Beyond individuals: the role of place and neighborhoods in health

Ana V. Diez Roux MD PhD
Center for Social Epidemiology and Population Health
Center for Integrative Approaches to Health Disparities
Department of Epidemiology
University of Michigan
October, 2008
Outline

• The role of population-level/contextual factors in shaping behaviors and biology

• Neighborhoods/places as an example of one such context

• Illustrate some of the ways in which this context is linked to health

• Highlight evidence needs/challenges in this area and policy implications
Why study the impact of neighborhoods on health

• Insufficiency of purely individual-based explanations

• Neighborhoods as contexts for:
  – Physical exposures
  – Social exposures

• Contribute to health inequalities

• Public health and policy relevance
Space (and places) as a key dimension across which health is patterned
A Local, National and Worldwide Scourge

Rising diabetes rates in New York City, in the nation and around the world are alarming health officials. The World Health Organization estimates that 171 million people were living with diabetes in 2000, and that 266 million will have it in 2030.

Diabetes rates are climbing in New York City ...

Percentage of adults reporting that they have diabetes:

... and the burden is not shared equally among the city's neighborhoods.

Percentage of adults reporting that they have diabetes:

- 0-3%
- 4-6%
- 7-9%
- 10-12%
- 13-15%

Sources: New York City Department of Health and Mental Hygiene; U.S. Centers for Disease Control and Prevention; World Health Organization
• Residential segregation by socioeconomic/ethnic characteristics predictive of health

• Place-based features as contributors and perpetuators of social differences in health
• Residential segregation by socioeconomic/ethnic characteristics predictive of health

• Place-based features as contributors and perpetuators of social differences in health
• Residential segregation by socioeconomic/ethnic characteristics predictive of health

• Place-based features as contributors and perpetuators of social differences in health
How do places affect health?
The example of cardiovascular disease
MESA Neighborhood Study

- Ancillary study to the Multiethnic Study of Atherosclerosis
  - Longitudinal study of 6800+ participants aged 45-64 years in six sites
    - NY, Baltimore, Forsyth, St. Paul, Los Angeles, Chicago
  - Detailed measures of cardiovascular disease, biologic markers, and behaviors
  - Neighborhood-level data
Are place-based factors related to diet?
# Adjusted ratios of stores per population by area socioeconomic characteristics

<table>
<thead>
<tr>
<th>Type of Store</th>
<th>Lowest Income</th>
<th>Middle Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocers</td>
<td>3.9 (3.3-4.7)</td>
<td>2.1 (1.8-2.6)</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>0.5 (0.3-0.8)</td>
<td>1.0 (0.7-1.3)</td>
</tr>
<tr>
<td>Convenience Stores</td>
<td>1.9 (1.4-2.5)</td>
<td>1.6 (1.2-2.1)</td>
</tr>
<tr>
<td>Meat &amp; Fish Markets</td>
<td>1.9 (1.3-2.7)</td>
<td>1.0 (0.7-1.5)</td>
</tr>
<tr>
<td>Fruit &amp; Veg. Markets</td>
<td>0.8 (0.5-1.4)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Natural Food Stores</td>
<td>0.4 (0.2-0.7)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Liquor Stores</td>
<td>1.5 (1.1-1.9)</td>
<td>0.9 (0.7-1.2)</td>
</tr>
</tbody>
</table>

Moore and Diez Roux 2004
### Adjusted ratios of stores per population by area socioeconomic characteristics

<table>
<thead>
<tr>
<th>Type of Store</th>
<th>Lowest Income</th>
<th>Middle Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocers</td>
<td>3.9 (3.3-4.7)</td>
<td>2.1 (1.8-2.6)</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>0.5 (0.3-0.8)</td>
<td>1.0 (0.7-1.3)</td>
</tr>
<tr>
<td>Convenience Stores</td>
<td>1.9 (1.4-2.5)</td>
<td>1.6 (1.2-2.1)</td>
</tr>
<tr>
<td>Meat &amp; Fish Markets</td>
<td>1.9 (1.3-2.7)</td>
<td>1.0 (0.7-1.5)</td>
</tr>
<tr>
<td>Fruit &amp; Veg. Markets</td>
<td>0.8 (0.5-1.4)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Natural Food Stores</td>
<td>0.4 (0.2-0.7)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Liquor Stores</td>
<td>1.5 (1.1-1.9)</td>
<td>0.9 (0.7-1.2)</td>
</tr>
</tbody>
</table>

Moore and Diez Roux 2004
Adjusted ratios of stores per population by area socioeconomic characteristics

