Links Between Public Transportation and Physical Activity

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Links Between Public Transportation and Physical Activity

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TREC/PSU Friday Transportation Seminar Series
November 7, 2014
My Journey

- Health psychology
  - Focus on health behavior change
  - Long history of examining individual-level factors
- Exposure to urban planning and transportation
  - Paradigm shift (good mentoring)
  - Critical physical activity and health behaviors
  - Link to environment, spatial data and methodology
- Researcher! practitioner? dangerous?
Objectives

- Rationale for public transportation focus within physical activity
- Evidence for link between public transport and physical activity (with increasing confidence?)
  - Transit-specific physical activity
  - Transit users versus non-users in overall physical activity
  - Same people, device-based transit specific
- ‘Natural experiments’
- Future work
U.S. death (thousands) risk factors

- Tobacco smoking
- High blood pressure
- Overweight-obesity (high BMI)
- Physical inactivity
- High blood glucose
- High LDL cholesterol
- High dietary salt
- Low dietary omega-3 fatty acids
- High dietary trans fatty acids
- Alcohol use
- Low intake of fruits and vegetables
- Low dietary polyunsaturated fatty acids

Danaei PLoS Medicine 2009
Percentage Meeting Physical Activity Recommendations in U.S. (Adults)

NHANES 2005-2006; Tucker 2011 AJPM
At Your Job?

[Graph showing the percentage change in total private US jobs from 1960 to 2010, with categories for light (2.0 to 2.9 METS), sedentary (<2 METS), and moderate (≥3.0 METS).]
Not likely at your job
At Home?

<table>
<thead>
<tr>
<th>Home (51% of total time)</th>
<th>Physical activity</th>
<th>Sedentary or light activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4%</td>
<td>95.6%</td>
<td></td>
</tr>
</tbody>
</table>

Hurvitz 2014 Prev Med
- PA programs among healthy adults - +14.7 minutes per week (only 2.1 mins/day!)
- Only get those already interested in physical activity (the ‘gym’ effect)
- Poor maintenance of effects after the program ends
- Programs require on-going funding and often end
- For those with resources (time, money)

Conn 2011 AJPH
Risk is Not Equitable

Indicator: Percent of Adults Who Are Obese, Health Reporting Areas, King County, 2007-2011

Legend

- Adult obesity rate
  - 29% - 35%
  - 23% - 28%
  - 17% - 22%
  - 10% - 16%

Rate = Percent of adults with Body Mass Index >= 30

Source: Washington State Department of Health, Center for Health Statistics, Behavioral Risk Factor Surveillance System supported in part by Centers for Disease Control and Prevention Cooperative Agreement
Produced by: Public Health-Seattle & King County
Assessment, Policy Development & Evaluation
3/13/2013
Comparison of Self-Report and Integrated Objective

U.S. Self-report
- Vigorous: 50.0%
- Other moderate: 22.0%
- Walking: 28.0%

Integrated objective
- Vigorous: 1.1%
- Other moderate: 37.1%
- Walking: 58.5%

Kang 2013 MSSE
Activity By Location: All TRAC Adults

Hurvitz 2014 *Prev Med*
People walk to get to places they want to go when places are nearby.

% of Trips to Shops by Walking
- Within 1 mile - 40%
- Within 3-4 miles - 1%

% of Trips to Work by Walking
- Within 1 mile - 35%
- Within 3-4 miles - 1%

% of Trips to School or Church by Walking
- Within 1 mile - 46%
- Within 3-4 miles - 1%

% of Trips for Social or Recreational Fun by Walking
- Within 1 mile - 60%
- Within 3-4 miles - 5%

SOURCE: USDOT, Federal Highway Administration, 2009 National Household Travel Survey.
Why focus on PA in relation to public transportation?

- Many/most trips are >1/2 mile
- Involves walking – most popular, among easiest
- Part of everyday life (stealth PA?)
- Better address equity?
- Not perceived as physical activity - doesn’t substitute?
Fig. 2. Hypothetical model of walking trips associated with transit use.
Different Designs

- Research design options (cross-sectional)
  - Examine transit-specific physical activity
  - Compare users versus non-users in overall physical activity
  - Person-day level examining both transit-specific and overall

- Threats to conclusions
  - Self-selection bias
    - Third variable confounding
  - Substitution
    - Same people (within transit users)
      - Measuring both global and transit-specific physical activity
Walking Associated with Transit

Walking (mins) to/from Transit

- Bus
- Rail
- <HS degree
- HS degree
- Undergrad
- Grad

<table>
<thead>
<tr>
<th>Mode</th>
<th>&lt;HS degree</th>
<th>HS degree</th>
<th>Undergrad</th>
<th>Grad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>23.7</td>
<td>29.3</td>
<td>24.8</td>
<td>23.0</td>
</tr>
<tr>
<td>Rail</td>
<td>23.9</td>
<td></td>
<td></td>
<td>20.6</td>
</tr>
</tbody>
</table>

