Background

- Most American adults are not meeting current recommended levels of physical activity
- Focus on environmental supports for physical activity
- Want to estimate effect of “walkability” in neighborhoods
  - Understanding pathways to physical activity
  - Policy interventions to increase physical activity
Background

- Problem is: What is a walkable neighborhood?
- Neighborhood walkability is studied two ways:
  1. Entering single items measuring walkability into regression analyses
  2. Building composite measures of walkability from many items
Background

Creating walkability measures has three key problems:

1. Multicollinearity of items
2. Context-dependence of walkability
   - “Macro” – Across different locations
   - “Micro” – Across definitions of neighborhoods
3. Interpretability of results
Objectives

- Develop a process for creating a summary measure of walkable neighborhoods
- Assess predictive validity of summary measure compared to:
  - Population density
  - Frank & colleagues walkability index
- Examine whether definitions of neighborhoods matter
Strategy

Using data from New York City:
- Perform principal components analysis (PCA) on typical “walkability” items to uncover structure
- Compare predictive validity of various walkability measures on BMI

Do this for neighborhoods defined as census tracts, zip-codes and 1km buffers
Neighborhood Walkability Items

1. Population Density
2. Subway stops (0, 1, 2+)
3. Bus stops
4. Land-use mix (entropy measure including only commercial and residential land use)
5. Retail floor area ratio (FAR)
6. Intersection Density
7. Residential units / building area
8. Residential units / land area
9. Percent commercial land use
Why use PCA?

- High correlation among independent variables measuring built environment
Correlation Matrix

1. Bus stops
2. 1 subway stop
3. 2+ subway stops
5. Land use mix
6. Retail FAR
7. Inter. Density
8. Units/Bldg. Area
9. Units/Land Area
Why use PCA?

- High correlation among independent variables measuring built environment
- Uncover different dimensions of variation
- Resulting variables (scales) are uncorrelated with each other
PCA Results/Dimensions of Built Environment

Three dimensions found in the built environment data for New York City:

First Dimension: Population Density
Second Dimension: Commercial Land Use
Third Dimension: Subway Density

PCA results are similar across tracts, zip codes and 1-km buffers
Population Density

LEGEND
- Community Districts
- Green Space
- Airports, Landfill

Population Density in quintiles (People per km²)
- 0 - 6,966
- 6,967 - 12,237
- 12,238 - 18,367
- 18,368 - 27,124
- 27,125 - 86,948

Data sources include US Census Bureau, Census of Population and Housing, 2000 and the NYC Department of City Planning.

Map prepared by the Built Environment and Health Project, Columbia University (www.beh.columbia.edu).
Active Living Research Conference
February 20, 2009
Predictive Validity

- Data: New York Cancer Project Cohort (N=13,201)
- Control for individual characteristics
  - age, gender, race/ethnicity, education
- Control for neighborhood characteristics
  - % black, % Hispanic, % poor
- Generalized estimation equations clustered by Universal Hospital Fund districts (N=42)
## Tract-Level Results

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</table>

- Explained variance is similar with pop. density among the highest.
# 1km Buffer-Level Results

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</tr>
</tbody>
</table>

- Explained variance of Pop. Density is just as high
- Second dimension – commercial presence – provides independent information
Conclusions

- Population density is as good as any single composite measure of walkability in New York City
- Multiple influences of built environment on BMI revealed through PCA
- PCA measures are similar across neighborhood definitions, but effects are not
Conclusions

- PCA measures are similar across neighborhood definitions
- Population density is as good as any single composite measure of walkability in New York City
- PCA reveals that two built environment constructs are associated with BMI
- Results somewhat dependent on neighborhood definition
Implications & Limitations

- Context is important
  - We describe a process that can be used to build and test composite measures
  - Replication required in different contexts
- Need to explore behavior-related outcomes (e.g. walking)
- Cross-sectional and observational design leaves us vulnerable to selection problems
Future Directions

- Measures of neighborhood walkability vs. walkable types of neighborhoods
  - Variable-centered vs. neighborhood-centered approaches
- Multi-context studies exploring built environment influences across different locations
- Methods to account for selection
- Process can be used for other complex concepts (e.g. safety)
Acknowledgments

We would like to thank

- National Institute for Environmental Health Science
- RWJF Health & Society Scholars Program

for their financial support of this project
More Info!

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