Neighborhood Environment Profiles Related to Physical Activity and Weight Status among Seniors: A Latent Profile Analysis

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Neighborhoods are multidimensional

- **Walkability** – high residential density, a mix of land uses, good street connectivity, retail design. （Saelens & Handy, 2008, TRB, 2005; Heath et al, 2006）

- **Public transportation** – access to bus and rail stations/stops. （Besser & Dannenberg, 2005）

- **Recreation environments** – access to parks, gyms, recreational facilities （Kaczynski & Henderson, 2007）

- **Microscale features** – quality of environment, pedestrian and cycling facilities, social factors, safety, crime, etc.

Analytical challenges

- Aspects of neighborhood built environment （BE） coexist: they are not independent

- Significant challenge is how to deal with the numerous variables & complexity of BE

- Possible that unique combinations of variables may have different functions for PA.

Several approaches hold promise

- Measure many variables and factor analyze in search of underlying constructs （Cerin, et al., 2009; Cervero et al., 2003）

- Combine disparate variables into a single index （e.g. walkability index） （Frank et al., 2010）

- Explore first and second order interactions between a few variables.

- Identify unique multivariate patterns that subgroups of individuals share. （Yan et al., 2010; Nelson et al., 2006; Norman et al., 2010）.

Purpose

- To explore whether distinct neighborhood environment profiles can be derived from a large range of reported BE features from an older adult sample.

- To test whether derived neighborhood environment profiles result in differences in adults' physical activity and weight status.

Seniors' Neighborhood Quality of Life Study （SNQLS）

SNQLS Methods

- Epidemiological study of built environment on multiple health outcomes for older adults.

- 66-97 years old, 52.9% female, 29.2% racial/ethnic minority

- Study Regions
  - Seattle-King County, WA (N =360)
  - Baltimore, MD - Washington, DC (N =354)

- Neighborhoods selected to maximize variance in walkability.
  - Low Walk/Low Income, Low Walk/High Income
  - High Walk/Low Income, High Walk/High Income

Neighborhood Environment Walkability Scale（NEWS）

- Residential density

- Land use mix-diversity

- Land use mix-access

- Street connectivity

- Walking & cycling facilities

- Aesthetics

- Pedestrian/traffic safety

- Crime safety

- *Nearest bus or train stop

- *Nearest park

- *Nearest recreation center or 'gym or fitness facility'

*Selected because of hypothesized association w/PA and policy relevance

NEWS available at: http://sallis.ucsd.edu

Measures

- **Actigraph Accelerometer**
  - Instructed to wear for all waking hours for 7 days
  - Valid day $\geq$10 valid hours of wear
  - Freedson adult cut-points for MVPA

- **CHAMPS Questionnaire for Older Adults** (STEWART et al. MSSE 2001)
  - **Walking for transportation** = sum of hours/week of walking for errands.
  - **Leisure-time PA**— sum of duration of leisure activities (e.g. walking, tennis, swimming, golf) and other moderate- and vigorous-intensity PA for leisure.
  - CHAMPS variables natural log transformed for regression models & antilogged to report geometric mean mins/wk

- **Body mass index (BMI)** calculated using self-reported weight and height.

Statistical Analyses

- Latent Profile Analysis
  - Useful when group membership of individuals is unknown -- must be inferred from response patterns.
  - LPA model conceptualized as a single categorical latent variable and a set of continuous indicators.
  - Divides a sample into mutually exclusive subgroups.
  - Maximizes between group variance & minimizes within group variance based on model fit criteria (usually AIC, BIC, LMR).
  - 11 environmental variables (8 NEWS subscales and 3 NEWS items).
  - Determined # of profiles using model fit, sample size of classes, and interpretability

- Independent analysis for Seattle and Baltimore regions.

