# Examining the Impact of a New Light Rail Line on Active Transportation: A Natural Experiment

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TRB/ACSM Moving Active Transportation to Higher Ground
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# Objectives

- Rationale
  - Prior physical activity links to public transportation
  - Rail versus bus transit
- TRAC baseline evidence about walking and public transportation
- TRAC longitudinal quasi-experimental ‘natural experiment’
  - Study design and methods
  - Baseline findings for walking and transit behavior
  - Longitudinal main physical activity outcomes

# Why focus on PA in relation to public transportation?

- Many/most trips are >1/2 mile, so active transportation as a single mode is less likely
- Often involves walking – most popular, among easiest
- Part of everyday life (stealth PA?)
  - Not perceived as physical activity - doesn't substitute?
- Better address health equity (compared to PA programs)?

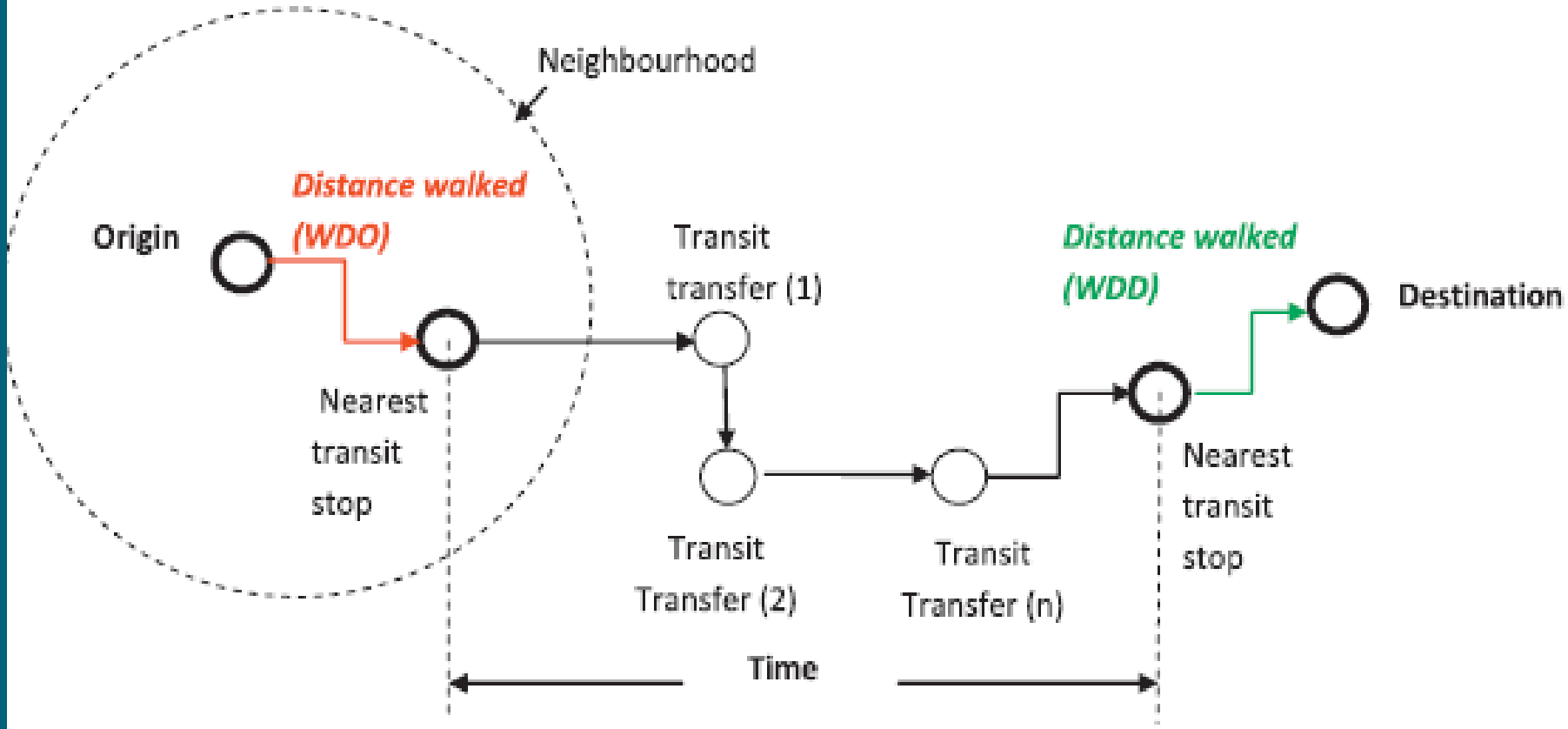



**Fig. 2.** Hypothetical model of walking trips associated with transit use.

Wasfi 2013 *Health Place*

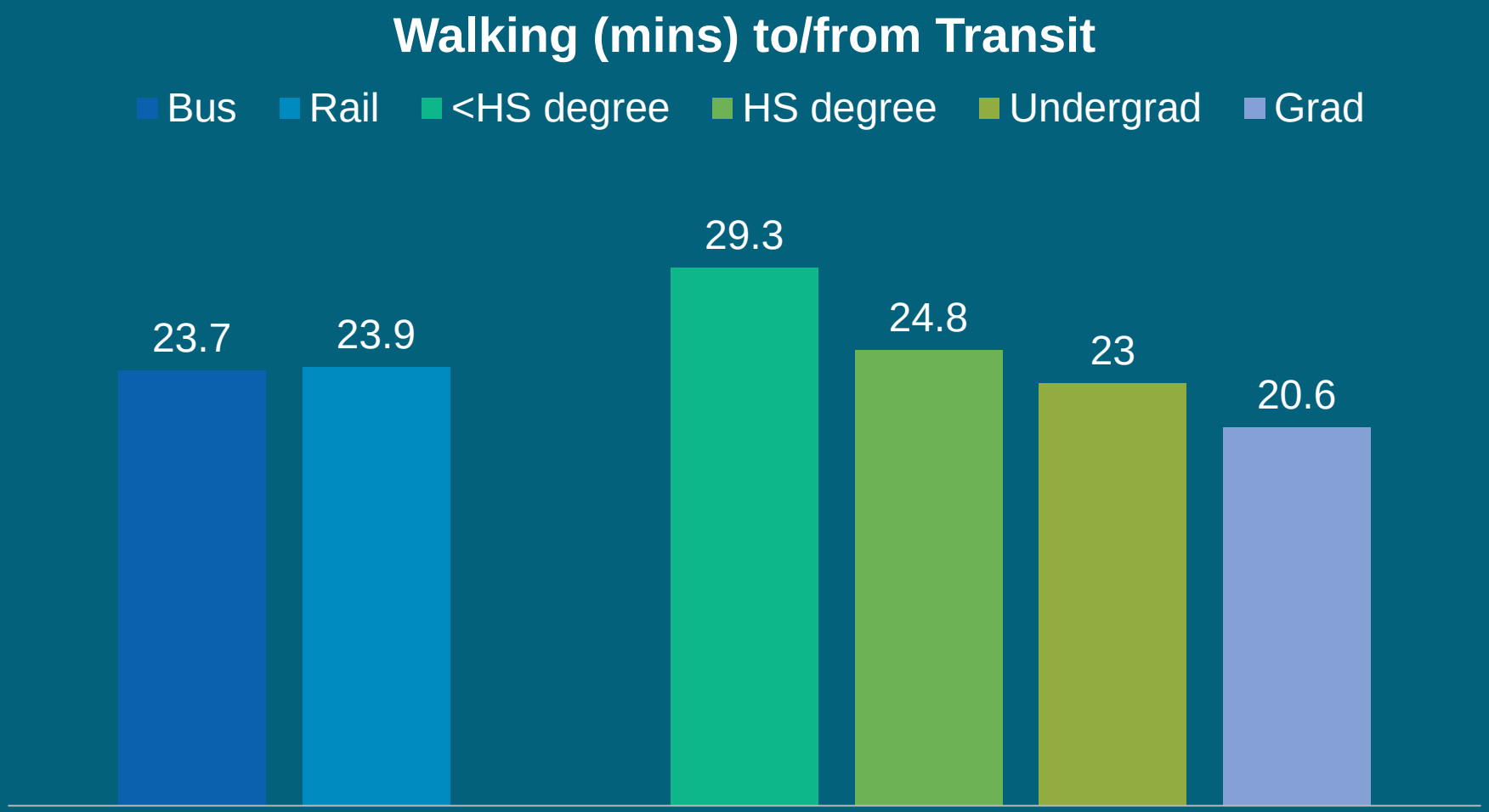
# Walking by Public Transportation Type

- 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

Wasfi 2013 *Health Place*

# Walking Associated with Transit




NHTS 2001; Besser 2005 *AJPM*

