More Than Meets the Eye: Density and Transportation During COVID-19

1:15-2:00pm ET

Speakers: Shima Hamidi, Reid Ewing, Sadegh Sabouri
Moderator: Robert Puentes
Road to Recovery Webinar: More Than Meets the Eye: Density and Transportation During COVID-19

July 1, 2020

Shima Hamidi
Bloomberg Assistant Professor
Bloomberg School of Public Health
Johns Hopkins University
shamidi2@jhu.edu

Reid Ewing
Distinguished Professor
City and Metropolitan Planning
University of Utah
ewing@arch.utah.edu

Sadegh Sabouri
PhD Student
City and Metropolitan Planning
University of Utah
Sadegh.Sabouri@utah.edu
To Model Something ...
Measuring Sprawl and Its Impacts

- Low Density
- Segregation of Uses
- Lack of Strong Centers
- Sparse Street Network

Released October 2002
Suburbia USA: Fat of the Land?

Report Links Sprawl, Weight Gain

By Rob Stein
Washington Post Staff Writer

Suburban sprawl appears to be contributing to the nation's obesity epidemic, making people less likely to walk and more likely to be overweight, researchers reported yesterday.

In the first comprehensive examination of whether suburbs spreading across the U.S. landscape are affecting Americans' health, the researchers studied more than 200,000 people in 448 counties, producing the first concrete evidence supporting suspicions that sprawl is aggravating the nation's growing weight crisis.

People who live in the most spread-out areas spend fewer miles each month walking and weigh about six pounds more on average than those who live in the most densely populated places. Probably as a result, they are almost as prone to high blood pressure as cigarette smokers, the researchers found.

"There are lots of other reasons why we should work to contain sprawl," said Reid Ewing of the University of Maryland's National Center for Smart Growth, who led the research at the University of Maryland.

The study also looked at heart disease and diabetes, but didn't find any statistically relevant relationship between sprawl and these diseases.

The study did find that the 25 densest counties.

People in more sprawling counties are also likely to have a higher body mass index (BMI), a standard measure of weight. A 0.75-point increase in the degree of sprawl was associated with an average weight gain of a little more than one pound per person, researchers found.

While researchers found no association between sprawl and diabetes or heart disease, they did find that people who live in the least sprawling areas had a 7.2 percent lower risk of developing high blood pressure than those in the most sprawling areas.

Sprawl and Obesity

New research links suburban sprawl to obesity. You are more likely to be overweight live in an area with low population density and a more expansive street grid.

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>SPRAWL INDEX SCORE</th>
<th>SPRAWL INDEX RANK</th>
<th>SPRAWL INDEX CENTER</th>
<th>SPRAWL INDEX DENSITY</th>
<th>SPRAWL INDEX SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frederick County, Maryland</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Anne Arundel County, Maryland</td>
<td>0.95</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Calvert County, Maryland</td>
<td>0.96</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Washington D.C.</td>
<td>1.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Prince George's County, Maryland</td>
<td>1.01</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Source: Smart Growth America; Surveys and other reports by project.
Connections to Outcomes

**Physical activity, obesity** (Ewing et al, 2003; Kelly-Schwartz et al, 2004; Sturm and Cohen, 2004; Doyle et al, 2006; Fan and Song, 2009; Plantinga and Bernell, 2007; Lee et al, 2009)

**Traffic fatalities** (Ewing et al, 2003)

**Air quality** (Kahn, 2006; Stone et al, 2010; Schweitzer and Zhou, 2010)

**Residential energy use** (Ewing and Rong, 2008)

**Emergency response times** (Trowbridge et al, 2009)

**Teenage driving** (Trowbridge and McDonald, 2008; McDonald and Trowbridge, 2009)

**Social capital** (Kim et al, 2006; Nguyen, 2010)

**Private-vehicle commute distances and times** (Ewing et al, 2003; Zolnik, 2011; Holcombe and Williams, 2012)
Most Sprawling vs. Most Compact MSAs

New York-White Plains-Wayne, NY-NJ

Hickory-Lenoir-Morganton, NC
Measuring Sprawl and Its Impacts: An Update

Shima Hamidi\textsuperscript{1}, Reid Ewing\textsuperscript{1}, Ilana Preuss\textsuperscript{2}, and Alex Dodds\textsuperscript{2}

Abstract
Across the nation, the debate over metropolitan sprawl and its impacts continues decade after decade. To elevate the debate, a decade ago, researchers developed compactness/sprawl indices for metropolitan areas and counties that have been widely used in health and other research. In this study, we develop refined compactness/sprawl indices based on definitions and procedures in earlier studies by Ewing and colleagues and validate them against transportation outcomes. The indices are being made available to researchers who wish to study the causes, costs and benefits, and solutions to sprawl and to practitioners who wish to check their community’s success in containing sprawl.

