Role of transportation and land use in obesity

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Outline

• Transportation elements
  – Street connectivity and walking
  – Traffic
  – Cycling infrastructure
  – Mass transit

• Land development elements
  – Land use, density

• The package of the above
Street connectivity and sidewalks

- Higher connectivity: shorter distances; safety from traffic
- RESIDE project, Perth (AU) Knuiman et al 2014
  - n=1813 participants into 73 new developments, 2003-2012
  - Street connectivity associated with higher walking

Street connectivity and sidewalks

• Higher connectivity: shorter distances; safety from traffic
• RESIDE project, Perth (AU) Knuiman et al 2014
  – n=1813 participants into 73 new developments, 2003-2012
  – Street connectivity associated with higher walking
  – Yet
    • “In low-density cities such as in Australia, installing sidewalks in established neighborhoods as a single intervention is unlikely to cost-effectively improve health” Veerman et al 2016
  – In dense areas, with mixed uses, key
Traffic

- High traffic around home associated with higher obesity in children Jerrett et al 2010
  - N=3318 So Cal children, 9-10 yrs. old at baseline (1993-96); followed until they were 18 yrs. old
  - Figure shows predicted BMI difference between 90th and 10th percentile in traffic
    - 0.27 higher BMI → 5% higher BMI by age 18
    - Small effect, but breadth of impact relevant
Cycling infrastructure

- Commuting and Health in Cambridge Study Mytton et al 2016
  - 2009-2012; n=809 adults
  - Maintenance of active commuting over one year had 1.14 lower BMI at the end of that year
    - Adjusting for socio-demographics; walking; well-being; other physical activity

Source: Monsere et al, 2012
Cycling infrastructure

- New bicycle lanes in Salt Lake City, Brown et al, 2016
  - Tracked bicycling activity over two years using accelerometers and GPS loggers
    • Pre-post construction, n=536 adults (MAPS study)
  - Greater use of a urban bicycle lane related to lower BMI and more calories burned

Source: Transportation for America, 2017

Mass transit

- In US, transit walkers added a median of 21 minutes daily while walking to and from transit Freeland et al 2013
  - Roughly 99 calories per day
Mass transit

• Pre- and post-construction studies
  – Charlotte Lynx, MacDonald et al 2010
  • Lower BMI, lower obesity for new LRT users

Mass transit

- Pre- and post-construction studies
  - Charlotte Lynx, MacDonald et al 2010
    - Lower BMI, lower obesity for new LRT users
  - Salt Lake City, Brown et al 2015
    - New users
      - Lower BMI
      - More moderate or vigorous physical activity
    - Former (bus) users
      - Gained weight
      - Were more sedentary, engaged in less activity

Source: Brown et al, 2015

**Cars**

- California ecological analysis, at county level

**Time spent commuting and miles traveled associated with higher obesity**

Source: Lopez-Zetina et al 2006

Cars
• California ecological analysis, at county level

Time spent commuting and miles traveled associated with higher obesity

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Land development

• Mixing of land uses
  – Recent review of 92 studies
    • “Land use mix and urban sprawl were more consistently associated with overweight or obesity than other physical environmental factors” Mackenbach et al 2014

• Density
  – An antithesis to “sprawl”
  – Cost effectiveness of destinations, sidewalks
Bringing transportation and land development together: The “package”

• Walkability
  – Density, land use mix, connectivity, safety, overall location
  – As a score or index (walkscore®, walkability index, etc.)

• IPEN 17 city, 12-country study, n=14,222
  – Walkability index negatively related to odds of being overweight/obese and to BMI De Bourdeaudhuij et al 2015

Bringing transportation and land development together: The “package”

• NIK study
  – n=730 families
  – Seattle and San Diego

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<thead>
<tr>
<th></th>
<th>High-High</th>
<th>Low-Low</th>
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<tbody>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
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<tr>
<td>Environment (PAE)</td>
<td>Ob* 7.7%</td>
<td>Ob 15.9%</td>
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<tr>
<td>Nutrition Environment (NE)</td>
<td>Ow† 23.7%</td>
<td>Ow 31.7%</td>
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Adjusting for parent weight status, race/ethnicity, income, household size, etc.