# Walking Trips to/from Transit

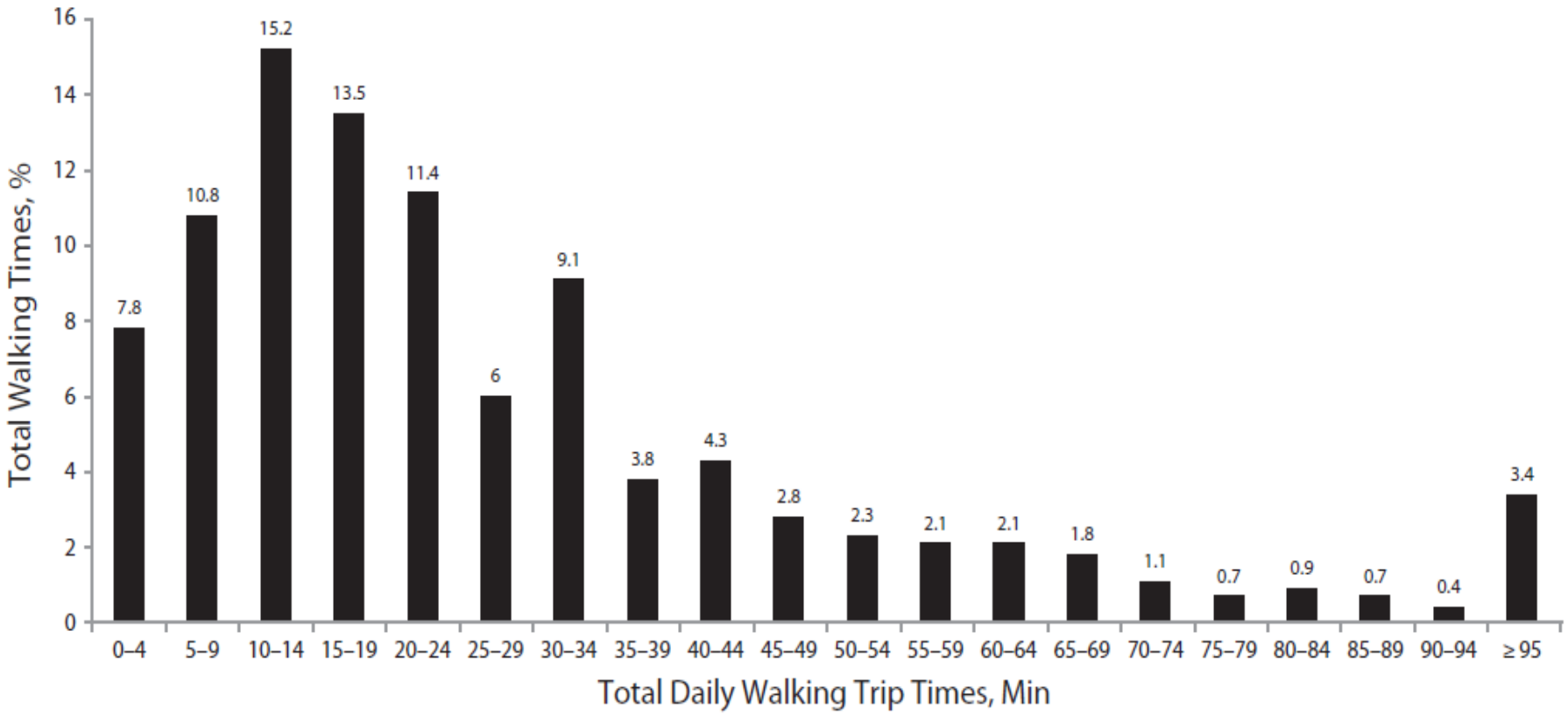
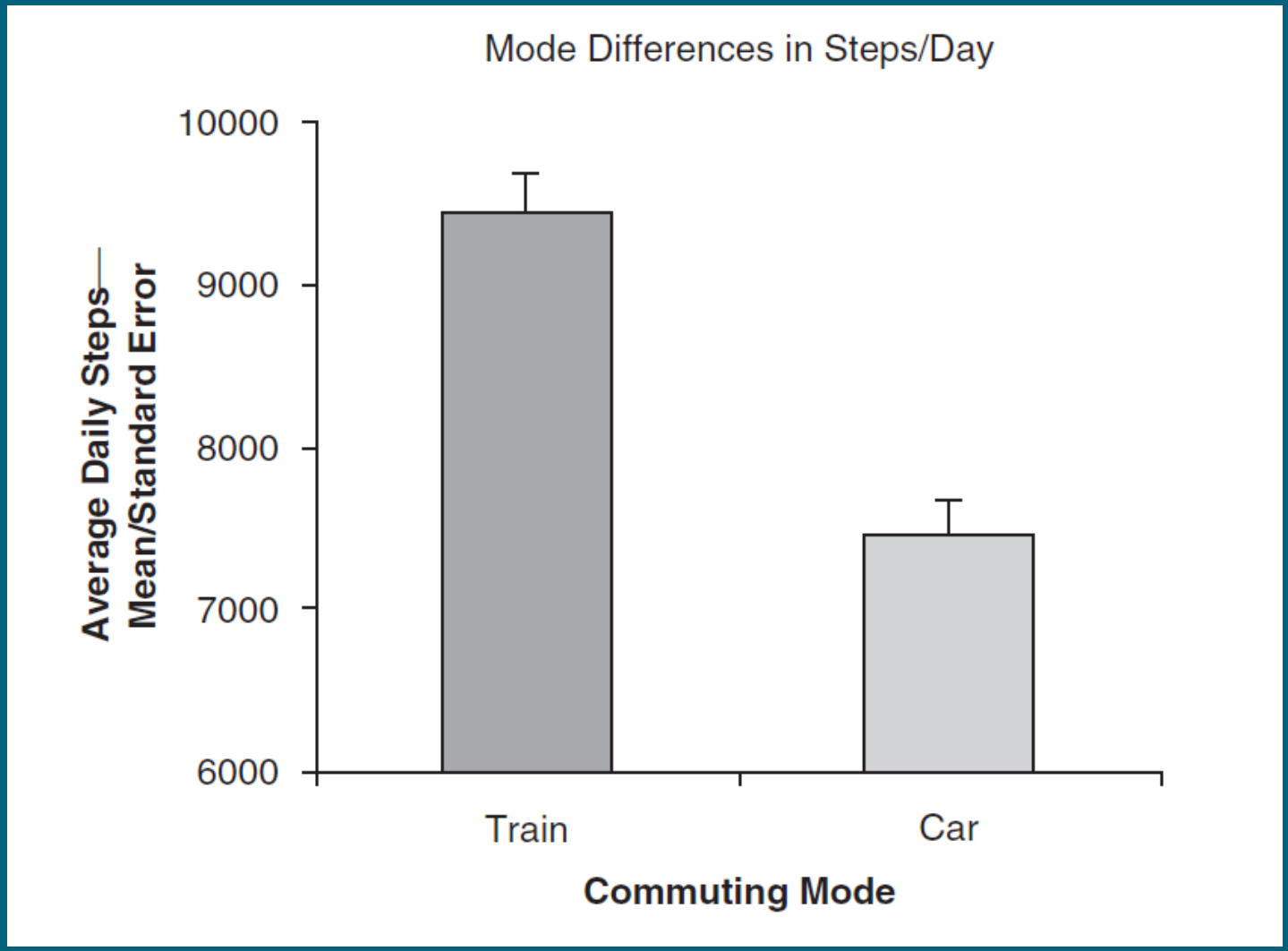



**FIGURE 1—Total daily walking trip times to and from transit: United States, 2009 National Household Travel Survey.**

Median = 21 minutes walking

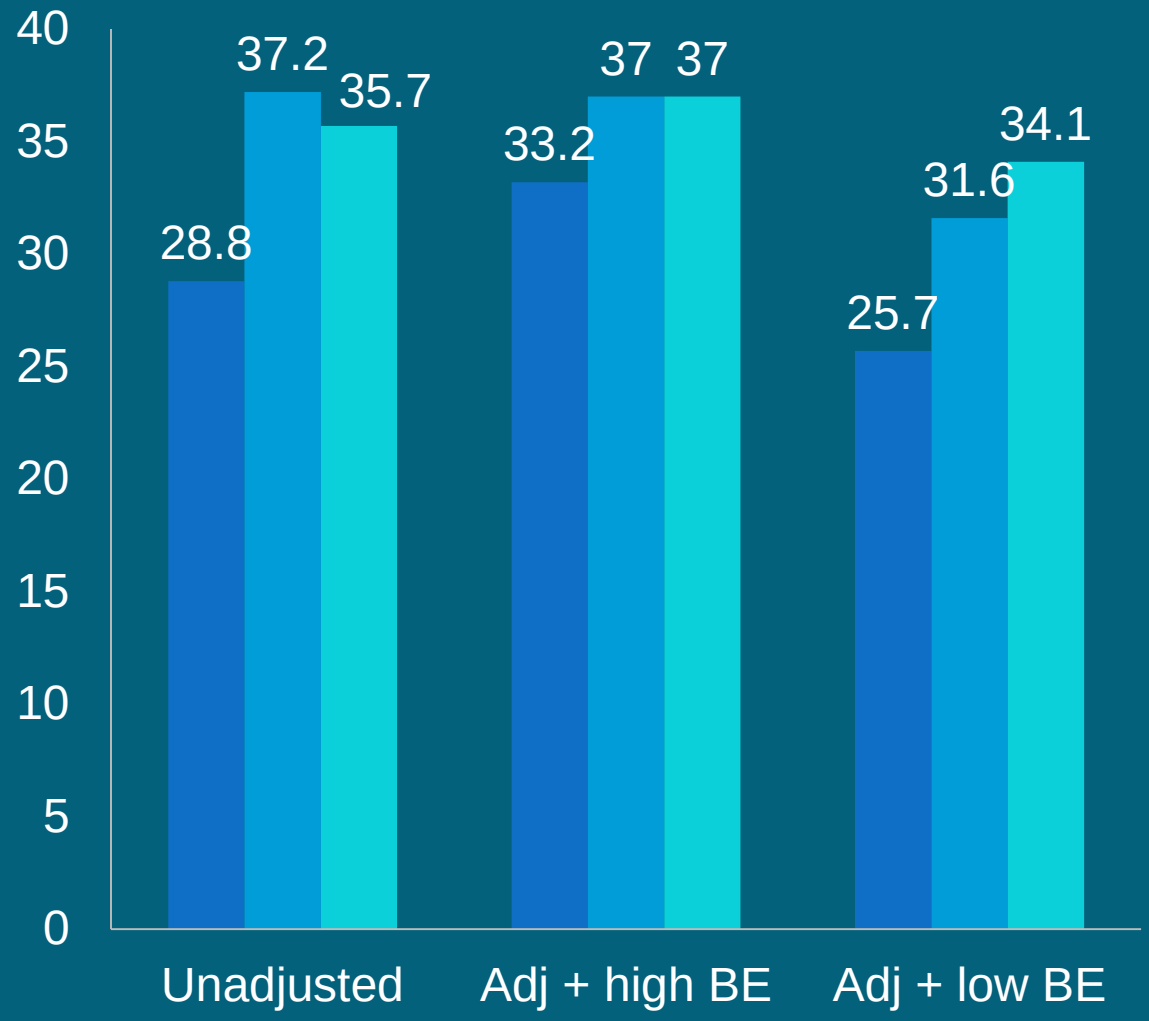
Freeland 2013 *AJPH*

# Differences in PA by Commute Mode




Wener 2007 *Environ Behav*

# Differences in PA by Transit Usage




Lachapelle 2011 J Phy Act Health

# Rissel Evidence Review

- 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

Rissel 2012 *Int J Environ Res Public Health*

# Walk Distances to LRT

| Reference | Sampling frame and process | Mean distance | Longest distance walked |
|---|---|---|---|
| Beimborn | Portland regional travel diaries | ~.24 miles | 1.14 miles |
| Dill | Portland residents near LRT stations | ~.33 miles | ~.93 miles |
| Kim | St. Louis LRT users | .47 miles | 95% walked <1.0 miles |
| Olszewski & Wibowo | Interviews at Singapore LRT stations | .40 miles | Upper quartile >.5 miles |
| O'Sullivan & Morrall | Interviews at Calgary LRT stations | .40 miles | N/A |
| Stringham | Toronto residents near LRT stations | .57 miles | Upper quartile >~.67 miles |
| Weinstein | Interviews at SF & Portland LRT stations | .58 miles | Upper quartile >.69 miles |