NHTS 2001; Besser 2005 AJPM
Walking Trips to/from Transit

Median = 21 minutes walking
Walking by Public Transportation Type

- City bus: 11.7 - 25.6 minutes
- Suburban bus: 15.7 – 29.6 minutes
- Peripheral bus: 25.4 – 39.2 minutes
- Subway: 19.6 – 33.5 minutes
- Commuter train: 34.6 – 48.5 minutes

*Simulated based on distance; range based on # of transfers*
## Walk Distances to LRT

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sampling frame and process</th>
<th>Mean distance</th>
<th>Longest distance walked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beimborn</td>
<td>Portland regional travel diaries</td>
<td>~.24 miles</td>
<td>1.14 miles</td>
</tr>
<tr>
<td>Dill</td>
<td>Portland residents near LRT stations</td>
<td>~.33 miles</td>
<td>~.93 miles</td>
</tr>
<tr>
<td>Kim</td>
<td>St. Louis LRT users</td>
<td>.47 miles</td>
<td>95% walked &lt;1.0 miles</td>
</tr>
<tr>
<td>Olszewski &amp; Wibowo</td>
<td>Interviews at Singapore LRT stations</td>
<td>.40 miles</td>
<td>Upper quartile &gt; .5 miles</td>
</tr>
<tr>
<td>O’Sullivan &amp; Morrall</td>
<td>Interviews at Calgary LRT stations</td>
<td>.40 miles</td>
<td>N/A</td>
</tr>
<tr>
<td>Stringham</td>
<td>Toronto residents near LRT stations</td>
<td>.57 miles</td>
<td>Upper quartile &gt; ~.67 miles</td>
</tr>
<tr>
<td>Weinstein</td>
<td>Interviews at SF &amp; Portland LRT stations</td>
<td>.58 miles</td>
<td>Upper quartile &gt; .69 miles</td>
</tr>
</tbody>
</table>
Differences in PA by Commute Mode

Mode Differences in Steps/Day

Average Daily Steps
Mean/Standard Error

Train
Car

Commuting Mode

Wener 2007 Environ Behav
### Differences in PA by Transit Usage

<table>
<thead>
<tr>
<th>Category</th>
<th>Unadjusted</th>
<th>Adj + high BE</th>
<th>Adj + low BE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-transit user</td>
<td>28.8</td>
<td>33.2</td>
<td>25.7</td>
</tr>
<tr>
<td>Infrequent transit user</td>
<td>37.2</td>
<td>37</td>
<td>37.2</td>
</tr>
<tr>
<td>Frequent transit user</td>
<td>35.7</td>
<td>31.6</td>
<td>34.1</td>
</tr>
</tbody>
</table>

- **Non-transit user**
- **Infrequent transit user (<50%)**
- **Frequent transit user (>50%)**

*Lachapelle 2011 J Phy Act Health*
27 studies

Between 8-33 minutes of physical activity associated with public transport (several studies 12-15 minutes)

10-29% of population met 30+ minutes of daily physical activity (recommended) just by public transport-related walking
Transit Frequency and Walking/PA

<table>
<thead>
<tr>
<th>Category</th>
<th>Transit walking</th>
<th>Non-transit walking</th>
<th>Non-walking PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not transit user</td>
<td>0</td>
<td>16</td>
<td>11.9</td>
</tr>
<tr>
<td>Low transit use (&lt;30% of days)</td>
<td>2.3</td>
<td>13.5</td>
<td>16.2</td>
</tr>
<tr>
<td>Medium transit use (31-59% of days)</td>
<td>6.5</td>
<td>21.7</td>
<td>27.8</td>
</tr>
<tr>
<td>High transit use (60+% of days)</td>
<td>14.8</td>
<td>21.7</td>
<td>40.5</td>
</tr>
</tbody>
</table>

Saelens 2014 AJPH
Transit-Related Physical Activity is Additive!

- Non-walking PA
- Walking (not transit-related)
- Walking (transit-related)

Non-transit users:
- 0 minutes per day
- 15.9 minutes per day (SD=19.1)
- 21.5 minutes per day (SD=23.9)

Transit users (non-transit days):
- 0 minutes per day
- 12.2 minutes per day (SD=20.0)
- 24.6 minutes per day (SD=24.9)

Transit users (transit days):
- 14.6 minutes per day (SD=12.5)
- 22.1 minutes per day (SD=23.7)
- 22.1 minutes per day (SD=23.7)
Current Work

- Natural experiment or ‘intervention’ effects
  - Level of impact, for whom, for how long?
- Interaction of infrastructure/service changes with programmatic interventions
- Documentation of costs- How much? To whom?
Travel Assessment and Community (TRAC) Project

- A natural experiment in which an environment changed
  - Addresses some concern about residential self-selection confounding
  - Relative to a demographically and built environment matched sample
  - Examine behavior change in response to environmental change (temporality)
- Use the best possible set of methods to evaluate physical activity and context
TRAC Design & Methods

- Pre-post group-matched cohort design
  - ‘Cases’ – adults living < 1 mile from LRT station
  - ‘Controls’ – adults in county living >1 mile from LRT station
- Attitudinal/psychosocial survey
- Congruent (for 7 days)
  - Accelerometer
  - Portable GPS
  - Travel log (place-based)
- Approximately 700 baseline participants
  - >500 participants 3-4 years later
TRAC: Preliminary Findings