- ANCOVA models tested relations between neighborhood profiles and PA & BMI, adjusting for demographics and other covariates

Baltimore Region

Neighborhood profiles for Older Adults in the Baltimore region (z-scores).
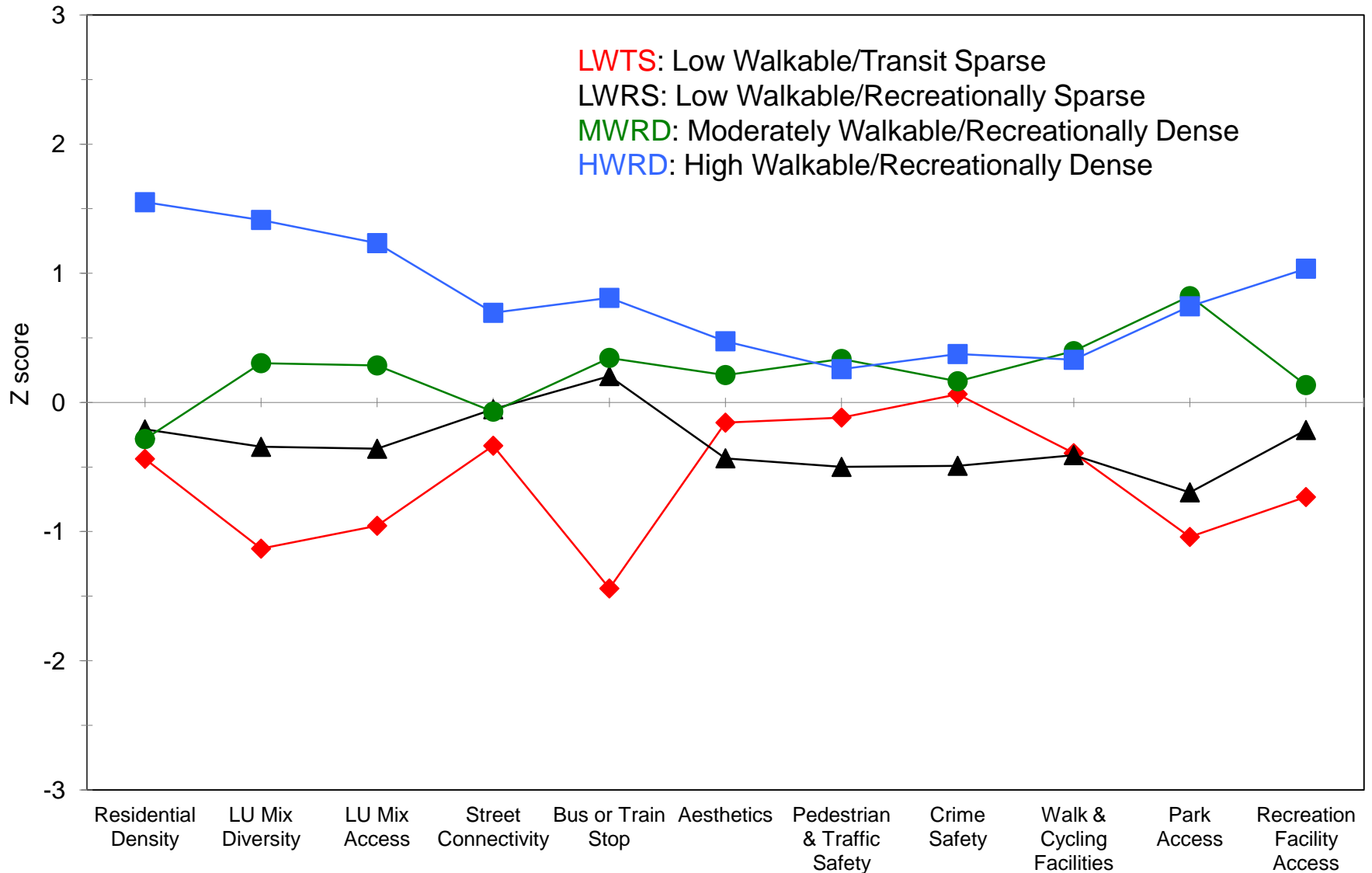
LWTS: Low Walkable/Transit Sparse
LWRS: Low Walkable/Recreationally Sparse
MWRD: Moderately Walkable/Recreationally Dense