# Different Design Options

- 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
    - Being active through public transportation made substitute for other physical activity
      - Measuring both global and transit-specific physical activity

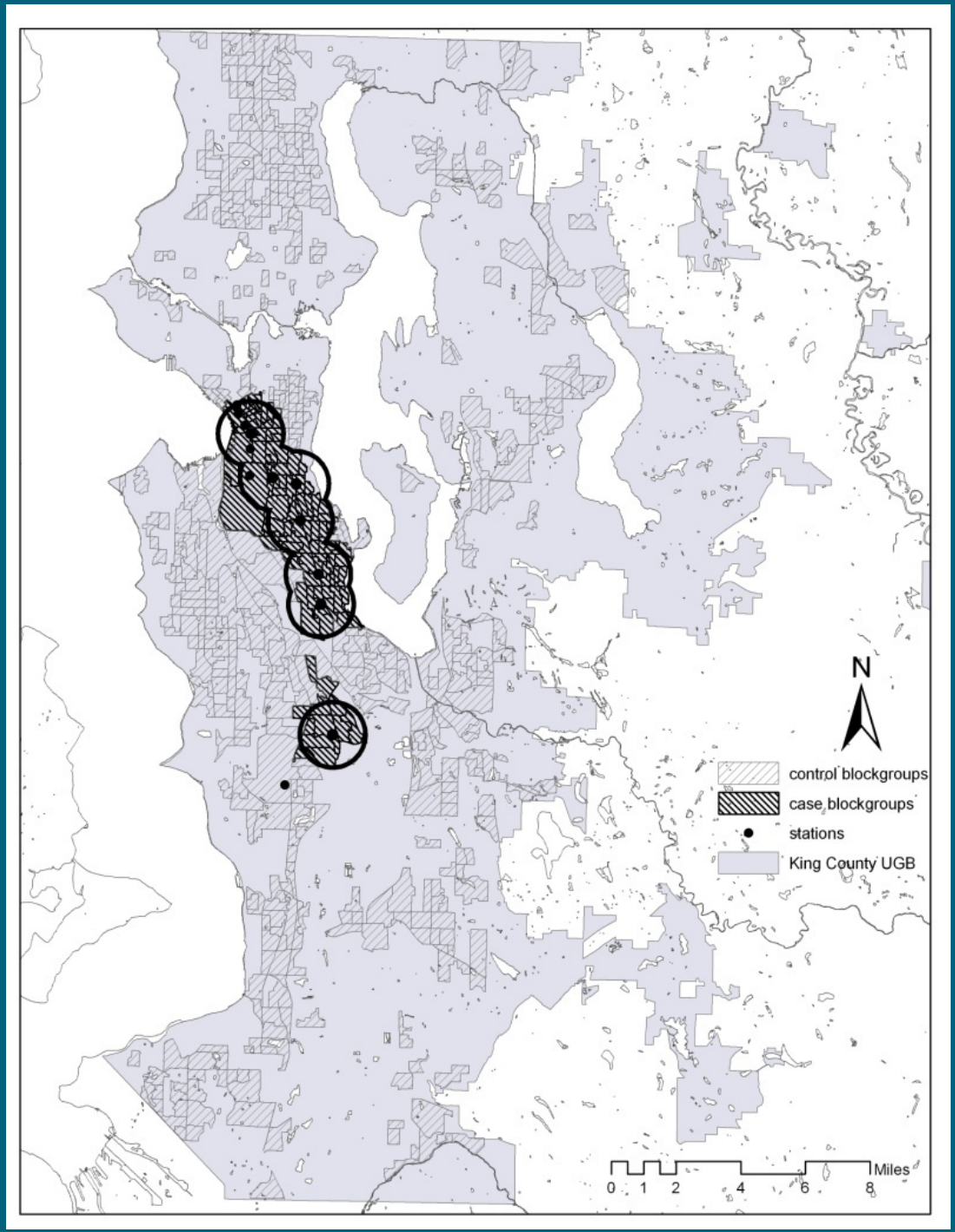
# Travel Assessment and Community (TRAC) Project

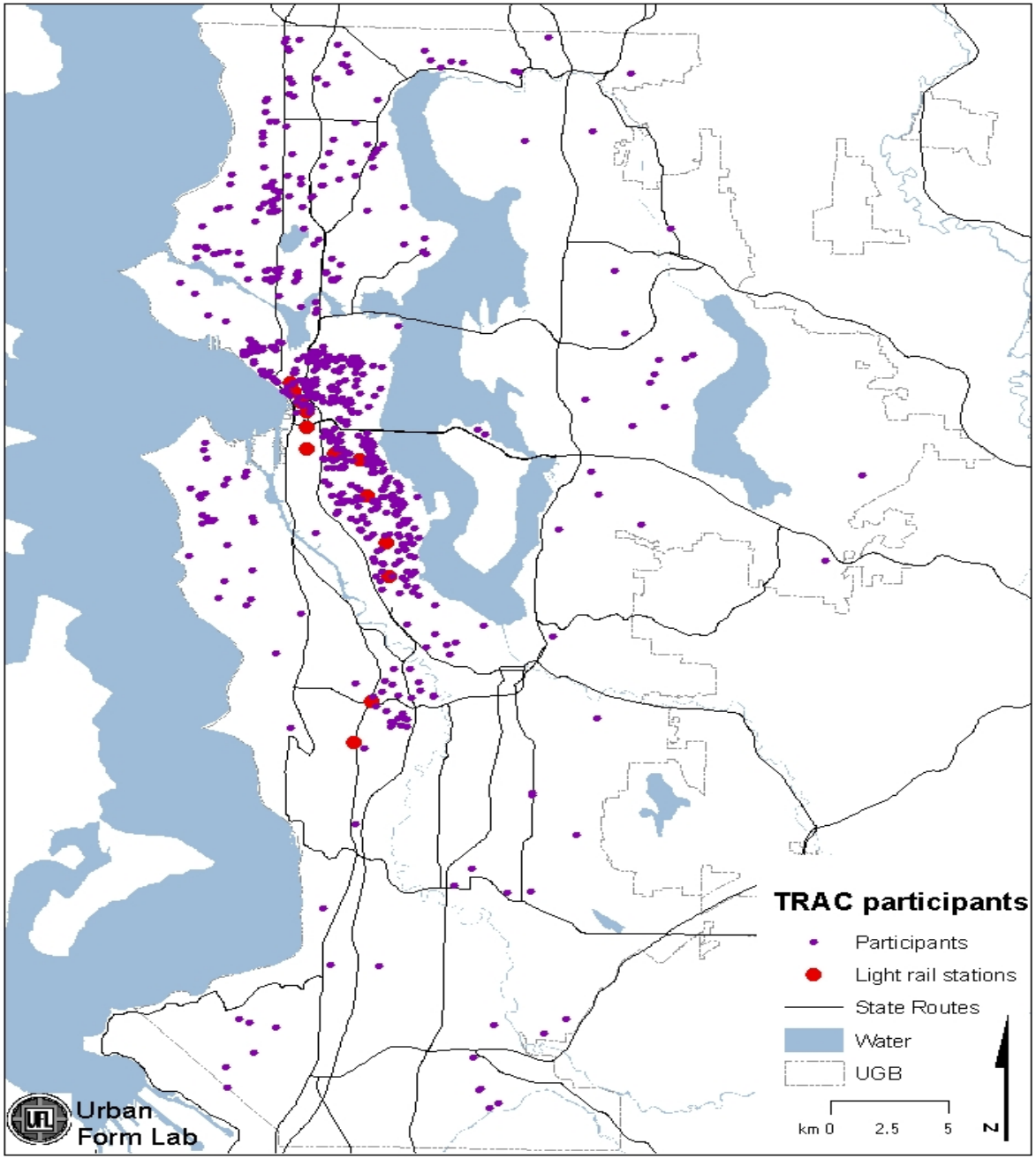
- A natural experiment in which an environment changed
  - Addresses some concern about residential self-selection confounding
  - Relative to a demographically and built environment matched sample
  - Examine behavior change in response to environmental change (temporality)
- Use the best possible set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


University of Washington
University Link
Capitol Hill
Westlake
University Street
Pioneer Square
International District/Chinatown
Seattle
Stadium
SODO
Mount Baker
Link operations & maintenance facility
Beacon Hill
Columbia City
Initial Segment
Othello
Rainier Beach
Tukwila
Tukwila International Blvd
Burien
SeaTac
Airport Link
SeaTac/Airport
N
Map Key
Link light rail and stations (opens 2009)
Link light rail and stations (opens 2016)

# TRAC Recruitment

- Group-matched cohort design
  - ‘Cases’ – adults living < 1 mile from (future) LRT station
  - ‘Controls’ – adults in county living >1 mile from (future) LRT station
- Additional eligibility
  - ≥ 18 years old
  - Able to walk outside home
  - English-speaking or willing to speak through interpreter
  - Living at this residence for > 1 year (and residence built > 3 years ago) and no current intentions to move
  - Contacted via public record information (address/phone)
- 6% overall enrollment; 11% agree/refuse


