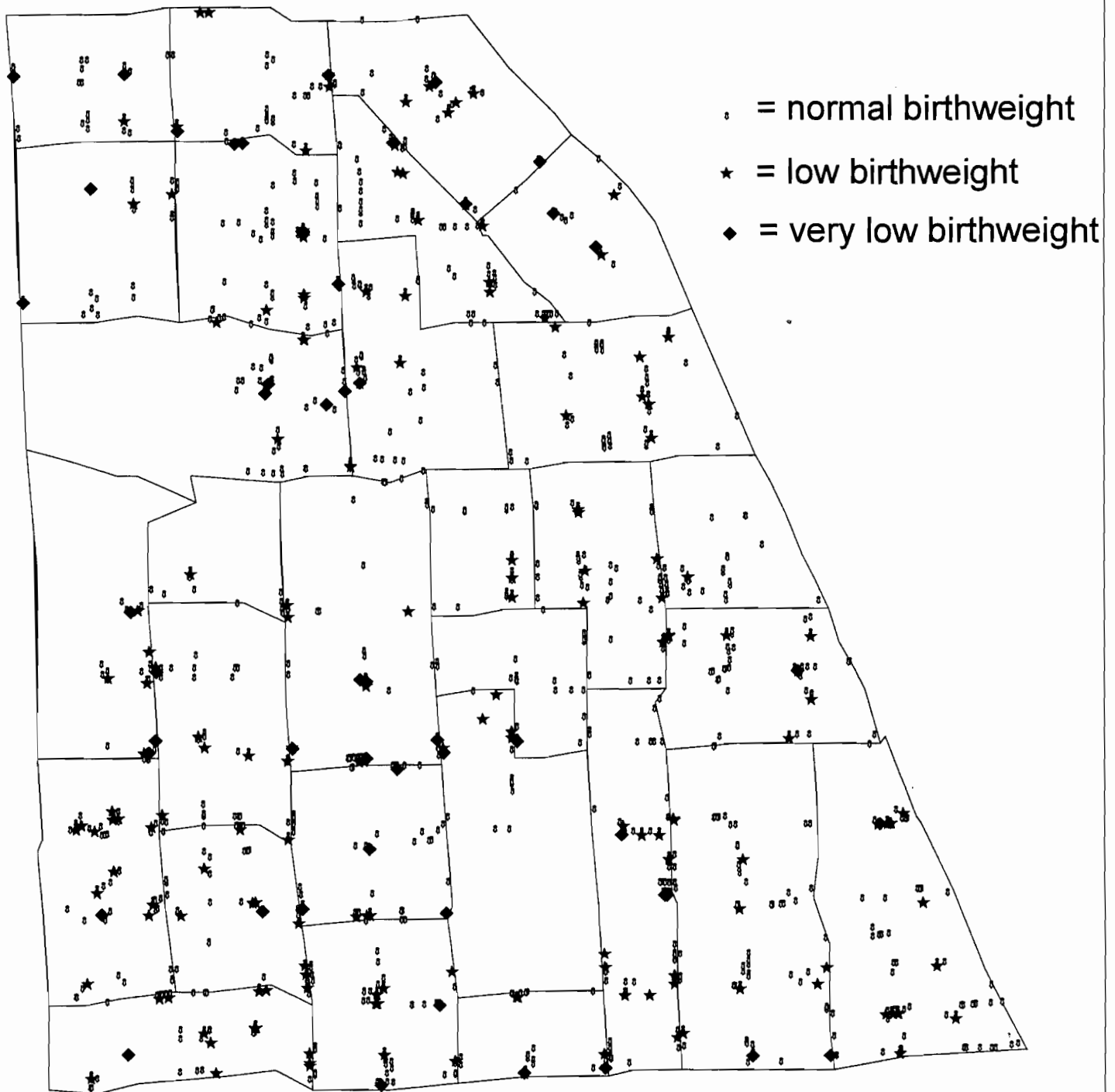
Map 8: Births to Healthy Start Clients ('93 - '94)

Factor Score
by Census Block Groups

■ 0.5 to 2.22 (9)
□ -0.5 to 0.5 (8)
□ -1.7 to -0.5 (12)