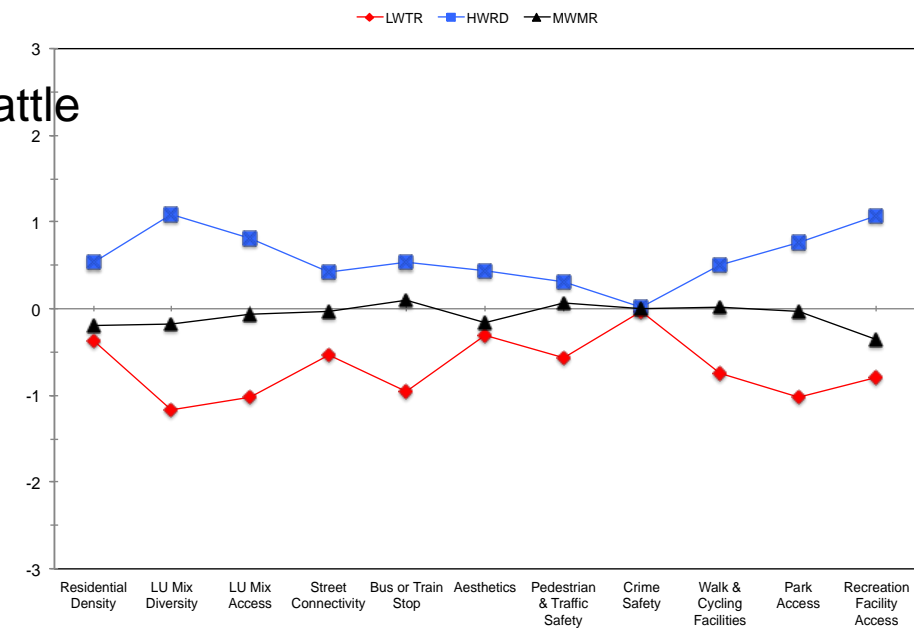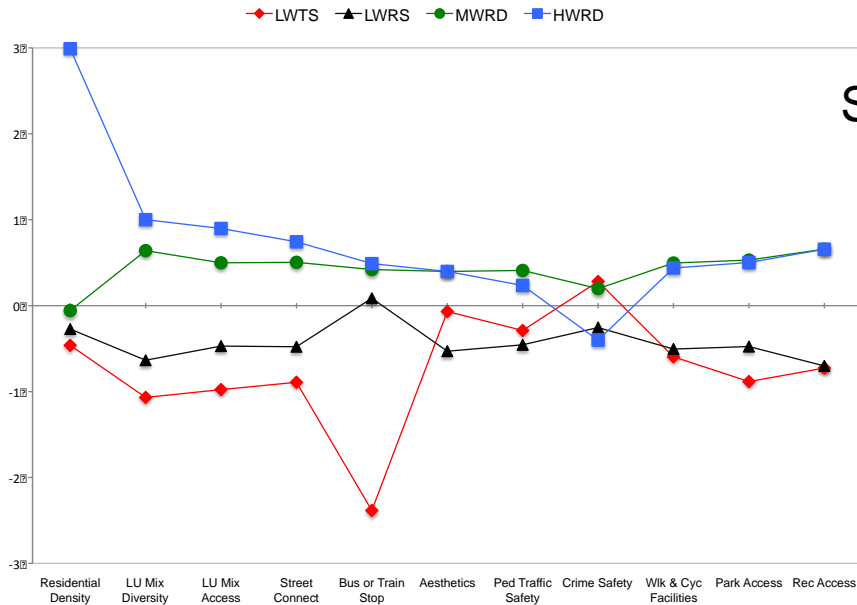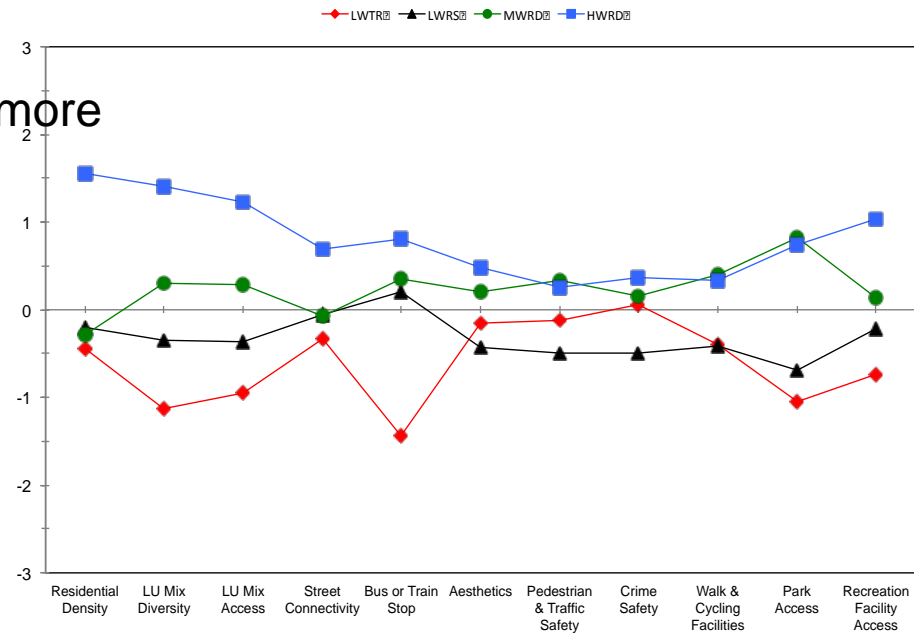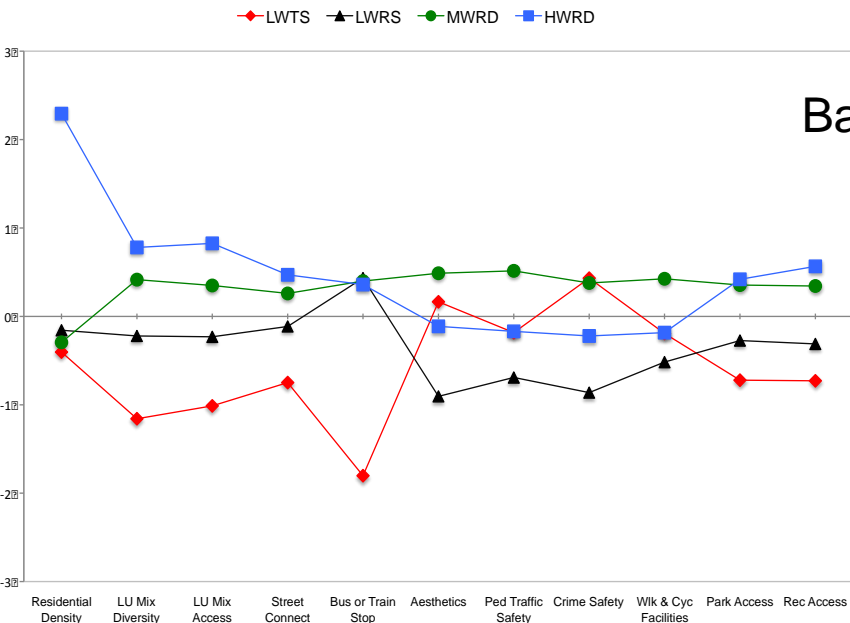HWRD: High Walkable/Recreationally Dense