N
control blockgroups
case blockgroups
stations
King County UGB
0 1 2 4 6 8
Miles


TRAC participants
Participants
Light rail stations
State Routes
Water
UGB
km 0
2.5
5
N
Urban
Form Lab

# TRAC ‘participant neighborhood’ summary

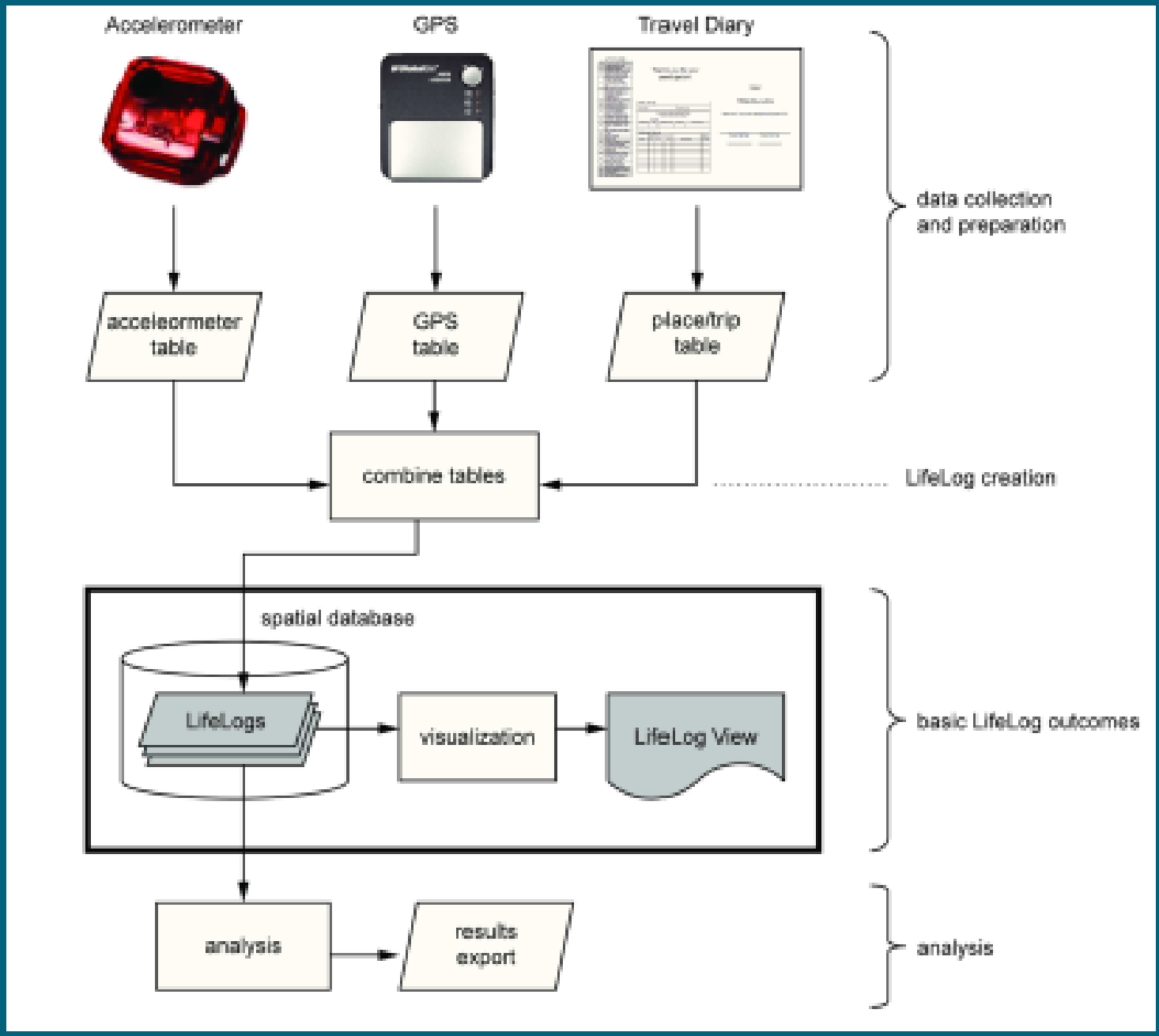
- Participant’s neighborhood defined as area within a ½-mile radius of residence, containing 539 acres; about a 10-minute walk)
- Land use
  - 6.3 dwelling units per acre (range: 1 – 30)
  - 5.3 jobs per acre (range: 0 – 272)
  - 16 acres of parkland (range: 0 – 220)
- Food & beverage destinations
  - 1 supermarket (range: 0 – 5)
  - 3 traditional restaurants (range: 0 – 120)
  - 3 fast-food restaurants (range: 0 – 26)
  - 4 coffee shops (range: 0 – 92)
- Transportation
  - 16 miles of streets, excluding freeways (range: 5.4 – 23)
  - 176 intersections (range: 47 – 342)
  - 0 miles of off-street trails (0 – 1.5 miles)

# TRAC Baseline Sample (N=684-723)

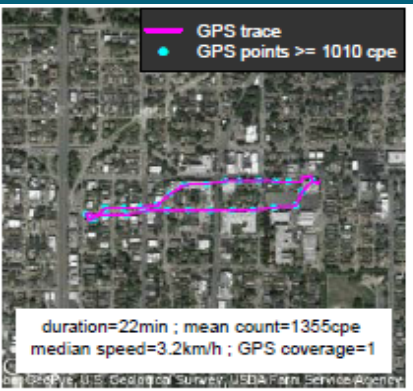
| Characteristic | Mean (SD), median, or % |
|---|---|
| Age (mean; yrs) | 51.5 (12.9) |
| Male (%) | 36.4% |
| Hispanic (%) | 2.1% |
| Race<br>- White<br>- African-American/Black<br>- Mixed race or Other race<br>- Asian<br>- Pacific Islander<br>- Native American or Alaskan | <br>82.4%<br>7.3%<br>4.6%<br>4.3%<br><1%<br><1% |
| Annual household income (median) | 60-69K |
| Education level (median) | College graduate |
| Vehicles in household | 1.4 (1.0) |

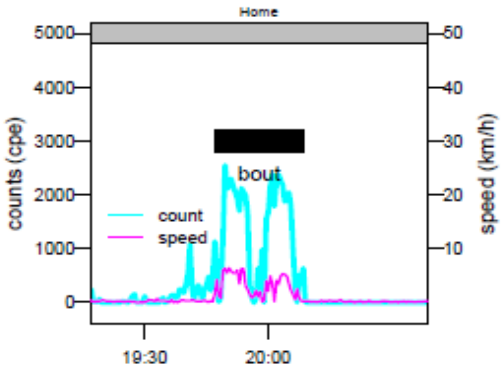
# TRAC Methods

- Longitudinal
  - Baseline (during the 1 year prior to LRT opening)
  - Post 1 (1-2 years after LRT opened)
  - Post 2 (3-4 years after LRT opened)
- Individual participant tracked by month/season, not duration since last assessed
- Demographic/attitudinal/psychosocial survey
- Device-based and trip report integration (for 7 days)
  - Accelerometer
  - Portable GPS
  - Travel log (place-based)