Map 9: Client Participation Levels 1993

Categorical Variable based on
Case Management Contacts/week

∘ = 0   lowest

∘ = 1

○ = 2

○ = 3

○ = 4   highest

depiction of neighborhood physical characteristics using maps provides a very useful way of identifying sections of a target area that may be at increased risk. Maps can present a tremendous amount of information in a user-friendly way. Even within a target area considered to be at high risk for poor pregnancy outcomes, mapping of physical characteristics can show the diversity of risk within a neighborhood. This information from neighborhood mapping can be useful to programs as they decide where to focus their resources and efforts, and/or to decide what mid-course corrections are needed to improve recruitment and participation of clients.

The technology exists and is now quite accessible to permit the widespread application of neighborhood mapping. Numerous computer software packages are now available and accessible to users without formal training in cartography or geography. MapInfo is one such package. Others include ArcInfo and EpiMap. The widespread use of such programs and the technical assistance which is now available makes the use of mapping technology an attractive and cost-effective evaluation tool, as well as a tool for epidemiologists, public health researchers and public health practitioners.

The spatial distribution of risks within a community can be further quantified and studied combining mapping with traditional statistical analytic techniques such as factor analysis or regression analysis. Figures 2 and 3 show the results of ecological analyses of rates of no prenatal care in Healthy Start Target Area A by specific neighborhood characteristics measured using neighborhood mapping techniques. The data are aggregated at the census block group level. Neighborhood mapping can be helpful to researchers trying to discern how residential context contributes to pregnancy outcomes or mediates the effects of programs on the outcomes experienced by program participants. For example, a study by O'Campo, Aronson and Johnson used neighborhood mapping data in a multi-level analysis of economic, physical and political characteristics of neighborhoods and the risk of low birth weight.[18] The data collected in this study will be used to explore such relationships, thereby helping to expand our understanding of the causes of poor pregnancy outcomes and the effectiveness of programs such as Healthy Start.

Neighborhood mapping can be useful in evaluating how programs contribute to physical changes in neighborhood conditions. The mapping of the Healthy Start target areas will be repeated at the end of the Healthy Start program. Maps will be used to present how neighborhood characteristics have changed. Some of these changes will be directly due to the activities of the program, others will be attributable to other developmental processes going on in the neighborhoods. Combined with other kinds of data, such as focus groups and key informant interviews, the role of Healthy Start in contributing to neighborhood transformation can be assessed (For example, preliminary data suggest that breastfeeding, normally quite rare in these neighborhoods, has doubled since the start of Healthy Start. The community evaluation will assess whether norms around infant feeding have changed).

Maps produced in studies such as these can be used in community settings, focus groups or in meetings with representatives of community organizations and service providers to stimulate action. As residents discuss the problems they experience in their neighborhoods and see data depicting these concerns in the form of maps they can become motivated to seek solutions to these problems. A next phase of the community evaluation of Healthy Start will entail using the data from the neighborhood mapping to stimulate the community problem solving capacity in the target areas.