Seattle Region

Neighborhood profiles for Older Adults in the Seattle region（z-scores）.

LWTR: Low Walkable, Transit & Recreation
LWRS: Moderately Walkable / Moderately Recreational
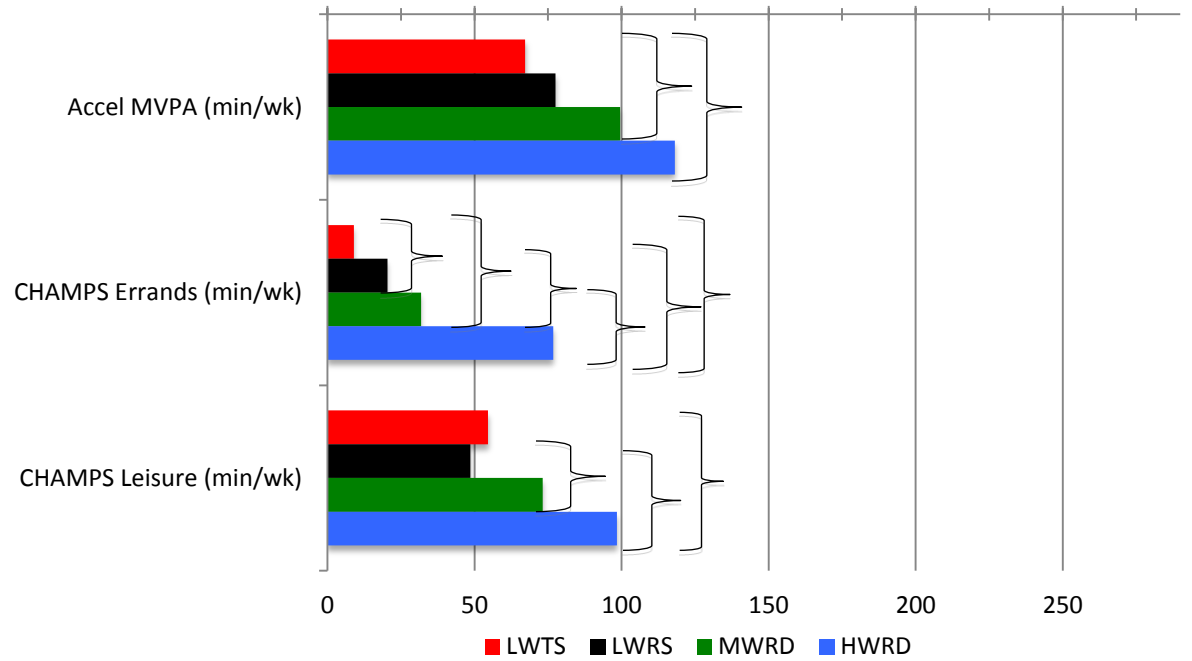HWRD: High Walkable/Recreationally Dense
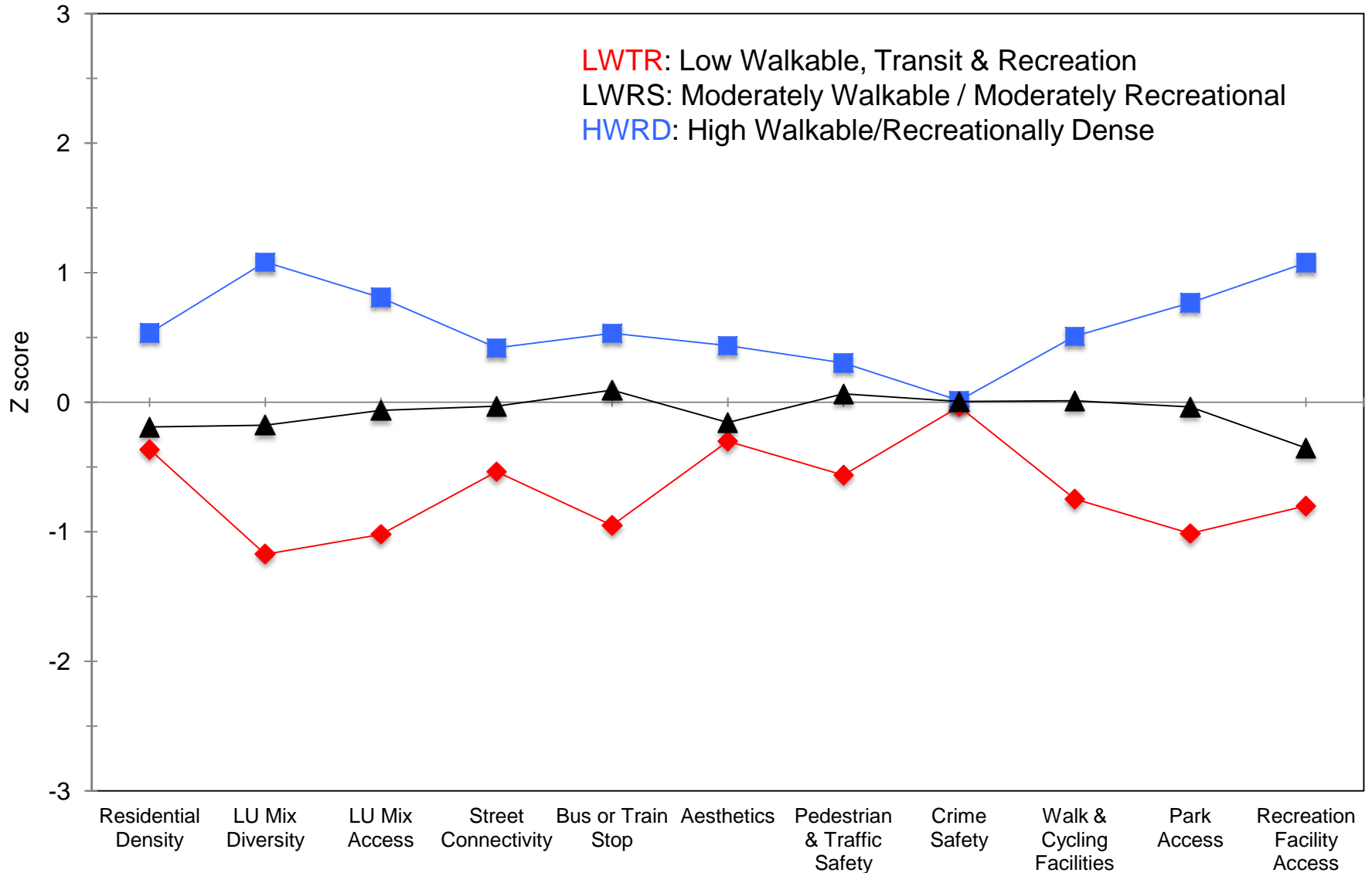
Baltimore