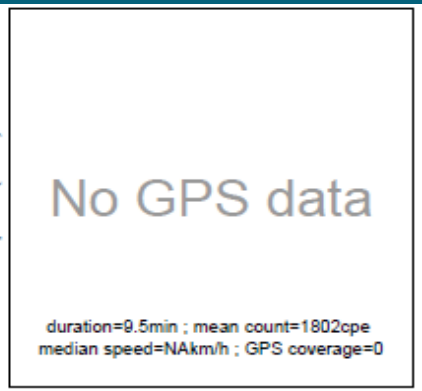


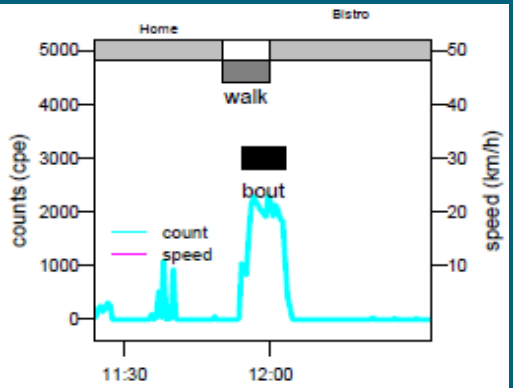

Hurvitz 2014 *Front Public Health*



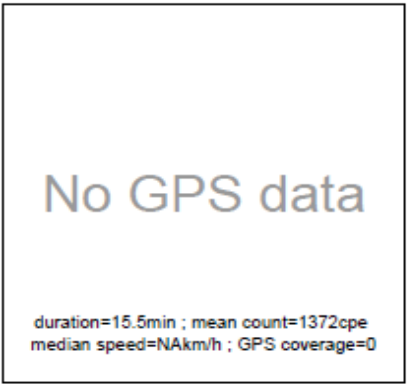



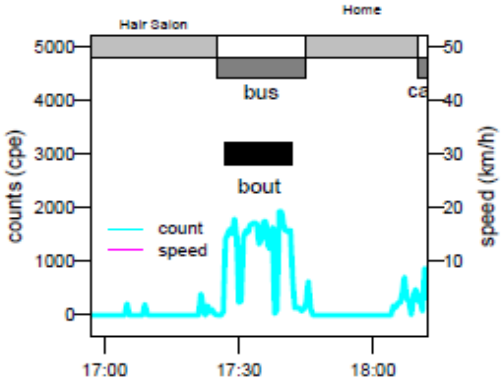

A: Walk1−GPS



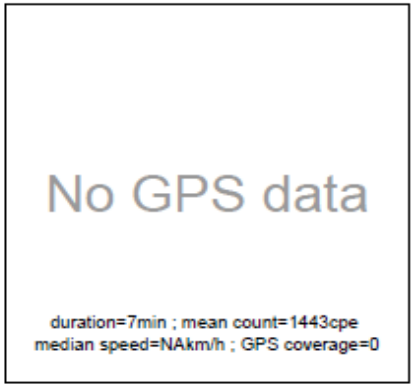



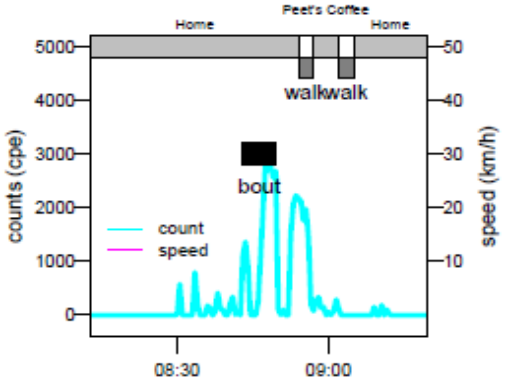

B: Walk2−Diary



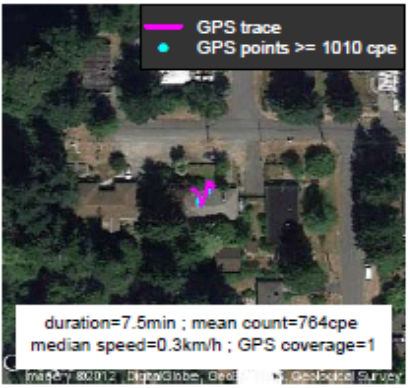



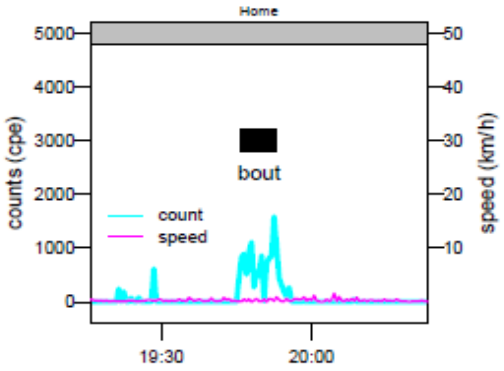

C: Walk3−Diary



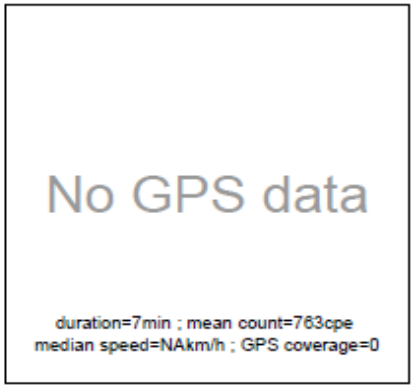



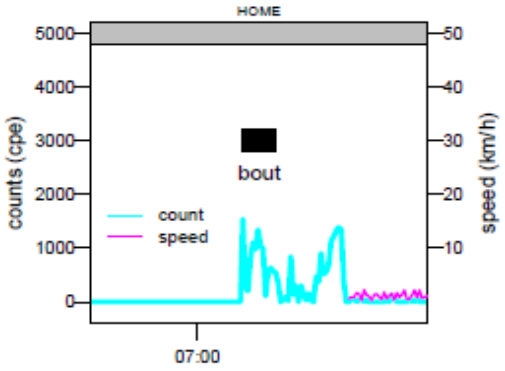

D: Walk4−Diary




E: NonWalk2−GPS



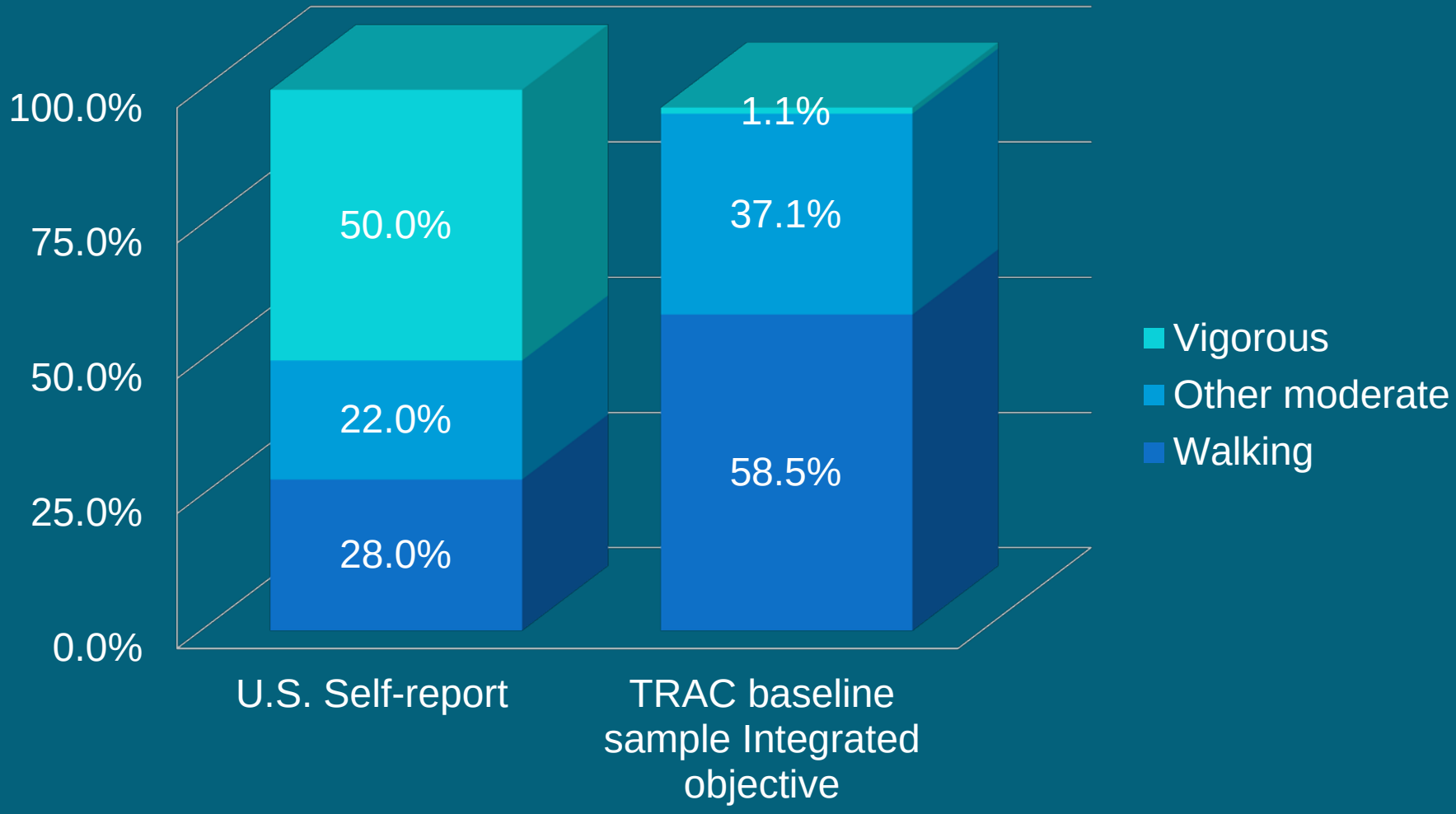




F: NonWalk3−Diary