<table>
<thead>
<tr>
<th>Type of Store</th>
<th>Lowest Income</th>
<th>Middle Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocers</td>
<td>3.9 (3.3-4.7)</td>
<td>2.1 (1.8-2.6)</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>0.5 (0.3-0.8)</td>
<td>1.0 (0.7-1.3)</td>
</tr>
<tr>
<td>Convenience Stores</td>
<td>1.9 (1.4-2.5)</td>
<td>1.6 (1.2-2.1)</td>
</tr>
<tr>
<td>Meat &amp; Fish Markets</td>
<td>1.9 (1.3-2.7)</td>
<td>1.0 (0.7-1.5)</td>
</tr>
<tr>
<td>Fruit &amp; Veg. Markets</td>
<td>0.8 (0.5-1.4)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Natural Food Stores</td>
<td>0.4 (0.2-0.7)</td>
<td>0.5 (0.3-0.8)</td>
</tr>
<tr>
<td>Liquor Stores</td>
<td>1.5 (1.1-1.9)</td>
<td>0.9 (0.7-1.2)</td>
</tr>
</tbody>
</table>

Moore and Diez Roux 2004
Smoke Before Food: A Tale of Baltimore City


Manuel Franco, MD, Arijit Nandi, MPH, Thomas Glass, PhD, and Ana Diez-Roux, MD, PhD
Food stores and healthy food availability indices in Baltimore

Neighborhoods by Racial Composition
- Predominantly Black
- Racially Mixed
- Predominantly White

226 Stores Healthy Food Availability Index
- Low
- Medium
- High

Franco, Diez Roux et al AJPM in press
### Healthy Foods Availability Index (HFAI) of two supermarkets

<table>
<thead>
<tr>
<th>Location</th>
<th>Baltimore City</th>
<th>Baltimore County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racial Composition</td>
<td>97% Black</td>
<td>93% White</td>
</tr>
<tr>
<td>Median HH Income</td>
<td>$ 20,833</td>
<td>$ 57,391</td>
</tr>
<tr>
<td>Skim milk</td>
<td>Yes, 2 points</td>
<td>Yes, 3 points</td>
</tr>
<tr>
<td>Fruits</td>
<td>17, 2</td>
<td>59, 4</td>
</tr>
<tr>
<td>Vegetables</td>
<td>38, 3</td>
<td>74, 4</td>
</tr>
<tr>
<td>Lean meat</td>
<td>No, 2</td>
<td>Yes, 3</td>
</tr>
<tr>
<td>Frozen foods</td>
<td>No, 0</td>
<td>Yes, 3</td>
</tr>
<tr>
<td>Low Na foods</td>
<td>No, 0</td>
<td>Yes, 2</td>
</tr>
<tr>
<td>100% whole wheat bread</td>
<td>Yes, 2</td>
<td>Yes, 4</td>
</tr>
<tr>
<td>Low sugar cereals</td>
<td>Yes, 2</td>
<td>Yes, 2</td>
</tr>
<tr>
<td>HFAI (0 to 27)</td>
<td>18</td>
<td>25</td>
</tr>
</tbody>
</table>

Franco et al AJPM in press
Adjusted relative probability (95% CL) of having a good diet for 1st vs. 4th quartile of food environment

- Participants with worst availability of supermarkets were 32-55% less likely to have a good quality diet
- Those who lived in areas with the worst ranked local food environments were 27-40% less likely to have a good diet

Moore, Diez Roux et al. AJE 2008
The physical environment and physical activity
Percent of tracts without a recreational facility by racial/ethnic composition and median income adjusted for tract area*

<table>
<thead>
<tr>
<th>Tract Racial/Ethnic Composition and Median Income</th>
<th>Percent</th>
<th>Pvalue for trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>69.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>81.4</td>
<td></td>
</tr>
<tr>
<td>Hisp/Black</td>
<td>79.4</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>57.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>White</td>
<td>38.4</td>
<td></td>
</tr>
<tr>
<td>Poorest</td>
<td>73.5</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Moderate</td>
<td>64.9</td>
<td></td>
</tr>
<tr>
<td>Wealthiest</td>
<td>45.5</td>
<td></td>
</tr>
</tbody>
</table>

* Proportions were adjusted to the mean area of the tracts using logistic regression

Moore et al 2008
Percent of participants reporting physical activity and prevalence ratios (PR) of activity by resource densities for windows of varying size*

*Adjusted for age, sex, race/ethnicity, income, site, neighborhood violence. Resource densities are adjusted for population.