Walking near LRT station

Minutes per day

Overall daily walking

Pre
Post 1

0-0.25 miles
0.25 - 0.50 miles
0.50 - 0.75 miles

0-0.25 miles
0.25 - 0.50 miles
0.50 - 0.75 miles
# BRT ridership growth

<table>
<thead>
<tr>
<th>BRT line (year open)</th>
<th>Baseline (before BRT) regular bus ridership per day</th>
<th>BRT ridership per day</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (2010)</td>
<td>5570</td>
<td>8236</td>
<td>48%</td>
</tr>
<tr>
<td>B (2011)</td>
<td>5070</td>
<td>5763</td>
<td>14%</td>
</tr>
<tr>
<td>C (2012)</td>
<td>4650</td>
<td>6684</td>
<td>44%</td>
</tr>
<tr>
<td>D (2012)</td>
<td>7630</td>
<td>8527</td>
<td>12%</td>
</tr>
<tr>
<td><strong>Totals (to date)</strong></td>
<td><strong>22920</strong></td>
<td><strong>29209</strong></td>
<td><strong>27%</strong></td>
</tr>
<tr>
<td>E (2014)</td>
<td>15304</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>F (2014)</td>
<td>8274</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>
ACTION Project Model

In Motion program

Individual-level factors
- travel attitudes/intentions
- perceived environment

BRT Exposure

Environmental-level factors
- BRT station environment
- neighborhood environment

Transit use

Physical activity
Get In Motion, North Seattle & Shoreline!

King County Metro is here to help you explore North Seattle, Shoreline, and beyond by walking, bicycling, riding the bus, and sharing rides.

Sign up below and choose your transportation information, including an ORCA card good for two weeks of unlimited travel*, and we’ll send it all right to your door at no cost to you.

Pledge to shift two or more round trips per week from driving alone to another option. Log those trips online or by postcard, and you’ll be entered into weekly reward drawings!

WHO IS ELIGIBLE?
You must live in North Seattle or Shoreline, be 16 or older, and have at least one car in the household.

Don’t have a car?
Become a Car-Free Champion!
Earn rewards by sharing your story. Instead of filling out this form, just contact us to learn more.

Questions? Call us at 206-477-2005 or email inmotion@kingcounty.gov

SIGN UP NOW & EARN REWARDS.

Stay connected! Facebook King County In Motion or Twitter @kcmetrobus

Sign up at kingcounty.gov/inmotion or mail us your completed form.
1. Pledge to Drive Less
Comprométase a Manejar Menos

- I pledge to reduce my drive-alone trips by two or more trips each week.
- I will log my trips:
  - online -OR- 
  - by postcard
- If you're not ready to pledge, skip to Step 2.

3. Select Your Resources
Seleccione Sus Recursos

- ORCA Card
- In Motion Tote Bag
- Recursos para Explorar sus Opciones
- Metro Bus Schedules
- Community Transit Bus Schedules
- Bus and ORCA Information
- Walking Maps and Info
- Biking Maps and Info
- Rideshare Information
- Carshare Information
- The Cost of Driving
- ACCESS - for people unable to take the bus

2. Tell Us Where to Send Your Information
Díganos Donde Mandar Su Información

NAME (PLEASE PRINT CLEARLY) / NOMBRE (POR FAVOR ESCRIBA CLARAMENTE)

HOME ADDRESS / DIRECCIÓN DE HOGAR: APT # / # DE APARTAMENTO

CITY / CIUDAD: ZIP / CÓDIGO POSTAL

PHONE / TELÉFONO: EMAIL / CORREO ELECTRÓNICO

Offer available until October 10, 2014 / Oferta disponible hasta el 10 de Octubre, 2014.

*Valid for two weeks from when you receive it: valid on regional buses, trains, streetcar, and ferries as a passenger.
Conclusions and Future Work

• Strong associations between public transportation use and physical activity
• Soon will have evidence about shifts in public transportation infrastructure/access and physical activity impacts
• Making the healthy choice the easy choice (convergence)
  • Interactions between public transportation change and programmatic interventions
    • Example - impact of work-based commute to work policies
Model & Vision:
Likelihood of Making the Healthy Choice

Information about options

Another (healthier) option exists, but unhealthy still easier

Healthy option as easy as less healthy option

Healthier option easier or better to choose than less healthy option
Making the healthy option an easy choice
Making it an easy or easier choice?
Making it a **much easier choice?**
Now: What is the choice?

Drive to work
- Time/convenience (50 mins)
- Cost to park (-$12.00)
- Cost to drive (-$6.00)
- Perceived safety
- Comfort

Not drive to work
- Convenience (bike - 90 mins; transit – 70 mins)
- Savings from not parking or driving
- Paid for not driving (+$4.00)
- Similar comfort?
- Perceived safety (coming)
WHEN YOU WALK IT, YOU ROCK IT
Acknowledgments

- My excellent research staff
- Other investigators within Seattle Children’s University of Washington (Vernez Moudon, Hurvitz)
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