Physical activity & transport in Bogotá: The case of TransMilenio

Olga L. Sarmiento
Outline

1. Context
   - Bus Rapid Transit (BRT) worldwide
   - TransMilenio

2. Aim

3. Methods

4. Results

5. Conclusions & policy implications
Bus Rapid Transit (BRT) & Bus of High Level of Service (BHLS)

“Flexible, rubber-tired form of rapid transit that combines stations, vehicles, services, running ways and information technologies into an integrated system with strong identity” (Levinson, Zimmerman, Clinger, Gast, et al., 2003).

BRT are usually considered part of multimodal transport systems
BRT & BHLS around the world

- 120 cities
- 280 corridors
- 4,300 Km
- 6,700 stations
- 30,000 buses
- 28 million passengers/day

Source: Hidalgo, D., & Gutiérrez, L., BRT and BHLS around the world: Explosive growth, large positive impacts and many issues outstanding, Research in Transportation Economics (2012)
• 30% of the trips in Bogotá are made by public transport (9% TransMilenio)

• TransMilenio buses operate in exclusive lanes with fixed stations ~500m

• Average of 1.2 million passengers per day

• The fastest mode of transport 28km/h

Source: Informe de indicadores, Encuesta de Movilidad de Bogotá 2011, Preparado por la Unión Temporal Steer Davies Gleave & Limited | Centro Nacional de Consultoría and Observatorio de Movilidad 2010
• Having ≥1 TransMilenio stations within the 1000-m buffer of the neighborhood periphery increased the odds of walking for utilitarian purposes (≥150 min/wk) **POR: 1.72 (IC 95% 1.19-2.47), p=0.006**

• Having ≥1 TransMilenio stations within the neighborhood increased the odds of reporting 10-149 min/wk of Leisure activity **POR: 1.3 (IC 95% 1.07-1.50), p=0.009**

Aim

To assess the association between the use of TransMilenio and walking for transport in adults from Bogotá
Methods
30 *neighborhoods* stratification variables:

- SES, slope, proximity to TransMilenio and public park provision

**IPEN**

- Walkability index (median split) and SES (high vs. low)

**Random selection**

- 5 blocks within each neighborhood
  - 10 households within each block
  - 1 adult within each household

18-70 years  N=1000

*Study Population 2010-2011*
Outcome and independent variables

- **Utilitarian physical activity**: minutes of walking for transport during the last 7 days (<150 minutes vs. ≥150 minutes (IPAQ)).

- **Module of transport** designed for IPEN (Curitiba, Cuernavaca and Bogotá)
  - Number of days that the adult used TransMilenio, bus, Car, taxi motorcycle (0 vs. ≥1 day)

- **Sociodemographic characteristics & BMI**

- **Built environment variables** (walkability index, distance to TM, # of TM stations, slope)– 1000m street network buffers around the centroid of the block

- **Multilevel Poisson-model** SAS 9.2 and Stata 12.0
### Characteristics of study population

<table>
<thead>
<tr>
<th>Study Population</th>
<th>N=1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40.1 (SD:14.5)</td>
</tr>
</tbody>
</table>
| Sex                            | Male: 36.3%  
|                                | Female: 63.7% |
| Education level                | <High school: 61.0%  
|                                | ≥High school: 39.0% |
| Socioeconomic status           | 1-2: 49.0%  
|                                | 3-5: 50.7% |
| BMI                            | Normal: 38.2 %  
|                                | Overweight: 44.4%  
|                                | Obesity: 17.4% |
| Car in the household           | 32%     |
Modes of transport in the last 7 days

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Bus</th>
<th>Carro</th>
<th>TransMilenio</th>
<th>Taxi</th>
<th>Alimentador de TransMilenio</th>
<th>Otro</th>
<th>Moto</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68.1</td>
<td>33.2</td>
<td>29.3</td>
<td>29.0</td>
<td>10.4</td>
<td>7.9</td>
<td>5.3</td>
</tr>
</tbody>
</table>
Physical activity & TM

≥150 min/wk

<table>
<thead>
<tr>
<th></th>
<th>TransMilenio user</th>
<th>No TransMilenio user</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>58%</td>
<td>48%</td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p=0.001

51%

Met PA recomendations walking for transport
Adjusted PR and 95% CI for the Association Between Walking ≥ 150min for transport and TM use in the last 7 days

Model adjusted for sex, age, ses, education, occupation, BMI, walkability index, distance to TM and # TM stations, slope
Limitations

• The cross-sectional design of this study did not allow us to infer causality.

• Reliability and validity of PA measures could be overestimated
a. Association between walking for transport 150 minutes per week (30 minutes per day per 5 days) and TransMilenio access
b. Association between walking during leisure time at least 10 minutes and TransMilenio access
c. Association between walking for transportation at least 10 minutes and BRT bus stop number (≥2)
d. Association between walking for transportation at least 10 minutes and bus stop number
e. Association between walking for transportation at least 10 minutes and train use
f. Association between walking 10,000 steps day and public transport use
g. Association between walking 10,000 steps day and public transport use
h. Association between walking for transport (up to 2.4Km/day) and Transit stop distance
Conclusions & policy implications

- Use of public transport contributes to meeting physical activity recommendations.
- TransMilenio users were more likely to walk \( \geq 150 \) minutes compared to non-users of TransMilenio.
  - Manager of TransMilenio SA -- co-benefit of the BRT system
- Continued improvements to public transit systems can lead to lasting improvements to opportunities for physical activity.
What is next....

• Bogotá
  – cross-sectional repeated study
  – Agent based modeling to assess scenarios of walking and TM used with the projected expansion

• IPEN network
  – To assess the association between PA and access to public transportation in 12 countries.
Gracias