Keywords
growth management, transportation, urban form, urban sprawl

Introduction
In 1958, William Whyte in his book \textit{The Exploding Metropolis} referred to a new notion in planning, “Suburban Sprawl,” and alerted Americans that their cities were becoming more sprawling. So began the debate over sprawl and its impacts. There is still little agreement on the definition of sprawl or its alternatives: compact development, pedestrian-
Urban sprawl as a risk factor in motor vehicle crashes

Reid Ewing  
University of Utah, USA

Shima Hamidi  
University of Utah, USA

James B Grace  
US Geological Survey, USA

Abstract
A decade ago, compactness/sprawl indices were developed for metropolitan areas and counties which have been widely used in health and other research. In this study, we first update the original county index to 2010, then develop a refined index that accounts for more relevant factors, and finally seek to test the relationship between sprawl and traffic crash rates using structural equation modelling. Controlling for covariates, we find that sprawl is associated with significantly higher direct and indirect effects on fatal crash rates. The direct effect is likely due to the higher traffic speeds in sprawling areas, and the indirect effect is due to greater vehicle miles driven in such areas. Conversely, sprawl has negative direct relationships with total crashes and non-fatal injury crashes, and these offset (and sometimes overwhelm) the positive indirect effects of sprawl on both types of crashes through the mediating effect of increased vehicle miles driven. The most likely explanation is the greater prevalence of fender benders and other minor accidents in the low speed, high conflict traffic environments of compact areas, negating the lower vehicle miles travelled per capita in such areas.
Is Sprawl Affordable for Americans?
Exploring the Association Between Housing and Transportation Affordability and Urban Sprawl

Shima Hamidi and Reid Ewing

Housing affordability has been one of the most persistent national concerns in the United States, mainly because housing costs are the biggest item in most household budgets. Urban sprawl has been proved by previous studies to be a driver of housing affordability. Previous studies, however, were structurally flawed because they considered only costs directly related to housing and ignored the transportation costs associated with a remote location. This study sought to determine whether, after transportation costs were taken into account, urban sprawl was still affordable for Americans. Multilevel modeling and the recently released location affordability indexes (LAIs) and metropolitan compactness indexes tested the relationship between sprawl and housing affordability. By controlling for covariates, this study found that in compact areas, the portion of household income spent on housing was greater but the portion of income spent on transportation was lower. Each 10% increase in a compactness score was associated with a 1.1% increase in housing costs and a 3.5% decrease in transportation costs relative to income. The combined cost of housing and transportation declined as the compactness score rose. As metropolitan compactness increased, transportation costs decreased faster than housing costs increased, creating a net decline in household costs. This is a novel finding, conditioned only on the quality of the data on which the LAI is based.

One result was the mortgage crisis and ensuing wave of foreclosures that swept the United States in the late 2000s and directly helped precipitate the global financial crisis (the Great Recession). Under traditional metrics of affordability, lenders granted loans to families who were unable to maintain mortgage payments, in many cases because of the crushing costs of transportation in an environment with record high prices for motor vehicle fuel. Foreclosures were centered in the Sunbelt states of Arizona and Nevada, where rapid suburban and exurban development occurred in automobile-dependent areas with virtually no transit access and no ability to walk to anything.

The recent foreclosure crisis raises the question of whether, after transportation costs are taken into account, urban sprawl is still affordable for Americans. This study seeks to answer this question and test the relationship between metropolitan sprawl and housing affordability by using the recently released location affordability indexes (LAIs) (funded by the U.S. Departments of Transportation and of Housing and Urban Development) and compactness indexes funded by the National Institutes of Health and the Ford Foundation. LAIs consider both housing and transportation costs, accounting for locational advantages and disadvantages usually ignored in housing affordability studies.
Relationship between urban sprawl and physical activity, obesity, and morbidity – Update and refinement

Reid Ewing *, Gail Meakins 1, Shima Hamidi 2, Arthur C. Nelson 3

Department of City and Metropolitan Planning, College of Architecture and Planning, 375 S 1530 E RM 235, Salt Lake City, UT 84112, USA

ARTICLE INFO

Article history:
Received 11 April 2013
Received in revised form
10 December 2013
Accepted 15 December 2013
Available online 21 December 2013

Keywords:
Obesity
Compactness
Sprawl
Physical activity
Built environment

ABSTRACT

Aims: This study aims to model multiple health outcomes and behaviors in terms of the updated, refined, and validated county compactness/sprawl measures.

