Multiple pathways from the built environment to health

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Global Health BSc
Urban planning and public health: Historical grounding

• Urban sanitary movement mid-19th century
  - Miasma theories - epidemics disease outbreak caused by filth and foul air
  - Frederick Law Olmsted, John H Rauch, Edwin Chadwick, Baron Haussmann, Ildefons Cerdà

• Planning focussed on the need for:
  – sunlight, ventilation, greenery, waste disposal including good drainage systems (sewers)
Empirical evidence of the built environment affecting our health

• Sprawl:
  – Traffic fatalities, especially pedestrian (Ewing et al 2003).

• Neighborhood factors (sidewalks, “walkability”, land use mix, density):
  – Mental health (Berke et al. 2007)

• Neighborhood “greenness”
  – Morbidity (Maas et al. 2009)
  – Obesity (Rundle et al. 2007, Tilt et al. 2007)
  – Mental health (Kaplan and Kaplan 1989, Weich et al. 2002)
Urban planning and public health: recent movements for creating healthier cities

Healthy Cities, Smart Growth, Active Living, New Urbanism
Behavior

• Travel mode choice
• Physical activity
• Social capital
• Diet

Society

Natural Environment

Built Environment

Health

Quality of Life
Travel mode choice

Determinants: 3 “D”s

• Density – dense land uses, dense and efficient transportation network

• Diversity – mix of land use types

• Design – “human scale”, building orientation, block length, parking location, landscaping, pedestrian and cycling amenities, etc
Physical activity

- People having nearby shops, public transit, sidewalks, bicycle facilities, and recreational facilities, were 20–50% more likely to meet physical activity guidelines (Study of 11 countries, Sallis et al. 2009).
Social capital and crime

• Social contact between neighbors is enhanced when there are opportunities for passive social contact, proximity between neighbors, and an appropriate space in which to interact.

• Designs that provide “Eyes on the street” prevent crime.
Diet and Nutrition

• Are pedestrian-friendly environments also healthy-foods environment?

• Is there an interaction between diet and activity?
Society

Environmental Quality

Built Environment

Health

Quality of Life

Behavior

- Mode choice and emissions
- Mode choice and exposures
- Land use and natural resources
Transportation behavior and emissions

Vehicle use generates:

- Emissions of air pollutants (typically largest contributor in urban environments)
- Green house gases (transport: 23% of emissions worldwide)
- Traffic noise

<table>
<thead>
<tr>
<th>EU city scenario</th>
<th>CO2</th>
<th>CO</th>
<th>VOC</th>
<th>NOx</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>% reduction in pollutant emissions</td>
<td>17.3</td>
<td>25.3</td>
<td>25.6</td>
<td>11.7</td>
<td>16.7</td>
</tr>
<tr>
<td>30% reduction in passenger car urban VMT</td>
<td>17.3</td>
<td>25.3</td>
<td>25.6</td>
<td>11.7</td>
<td>16.7</td>
</tr>
</tbody>
</table>
Travel mode choice and exposures

Mode choice and exposures:

- Air pollution
- Noise
- UV
- Heat

Exposure in travel modes in Barcelona, Spain

UFP concentration

<table>
<thead>
<tr>
<th>Mode</th>
<th>UFP concentration (pt/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>20000</td>
</tr>
<tr>
<td>Bike</td>
<td>40000</td>
</tr>
<tr>
<td>Bus</td>
<td>60000</td>
</tr>
<tr>
<td>Car</td>
<td>80000</td>
</tr>
</tbody>
</table>

Inhaled UFP in 24 hours

<table>
<thead>
<tr>
<th>Mode</th>
<th>Inhaled UFP (pt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>50</td>
</tr>
<tr>
<td>Bike</td>
<td>100</td>
</tr>
<tr>
<td>Bus</td>
<td>150</td>
</tr>
<tr>
<td>Car</td>
<td>200</td>
</tr>
</tbody>
</table>
Natural Resources

impacts of auto-oriented environments and urban sprawl:

- Polluted runoff from vehicle use (e.g. heavy metals, nitrogen loads) into waterways
- Increased impervious surfaces and effects on water quality and quantity, flooding, and vectors of disease
- Loss of farmland, forests, wetlands and open space
- Land fragmentation and effects on natural habitats and vectors of disease
Physical inactivity

Figure 6: Deaths attributed to 19 leading risk factors, by country income level, 2004.