Seattle

NQLS (Younger Adults)

SNQLS (Older Adults)

SNQLS Baltimore

SNQLS Seattle
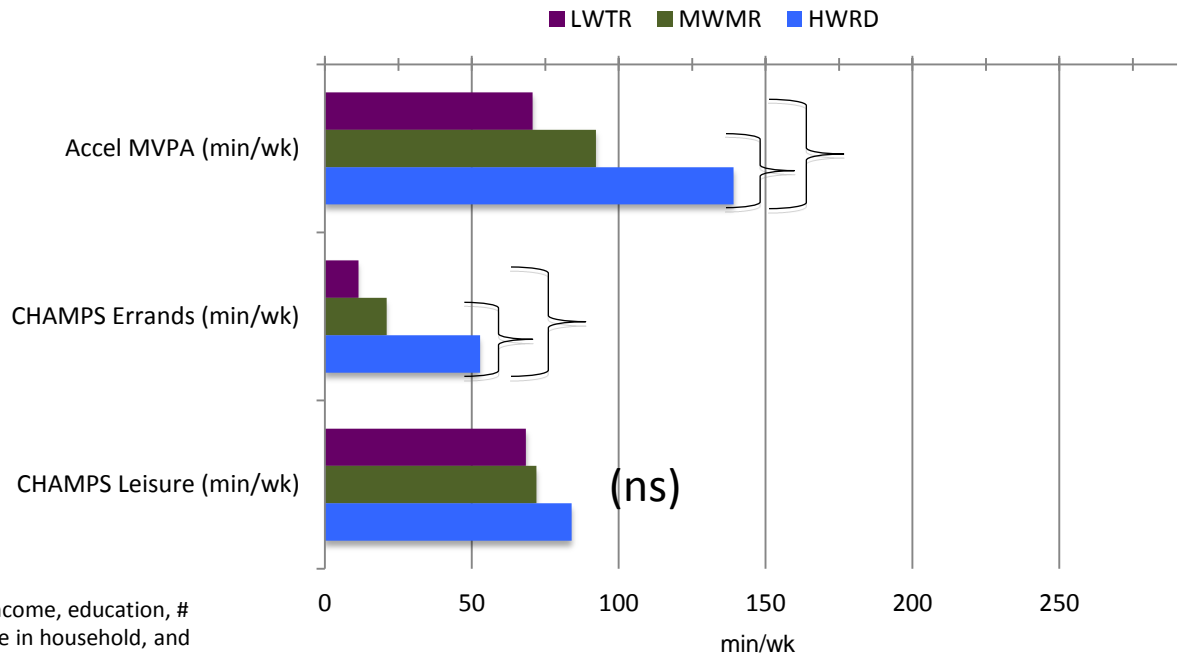
All models were adjusted for sex, age, ethnicity, annual household income, education, # motor vehicles/adults in household, marital status, number of people in household, and length of time at current address.