Diez Roux et al 2006
Associations of land use measures with walking >90 min/week (vs. not walking)

<table>
<thead>
<tr>
<th></th>
<th>Walking to places OR [95% CI]</th>
<th>Walking for exercise OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (hundreds of persons/hectare)</td>
<td>1.41 [1.21,1.65]</td>
<td>1.09 [1.08,1.11]</td>
</tr>
<tr>
<td>% parcel area in retail (in 10% increments)</td>
<td>1.28 [1.00,1.65]</td>
<td>1.08 [1.01,1.16]</td>
</tr>
<tr>
<td>Entropy (0-1; 1 is even)</td>
<td>2.24 [1.43,3.51]</td>
<td>1.61 [1.33,1.96]</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, race/ethnicity, income, and street connectivity. Land use measures are for 200 m buffers around the home.

Rodriguez et al unpublished
The stress pathway
Cortisol profiles by categories of neighborhood violence

Adjusted for age, sex, race, and income.
What about biomedical risk factors?
## Community survey scales

| Walking/PA environment                          | 1. My neighborhood offers many opportunities to be physically active.  
|                                               | 2. Local sports clubs and other facilities in my neighborhood offer many opportunities to get exercise.  
|                                               | 3. It is pleasant to walk in my neighborhood.  
|                                               | 4. The trees in my neighborhood provide enough shade.  
|                                               | 5. In my neighborhood it is easy to walk places.  
|                                               | 6. I often see other people walking in my neighborhood.  
|                                               | 7. I often see other people exercise (for example jog, bicycle, play sports) in my neighborhood. |
| Availability of healthy foods                  | 1. A large selection of fresh fruits and vegetables is available in my neighborhood.  
|                                               | 2. The fresh fruits and vegetables in my neighborhood are of high quality.  
|                                               | 3. A large selection of low fat products is available in my neighborhood. |
| Safety                                        | 1. I feel safe walking in my neighborhood day or night.  
|                                               | 2. Violence is not a problem in my neighborhood.  
|                                               | 3. My neighborhood is safe from crime |
| Social cohesion                               | 1. People around here are willing to help their neighbors.  
|                                               | 2. People in my neighborhood generally get along with each other.  
|                                               | 3. People in my neighborhood can be trusted.  
|                                               | 4. People in my neighborhood share the same values |
Relative prevalence of Hypertension associated with better neighborhood characteristics

Neighborhood Characteristics

Walking Environment M1
Walking Environment M2
Healthy Foods M1
Healthy Foods M2
Safety M1
Safety M2
Social Cohesion M1
Social Cohesion M2

Relative prevalence of hypertension

Model 1 (M1): adjusted for site, age, gender;
Model 2 (M2): adjusted for site, age, gender, education, income,

Based on EB estimates

Mujahid, Diez Roux et al Epidemiology 2008
Reduction in risk of developing type II diabetes associated with better neighborhood characteristics

Data from 5 years of follow-up (2000-2006) of the Multi-Ethnic Study of Atherosclerosis, adjusted for age, gender, family history of diabetes, income, assets, education, race/ethnicity, alcohol use, and cigarette smoking.
Multilevel dynamic processes
Structural features of neighborhoods → Neighborhood food availability → Dietary behaviors → CVD
Structural features of neighborhoods → Neighborhood food availability → Dietary behaviors → CVD

Family Income → ?
Neighborhood food availability
Dietary behaviors
CVD

Other neighborhood factors
Structural features of neighborhoods
Family Income
Dietary behaviors
CVD
Neighborhood (spatial) patterning of health emerges from the functioning of a system:

- individuals interact with their environment
- individuals interact with each other
- individuals and environments adapt and change over time

Auchincloss and Diez Roux AJE 2008
What kind of evidence do we need?

- Rigorous observational studies
- Natural experiments
- Qualitative studies
- Simulation/systems approaches
- Action based on “best available evidence” and systematic evaluation of this action
Why focus on places/neighborhoods?

- Mutually reinforcing nature of place-based and individual inequalities
- Neighborhood differences not “naturally” determined
- Result from specific policies, amenable to intervention
- Health impact of non health policies
- Changes in neighborhood environments likely to have multiple health and non health benefits
“Environment” (broadly defined) as crucial to understanding variability in health

• As antecedent to biologic/behavioral processes

• As modifier of genetic effects

• As integral part of systems from which health emerges

Diez Roux Annals of Epidemiol 2007
“…the burden of disease on a human population is part of an environmental system and the interrelatedness of the components of the system cannot be understood by pursuing research whose rationale is to divide and isolate the components in ever greater detail.”

“If we consider disease to be embedded in a complex network in which biologic, social, and physical factors all interact, then we are impelled to develop new models and adopt different analytic methods..”

R. Stallones, 1973
“New” paradigm in public health
Interdisciplinary
Transportation, urban planning, food access, community development policies as health policies