Methods: Multiple health outcomes and behaviors are modeled using multi-level analysis.

Results: After controlling for observed confounding influences, both original and new compactness measures are negatively related to BMI, obesity, heart disease, high blood pressure, and diabetes. Indices are not significantly related to physical activity, perhaps because physical activity is not defined broadly to include active travel to work, shopping, and other destinations.

Conclusions: Developing urban and suburban areas in a more compact manner may have some salutary effect on obesity and chronic disease trends.

© 2013 The authors. Published by Elsevier Ltd. All rights reserved.
NATURAL EXTENSION TO COVID-19
Does Density Aggravate the COVID-19 Pandemic?
Early Findings and Lessons for Planners

Shima Hamidi  Sadegh Sabouri  Reid Ewing

ABSTRACT
Problem, research strategy, and findings: The impact of density on emerging highly contagious infectious diseases has rarely been studied. In theory, dense areas lead to more face-to-face interaction among residents, which makes them potential hotspots for the rapid spread of pandemics. On the other hand, dense areas may have better access to health care facilities and greater implementation of social distancing policies and practices. The current COVID-19 pandemic is a perfect case study to investigate these relationships. Our study uses structural equation modeling to account for both direct and indirect impacts of density on the COVID-19 infection and mortality rates for 913 U.S. metropolitan counties, controlling for key confounding factors. We find metropolitan population to be one of the most significant predictors of infection rates; larger metropolitan areas have higher infection and higher mortality rates. We also find that after controlling for metropolitan population, county density is not significantly related to the infection rate, possibly due to more adherence to social distancing guidelines. However, counties with higher densities have significantly lower virus-related mortality rates than do counties with lower densities, possibly due to superior health care systems.

Takeaway for practice: These findings suggest that connectivity matters more than density in the spread of the COVID-19 pandemic. Large metropolitan areas with a higher number of counties tightly linked together through economic, social, and commuting relationships are the most vulnerable to the pandemic outbreaks. They are more likely to exchange tourists and businesspeople within themselves and with other parts, thus increasing the risk of cross-border infections. Our study concludes with a key recommendation that planners continue to advocate dense development for a host of reasons, including lower death rates due to infectious diseases like COVID-19.

Keywords: COVID-19, density, infectious diseases, pandemic, urban sprawl
“The pandemic has been particularly devastating to America’s biggest cities, as the virus has found fertile ground in the density that is otherwise prized.” (New York Times, April 23, 2020)
“It's very simple. It's about density. It's about the number of people in a small geographic location allowing that virus to spread. ... Dense environments are its feeding grounds.”

(Governor Cuomo, Quoted By CNN, May 2, 2020)
Density vs. Metropolitan Size

New York-Newark-Jersey City MSA
(pop = 19,990,592)

Albany-Schenectady-Troy MSA
(pop = 880,481)

Schenectady County
Density= 1100
Death rate= 1.86

Dutchess County
Density= 518
Death rate= 4.63

New York-Newark-Jersey City MSA
(pop = 19,990,592)

The darker color represents higher density
Density vs. Crowding

Miami Beach, FL


Collin County, TX

https://foursquare.com/scruffyduffies?openPhotoId=506ca4b9e4b0280a130d7f0
Built Environment, Urban Sprawl, and Highly Contagious Infectious Diseases

- H1N1 (Swine Flu) 2009
- Ebola 2014
- COVID-19

Spanish Flu 1918, Arizona (Source: www.azcentral.com)
Dynamics Behind a Pandemic Spread Are Highly Complex

- Sociodemographic Characteristics
- Social Inequities
- Access to Resources, Workplace Policies, Job Security, etc.
- Travel & Tourism
- Healthcare Facilities and Measures of Social Distancing
Conceptual Framework and Research Design

Modeling Approach:

Structural Equation Modeling (SEM)

County density

(Direct)

COVID-19 infection rates

COVID-19 mortality rates

COVID-19 mortality rates

COVID-19 mortality rates

County density

COVID-19 infection rates

County density

COVID-19 infection rates
Sources of Raw Data:
ACS 2017, Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE), Federal Aviation Administration.
Explanatory Variables (Part II)