SNQLS Baltimore BMI

Legend:
- LWTS (red)
- LWRS (black)
- MWRD (green)
- HWRD (blue)
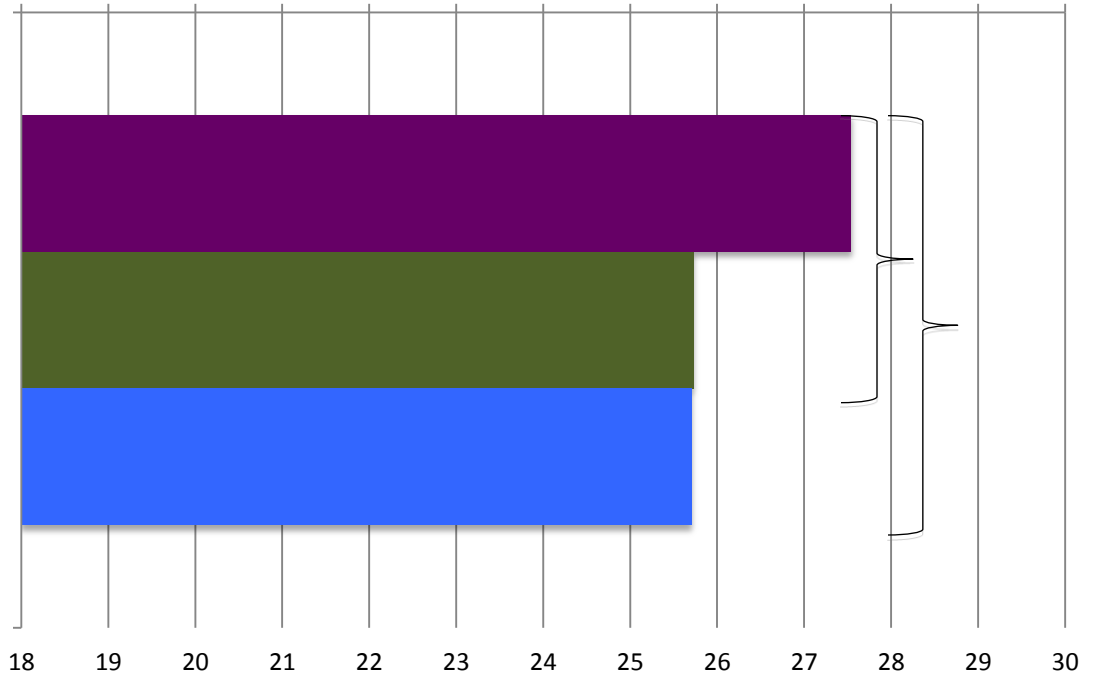
(ns)