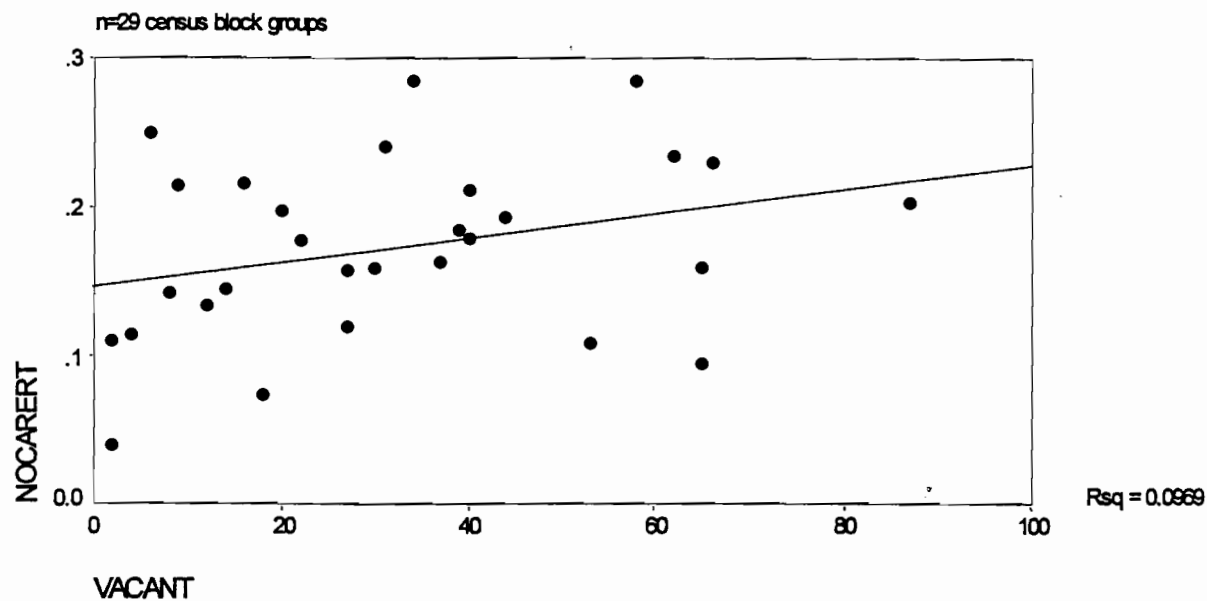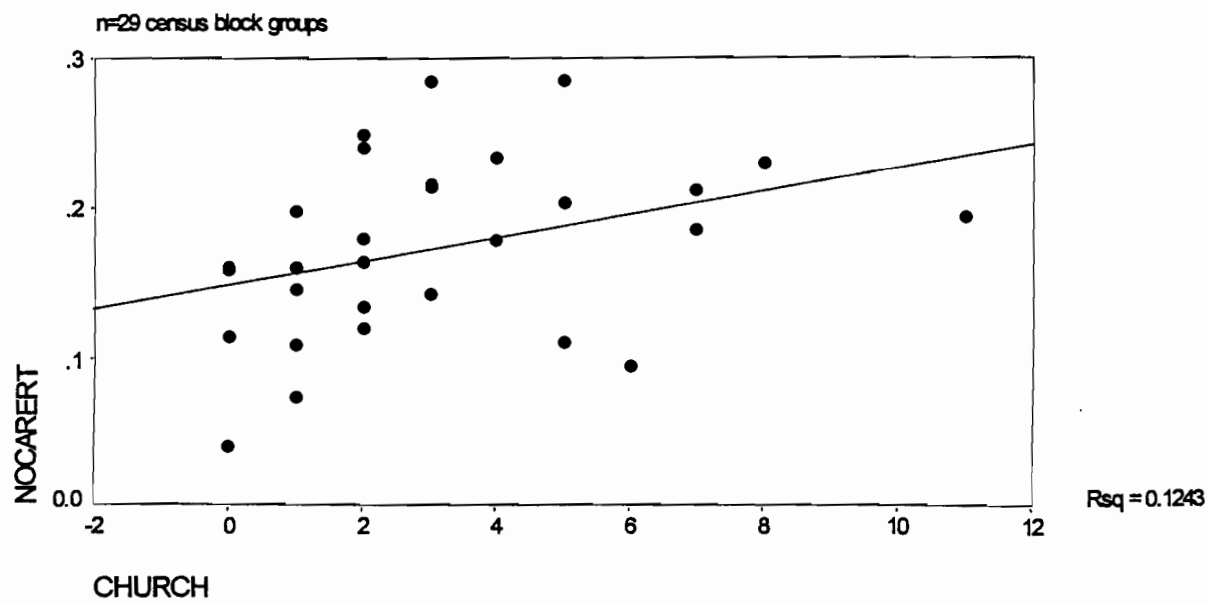Figure 2: Ecological Analysis of No Prenatal Care Rate
by Count of Vacant Houses

Rsq = 0.0969

Figure 3: Ecological Analysis of No Prenatal Care Rate
by Count of Churches/Temples/Mosques

Rsq = 0.1243

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