Sources of Raw Data:
ACS 2017, LEHD 2017, County Health Ranking (RWJF) 2020, Centers for Medicare & Medicaid Services 2019, COVID Tracking Project, Maryland Transportation Institute
Data

Unit of Analysis: County

# of Counties: 913

Date: May 25, 2020
Outcome Variables:
1- (Natural Log of) Confirmed Cases of Coronavirus Per 10,000 Population
2- (Natural Log of) Confirmed Deaths Per 10,000 Population Due to COVID-19
Effects of Density, Socioeconomic and Healthcare Characteristics on COVID-19 Infection Rate

- ln of activity density
- % of Black population
- % of population aged 60 +
- % of college educated population
- ln of MSA population
- COVID-19 testing rate
- enplanement rate
- % staying at home

COVID-19 Infection Rate
Effects of Density, Socioeconomic and Healthcare Characteristics on COVID-19 Mortality Rate

- % of smokers
- % of Black population
- In of virus rate
- % of population aged 60 +
- In of MSA population
- In of activity density
- ICU bed rate
- % staying at home

COVID-19 Mortality Rate
### Direct, Indirect, and Total Effects on COVID-19 Mortality Rate

<table>
<thead>
<tr>
<th></th>
<th>Direct Effect</th>
<th>Indirect Effect</th>
<th>Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln of activity density</td>
<td>-0.118</td>
<td>0.005</td>
<td>-0.113</td>
</tr>
<tr>
<td>ln of MSA population</td>
<td>0.087</td>
<td>0.132</td>
<td>0.219</td>
</tr>
<tr>
<td>enplanement rate</td>
<td>0</td>
<td>-3E-06</td>
<td>-3E-06</td>
</tr>
<tr>
<td>COVID-19 testing rate</td>
<td>0</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>% of population aged 60+</td>
<td>0.048</td>
<td>-0.021</td>
<td>0.028</td>
</tr>
<tr>
<td>% of college educated population</td>
<td>0</td>
<td>-0.020</td>
<td>-0.020</td>
</tr>
<tr>
<td>% of Black or African American population</td>
<td>0.003</td>
<td>0.017</td>
<td>0.021</td>
</tr>
<tr>
<td>% of smokers</td>
<td>0.021</td>
<td>0</td>
<td>0.021</td>
</tr>
<tr>
<td>ICU bed rate</td>
<td>-0.029</td>
<td>0</td>
<td>-0.029</td>
</tr>
<tr>
<td>ln of virus rate</td>
<td>0.974</td>
<td>0</td>
<td>0.974</td>
</tr>
<tr>
<td>% staying at home</td>
<td>0.044</td>
<td>0.055</td>
<td>0.099</td>
</tr>
</tbody>
</table>
Follow Up Research

✓ Cross-Sectional $\rightarrow$ Longitudinal/Time-Series
Follow Up Research

✓ Almost Consistent Findings With Our First Study
✓ Findings:
  ✓ Large Metropolitan Size $\rightarrow$ Significantly Higher COVID-19 Infection and Mortality Rates
  ✓ County Density $\rightarrow$ Significantly Lower COVID-19 Infection and Death Rates
Planners Should Continue to Advocate for Compact Development

- “According to a survey in May 2020, about 27% of adults and 43% of millennials who were surveyed are considering moving to suburban and exurban areas. Businesses are following them with suburban office relocations.”

- “The United States Commercial Real Estate Services (CBRE) reports that, in the first quarter of 2020, nine out of 10 largest office markets in the US recorded an increase in downtown vacancy rates of 30 basis points as compared to the 10-basis points in suburban areas.”

- “Planners should continue to practice and advocate for compact places rather than sprawling ones due to several environmental, transportation, health, and economic benefits of compact development confirmed by dozens of empirical studies.”
Concluding Remarks

“The fact that density is unrelated to confirmed virus infection rates and inversely related to confirmed virus death rates is important, unexpected, and profound. It has implications for community design, regional planning, transportation expenditures, urban redevelopment, tax policy, congestion pricing, smart growth, affordable housing, and nearly every other front-burner issue important to planners.”

(Hamidi et al., 2020)


Shima Hamidi (shamidi2@jhu.edu)
Sadegh Sabouri (Sadegh.Sabouri@utah.edu)
Reid Ewing (ewing@arch.utah.edu)

Thank you
Q&A Session
What are your questions?