* p=0.02
† p=0.08

Bringing transportation and land development together: The “package”

- **MESA study** Hirsch et al 2014
  - Baltimore, Chicago, Forsyth County, Los Angeles, New York, St. Paul
  - n= 5506 adults, 45-84 without CVD at baseline
  - BMI and WC assessed at baseline (2000-2) and four subsequent visits (2010-12)
  - Development intensity associated with less pronounced increase BMI, decrease in WC

Adjusting for age, gender, race/ethnicity, education, income, employment, marital status, car ownership, health status, cancer, alcohol, smoking, and time in transport

- Development intensity
- Connected retail centers
- Public transportation

Bringing transportation and land development together: The “package”

- MESA again Hirsch et al 2014b
  - n=subset of 701 participants that moved (2004-2012), with walkscore® (range 0-100)

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<thead>
<tr>
<th>Variable</th>
<th>Change or OR (9% CI)</th>
<th>P</th>
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<tr>
<td>Transport walking</td>
<td></td>
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<tr>
<td>Mean change in mins</td>
<td>16.04 (5.12, 26.96)</td>
<td>.004</td>
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<tr>
<td>OR of meeting everybody walks</td>
<td>1.11 (1.02, 1.21)</td>
<td>.01</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
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<tr>
<td>Mean change in BMI</td>
<td>-0.06 (-0.12, -0.01)</td>
<td>.02</td>
</tr>
<tr>
<td>OR of becoming a higher BMI category</td>
<td>1.00 (0.97, 1.02)</td>
<td>.79</td>
</tr>
</tbody>
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After adjusting for time-varying age, income, season, working status, health compared with others, arthritis, cancer diagnosis, and for BMI transport and leisure walking.
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- Southern Ontario CA Creatore et al 2016
  
  - Outcomes
    - Annual prevalence of OW and Obesity from community health survey participants 2001-2012
    - Incidence of diabetes
  
  - Exposures
    - Density
    - Destinations
    - Street connectivity
    - Walkability, in quintiles

Bringing transportation and land development together: The “package”

- Southern Ontario CA

Adjusted Prevalence of Overweight and Obesity Among Adults Aged 30 to 64 Years and Living in Urban Areas, by Walkability Quintile, 2001-2012

Error bars indicate 95% CIs around prevalence

Source: Creatore et al 2016
Conclusions

• Magnitude of challenge (and the potential of actions)
  – Nationally, 53% of population (~170 million) in suburban environments
    • Using a meager 4 household per acre
• Planners at the heart of the issue
  – Transportation, land use, community development
  – Both as contributing cause and remedy
• Stitching together change

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<tr>
<th>Metro</th>
<th>Share of households living in low-density neighborhoods (&lt;1 household per acre)</th>
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<tbody>
<tr>
<td>Los Angeles-Long Beach-Anaheim, CA</td>
<td>5.1 percent</td>
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<tr>
<td>Miami-Fort Lauderdale-West Palm Beach, FL</td>
<td>7.7 percent</td>
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<td>San Jose-Sunnyvale-Santa Clara, CA</td>
<td>9.6 percent</td>
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<td>San Francisco-Oakland-Hayward, CA</td>
<td>11.5 percent</td>
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<tr>
<td>Las Vegas-Henderson-Paradise, NV</td>
<td>11.7 percent</td>
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<tr>
<td>New York-Newark-Jersey City, NY-NJ-PA</td>
<td>13.2 percent</td>
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<tr>
<td>Salt Lake City, UT</td>
<td>13.4 percent</td>
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<td>San Diego-Carlsbad, CA</td>
<td>14.2 percent</td>
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<td>Denver-Aurora-Lakewood, CO</td>
<td>17.2 percent</td>
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<td>Urban Honolulu, HI</td>
<td>17.3 percent</td>
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Source: Census

Kolko, 2105