- Estimated effect of anthropogenic PM2.5 on life expectancy in months
- Contributes worldwide to:
  - 21.5% of ischemic heart disease
  - 11% of ischemic stroke
  - 14% of diabetes
  - 16% of colon cancer
  - 10% of breast cancer

WHO Burden of Disease ranking

Large scale prospective study in Copenhagen: bike commuting can reduce the risk of premature mortality by approximately one third (Andersen et al., 2000).

Contributes worldwide to:
- 21.5% of ischemic heart disease
- 11% of ischemic stroke
- 14% of diabetes
- 16% of colon cancer
- 10% of breast cancer
Estimated effect of anthropogenic PM2.5 on life expectancy in months worldwide, #8 in high income countries.

Worldwide accounts for:
- 3% of mortality from cardiopulmonary disease;
- 1% of mortality from acute respiratory infections in children under 5 yr.
Traffic injuries

Cycling Fatality Rates in Europe and North America, 2002/2005 (Cyclist deaths per 100 million km cycled)
Pucher 2008
HEALTH AND OTHER EXPOSURES

- Green space
- Social interaction
- Congestion
- Time spent in a car
- Diet
- Food and water contamination (from deposition on crops and waterways)
- Vectors of disease (mosquitoes, lyme disease)
- Climate change
The built environment may impact the good functioning of society because of:

- The lack of time/place for social engagement
- Social inequities it can trigger
- The economic costs it can impose
Discussion

- Urban planning policies have multi-faceted interconnected impacts on health
- Relevant to consider the built environment holistically, as a complex system
  - Feedback effects
  - Synergies
  - Unintended consequences
- Simplifications are necessary, however
  - Lack of knowledge
  - Magnitude and importance of effect - prioritizing
Example: Barcelona BICING case study

Inaugurated March 2007

In 2009: 182 000 subscribers
6000 bikes
425 stations

The health risks and benefits of cycling in urban environments compared with car use: health impact assessment study

David Rojas-Rueda predoctoral researcher, Audrey de Nazelle researcher, Marko Tainio researcher, Mark J Nieuwenhuijsen research professor
Simplified model: impacts of the bicing program on mortality

- Mortality impacts on Bicing users “new” to cycling:
  - 25,427 bicing users
  - 4.93 km/work-day

PhD student: David Rojas
Results: mortality in new cyclist population

<table>
<thead>
<tr>
<th></th>
<th>Air pollution</th>
<th>Traffic mortality</th>
<th>physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Risk Bike vs Car</td>
<td>1.002</td>
<td>1.0007</td>
<td>0.80</td>
</tr>
<tr>
<td>Attributable fraction of mortality</td>
<td>0.002</td>
<td>0.0007</td>
<td>-0.23</td>
</tr>
<tr>
<td>Deaths / year</td>
<td>+0.13</td>
<td>+0.03</td>
<td>-12.46</td>
</tr>
</tbody>
</table>
### Comparison with other studies

<table>
<thead>
<tr>
<th>scenario</th>
<th>physical activity</th>
<th>Air pollution</th>
<th>Traffic mortality</th>
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<tbody>
<tr>
<td><strong>Our study, Barcelona: deaths in new cyclist population (25 427)</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bicing</td>
<td>-12.46</td>
<td>+0.13</td>
<td>+0.03</td>
</tr>
<tr>
<td><strong>De Hartog et al. (2010), Holland: years of life gained per 500 000 shifting mode</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mode shift car to bike</td>
<td>+337 896</td>
<td>-28 135</td>
<td>-9 639</td>
</tr>
<tr>
<td><strong>Rabl &amp; de Nazelle (2011), Europe: mortality cost per individual who shifts from car to bike (Euros/year)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode shift car to bike</td>
<td>+1 310</td>
<td>-17.5</td>
<td>-105</td>
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Seminar

• Comments, questions, clarifications, critiques?
• What was not covered in this overview?
  – Elements
  – Synergies, feedbacks
  – Unintended consequences
• What would be relevant to consider in your own city?
• How might improvements for health-enhancing cities come about? (how to make it happen?)
• How useful would it be to develop a comprehensive health impact assessment of planning policies in your city?