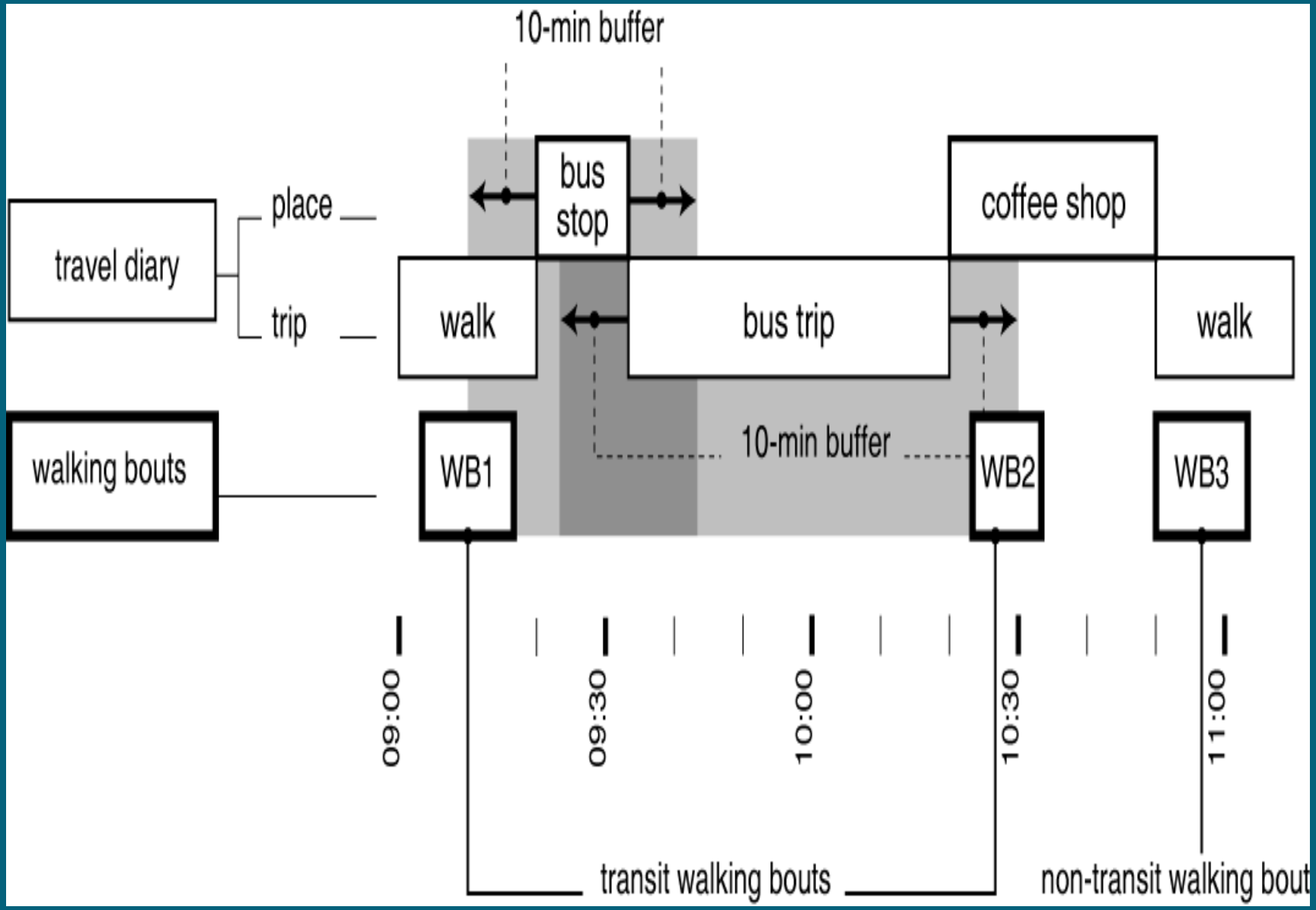
Kang 2013 *MSSE*

# TRAC Baseline Findings

# Comparison of Self-Report and Integrated Objective

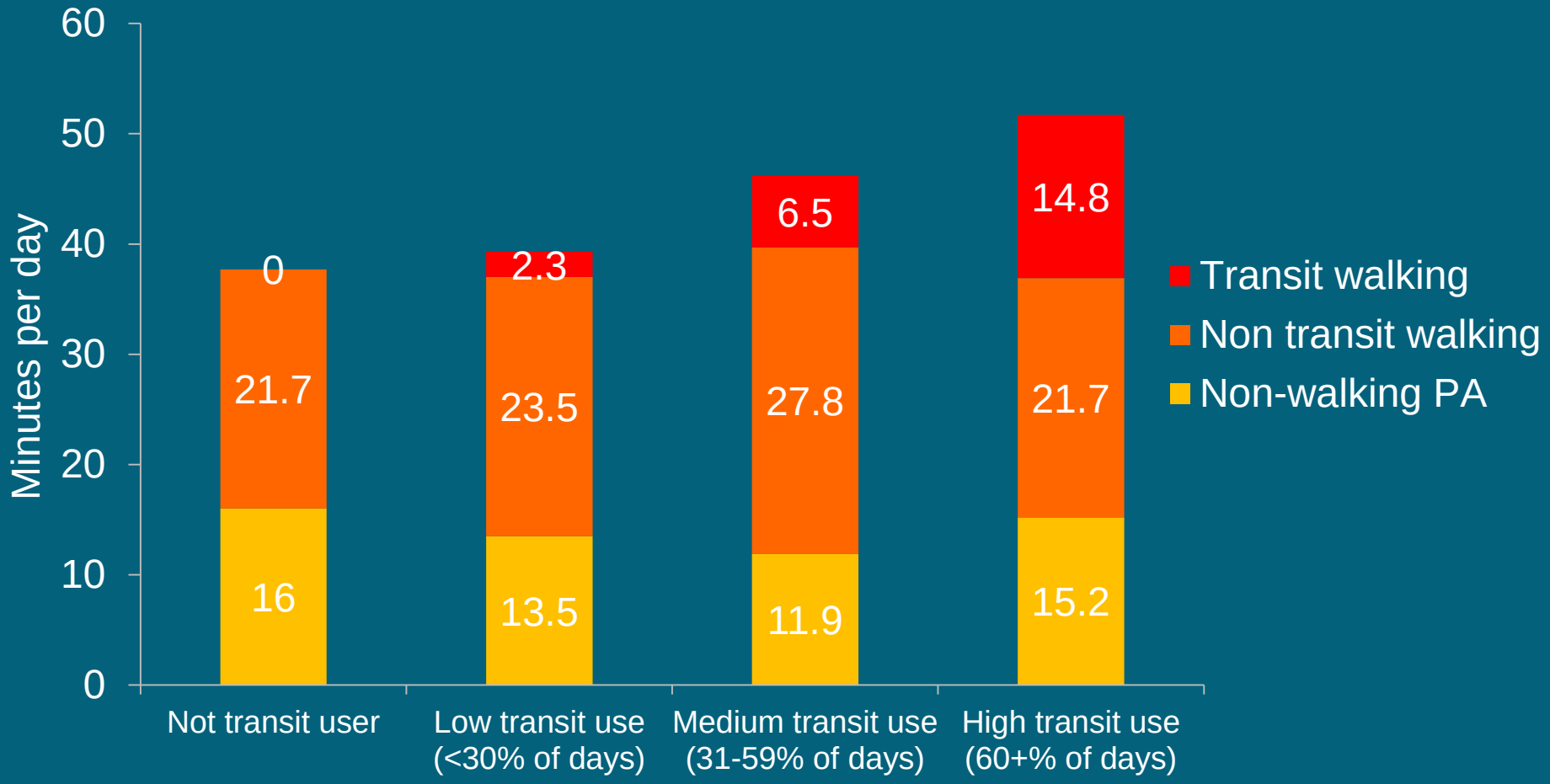



Kang 2013 *MSSE*



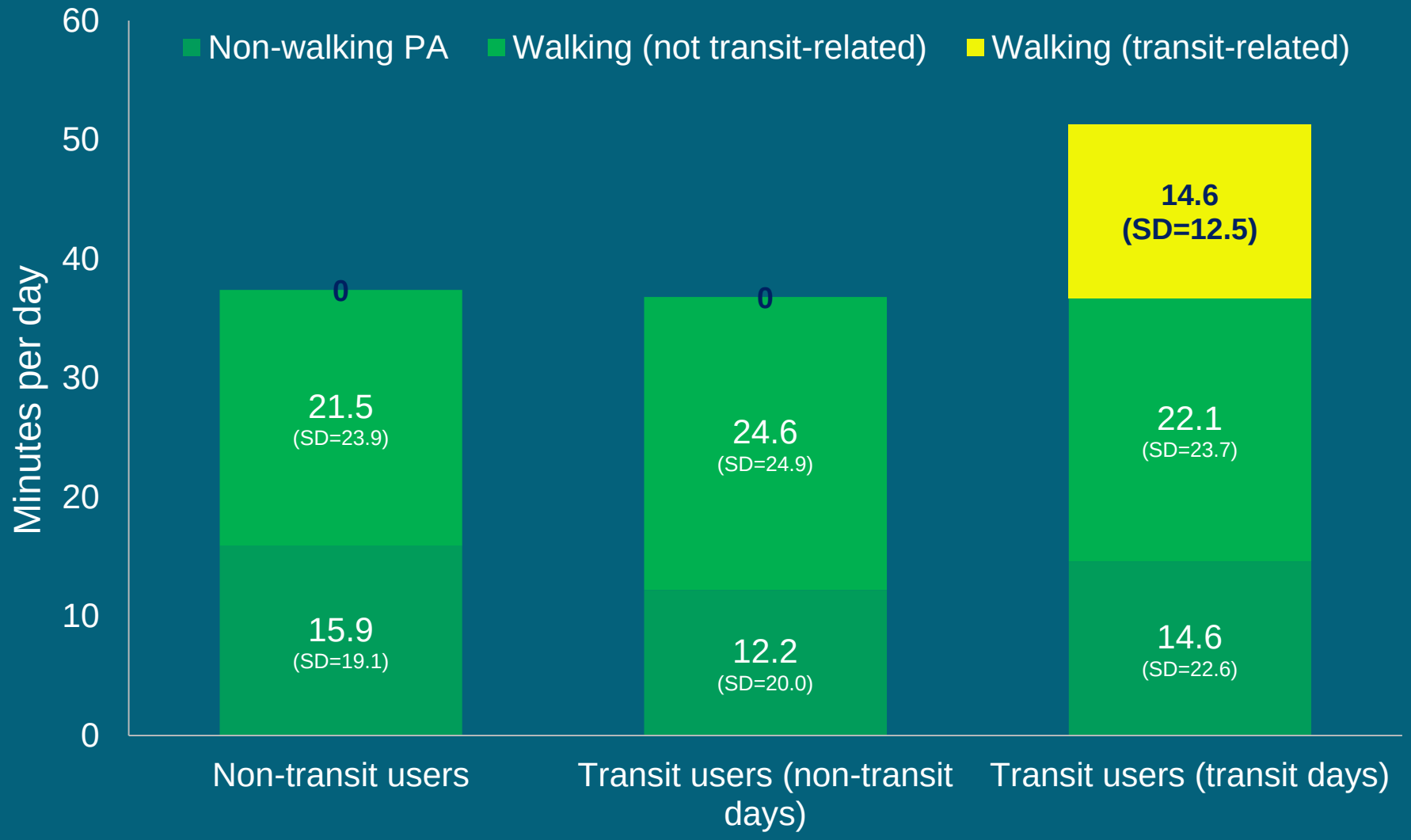

Saelens 2014 *AJPH*

# Baseline Transit Frequency and Walking/PA




Saelens 2014 *AJPH*

# Baseline Transit-Related Physical Activity

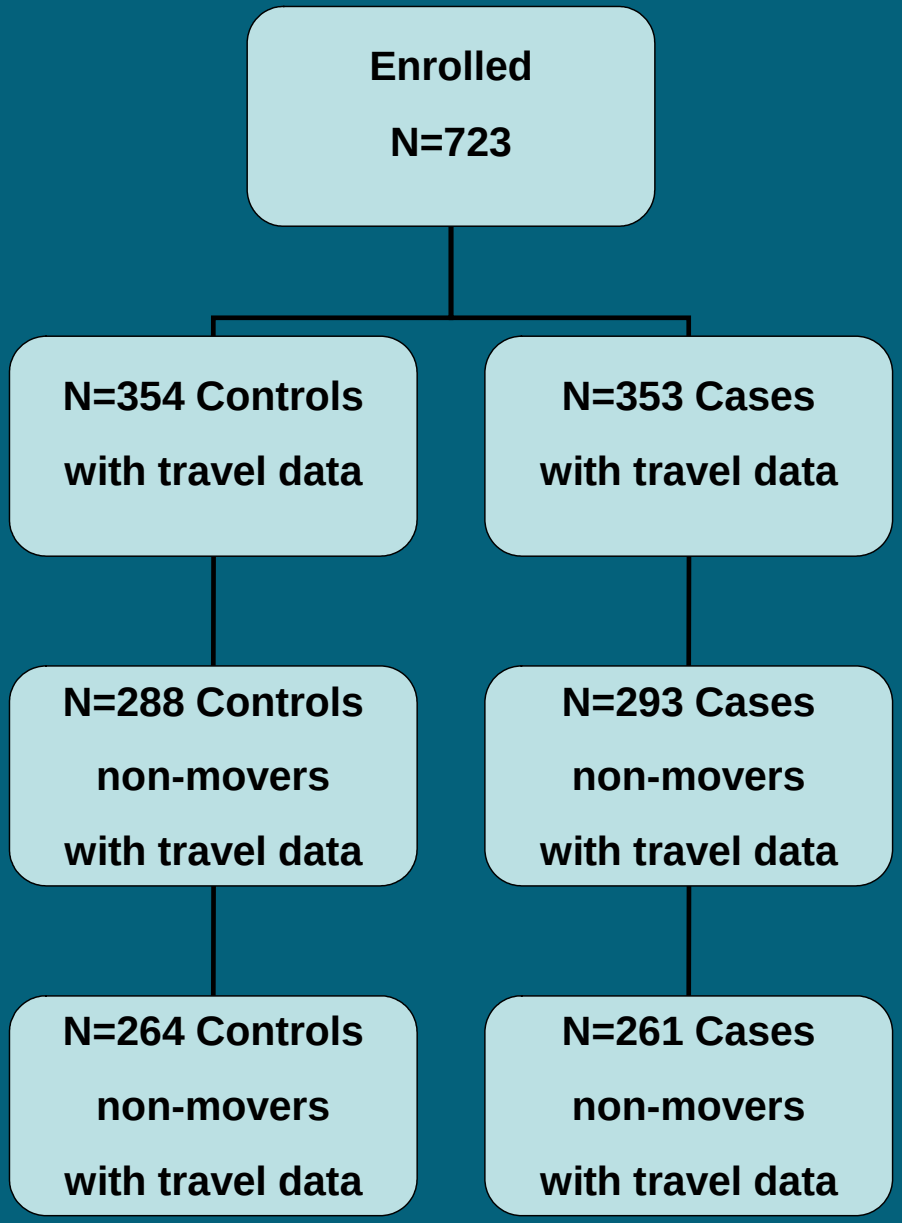



Saelens 2014 *AJPH*

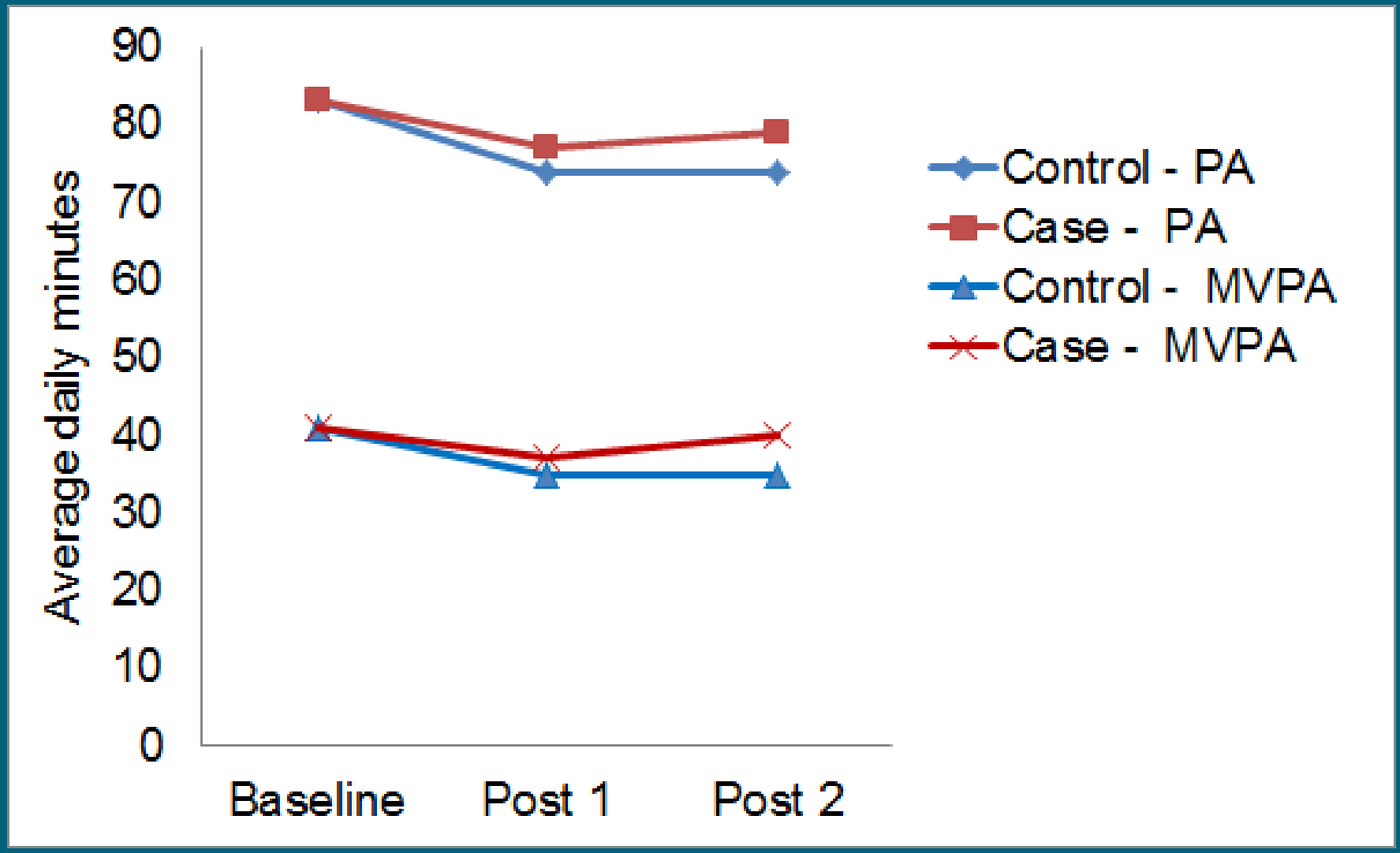
# TRAC Baseline Demographics, Physical Activity, and Transit By Condition

| | Control (n=354) | Case (n=353) |
|---|---|---|
| Age | 51 (13) | 52 (13) |
| Male (%) | 37% | 40% |
| Household income (median) | 60-69K | 60-69K |
| Race/ethnicity (% non-Hispanic white)* | 87% | 76% |
| Employed (%) | 68% | 63% |
| Single person household (%) | 39% | 42% |
| | | |
| Daily physical activity minutes (1000+ cpm, continuous) | 83 (39) | 83 (37) |
| Daily MVPA minutes (1952+ cpm, continuous) | 41 (27) | 41 (25) |
| Daily walking minutes (in bouts) | 25.7 (24.9) | 30.4 (35.1) |
| Daily transit-related walking minutes (in bouts) | 2.9 (7) | 3.0 (7.8) |
| | | |
| Transit use (trips) | 2.8 (5.2) | 2.8 (5.6) |
| - No trips | 61% | 57% |
| - 1-5 trips | 21% | 25% |
| - 6+ trips | 18% | 18% |

# TRAC Participant Flow By Condition

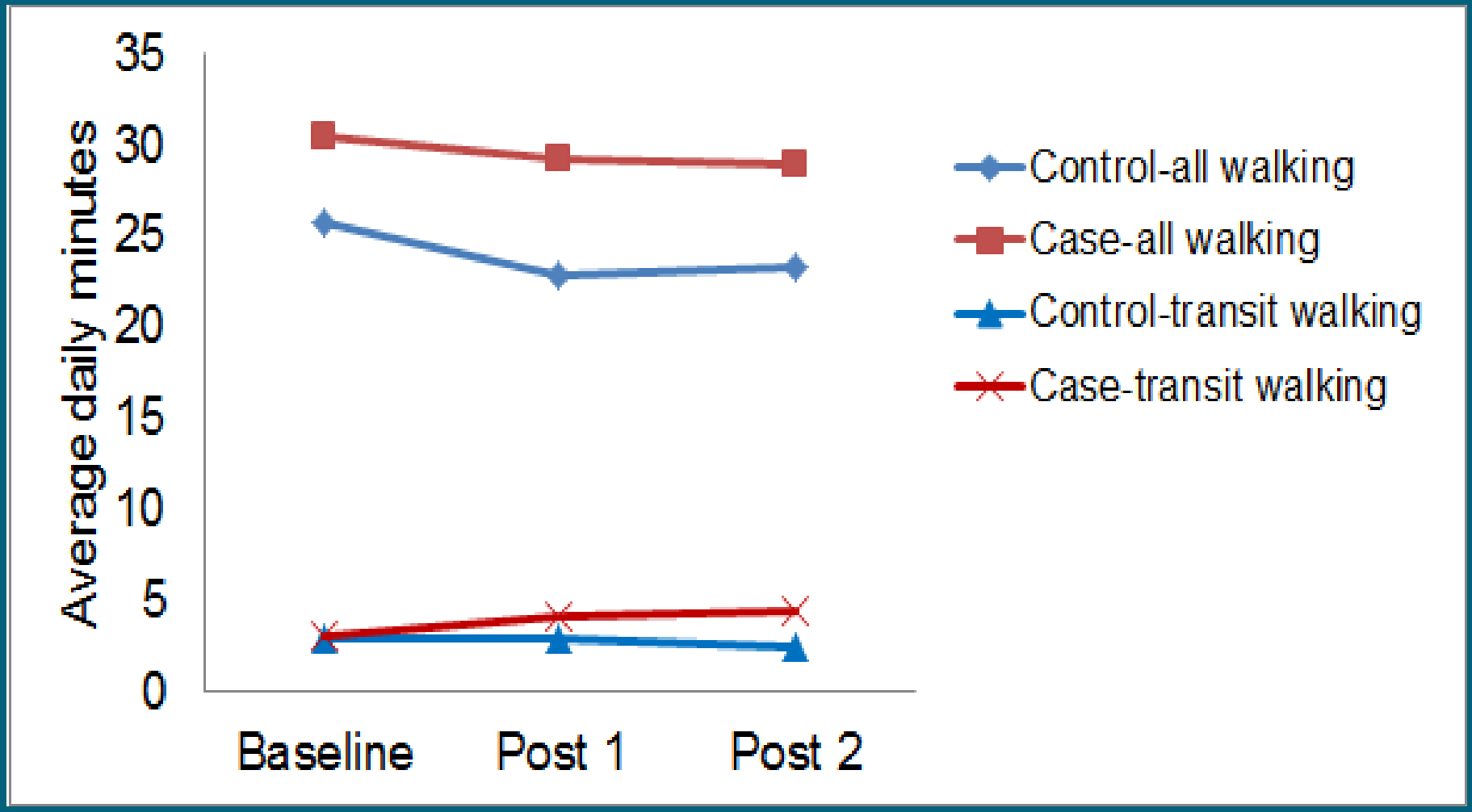


# TRAC Results: Change in Overall PA and MVPA



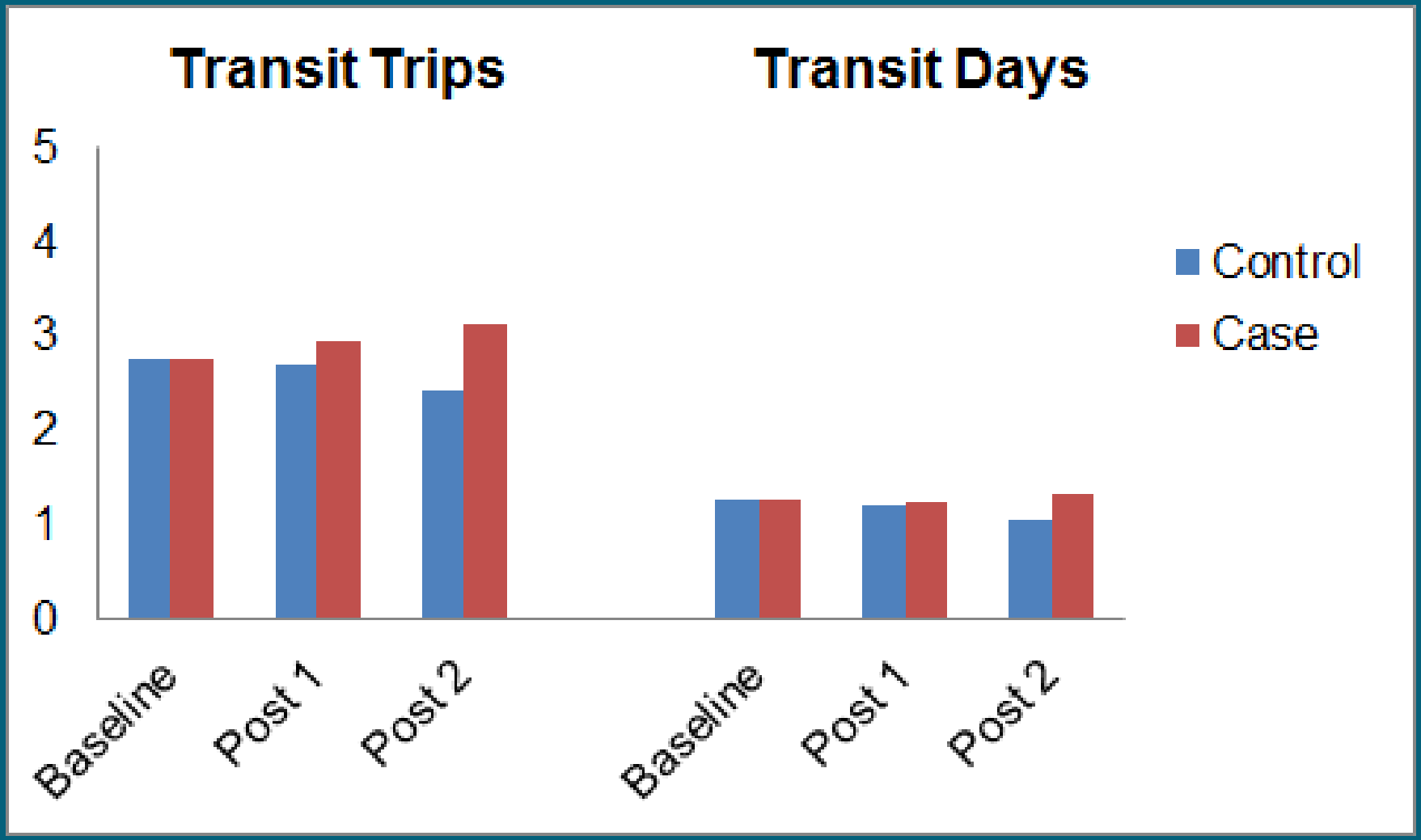

Time * Condition interaction both p>.15, covarying for demographics

# TRAC Results: Change in all walking & transit walking




Time * Condition interaction p=.89 for all walking; p<.02 for transit walking

# TRAC Results: Change in transit use




Time * Condition interaction for transit trips count cross-tabs p=.33

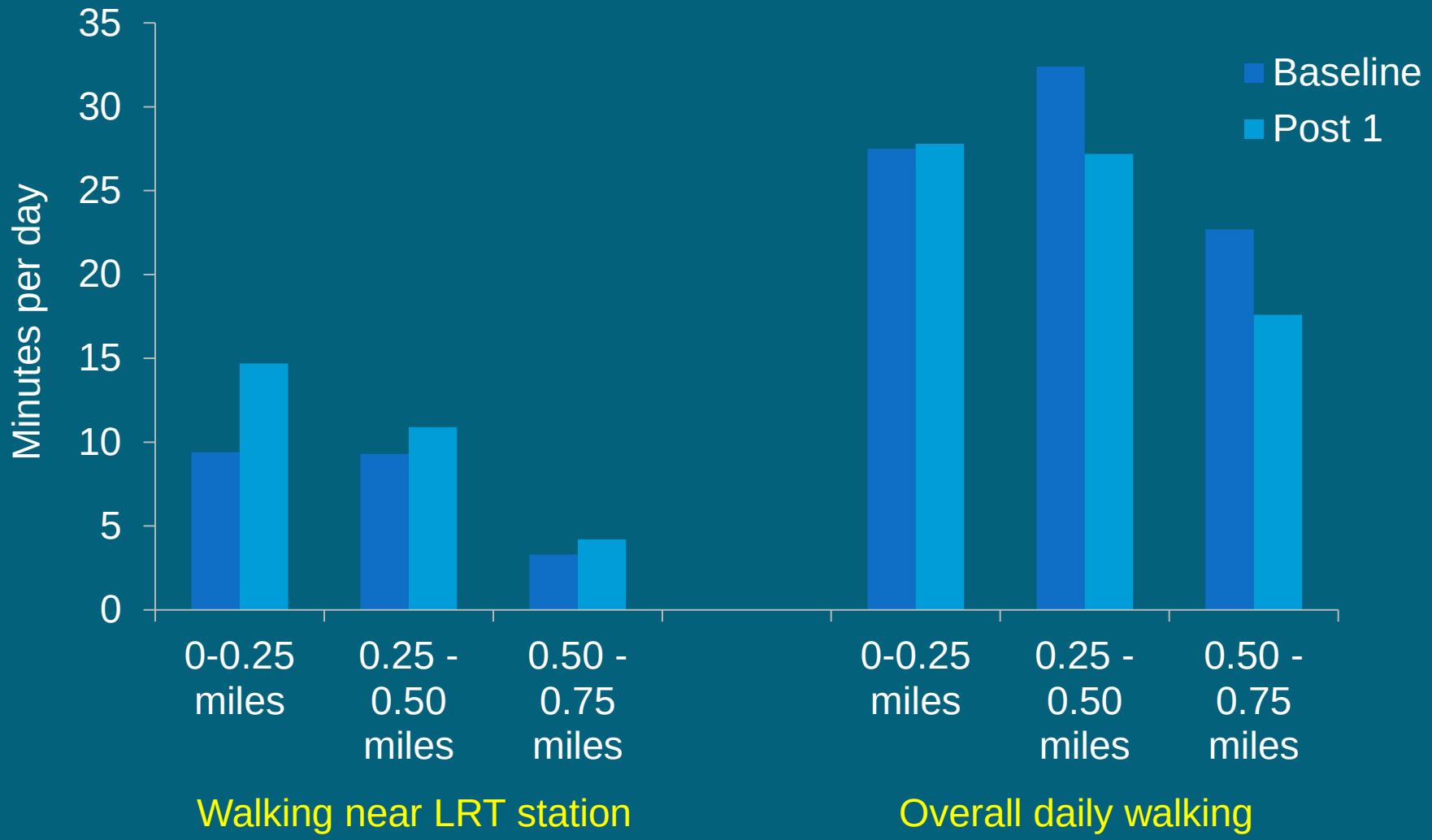
# TRAC PA Conclusions

- Lack evidence of significant differential change in overall physical activity or walking between those living close (<1 mile) versus further away (> 1 mile) from LRT
- Some evidence that walking related to transit remained relatively higher in those living close to LRT
- No significant changes in overall transit use, considered by total trips or days

# Further Analyses

- Transit users versus non-users
  - Switch to LRT versus not switching
- Differential impacts by
  - baseline transit use
  - age or gender
  - other demographic factors
  - station location
- Changes in built environment or other aspects of transportation system

# Further Analyses: Reconsider ‘Caseness’?



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- My excellent research staff
- My fellow investigators and collaborators
- University of Washington Urban Form Lab (staff & students)
- Funders – NIH-NHLBI (R01 HL091881) & TransNow

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