SNQLS Seattle BMI

Legend:
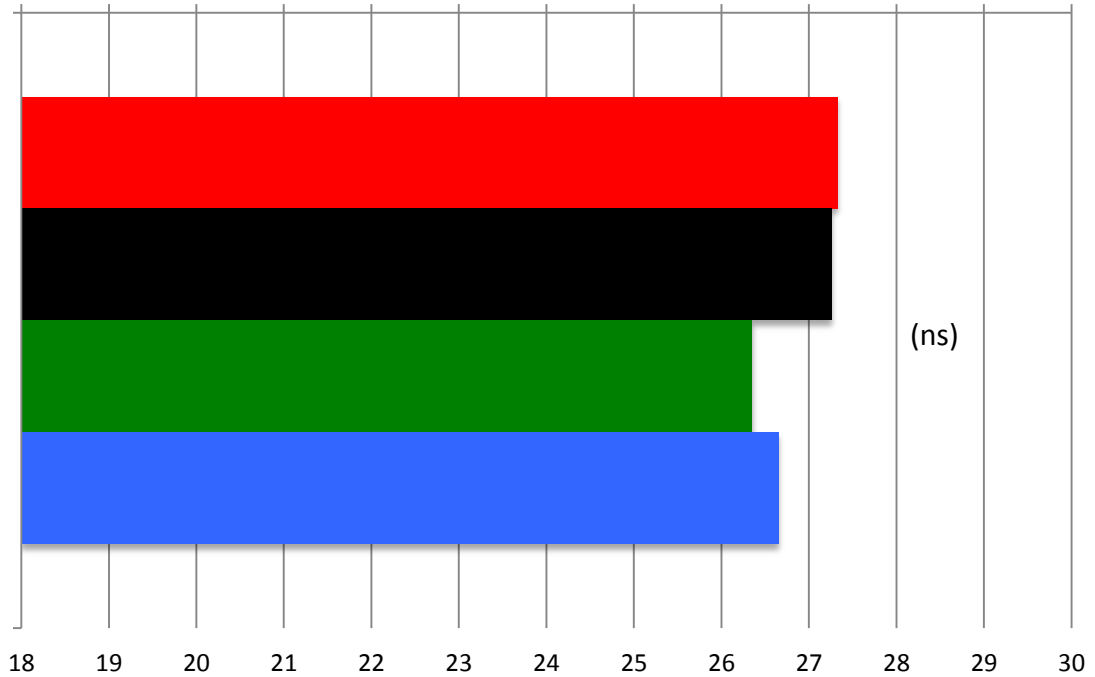- LWTR (purple)
- MWMR (olive)
- HWRD (blue)

All models were adjusted for sex, age, ethnicity, annual household income, education, # motor vehicles/adults in household, marital status, number of people in household, and length of time at current address.

CONCLUSIONS

Overall

- Represents a first step to operationalizing and testing the concept of "activity supportive neighborhoods".

- Patterns that included a combination of high walkability w/good access to transit, parks and recreation facilities.

- Individuals living in activity-supportive n'hoods had best health and behavioral characteristics in NQLS/SNQLS.

- Results for BMI inconsistent, but direction of activity-supportive neighborhoods to BMI in expected direction.

- Other neighborhood types emerged & associated with PA.

Profile Differences

- Walkability components

  - Differentiated profiles.

  - Consistently associated with PA. （Gebel et al. 2007）

  - Residential density needed to support shops/services. Critical mass.

  - People on the street.   Behavioral modeling. （Adams et al, 2006）

  - More destinations & reduced travel burden. （Frank et al, 2003）

- Transit access

  - Differentiated profiles.   Large differences between profiles.

  - Public transit users walk 19 minutes more each walking trip （Besser & Dannenberg, 2005）

  - Light rail users lost 6 lb over 18 months. （MacDonald et al, 2010）

Profile Differences Cont.

- Parks and recreation facilities

  - Differentiated profiles.

  - Review found that access to parks associated with increased activity levels （Kaczynski & Henderson, 2007）.

  - Within parks, more features （e.g. trails, sports facilities） more activity.

- Microscale features

  - Not as stable as other BE features. Tended to vary more across profiles.

  - More difficult to report.

  - Better measures and research needed.

Why is this important?

- Isolating individual BE variables may underestimate effect sizes. Combined approach may produce stronger associations than single variables.

- "Profiling neighborhoods" may reveal optimal neighborhoods for PA or types for more targeted improvements for public health interventions or policy actions.

- Examining patterns informs ecological models of some of the complex BE combinations present.

Methodological Considerations

- Limitations included:
    - Exploratory approach
    - Non-random sampling
    - Sampling maximized range of BE attributes
    - Reported BE
    - No food environment for BMI
    - No adjustment for residential self-selection
    - Multilevel modeling
    - Unmeasured or objectively-measured variables could produce different characterizations of neighborhoods

- Strengths included:
    - Use of validated measures for BE and PA.
    - Objective PA
    - Evidence of concurrent validity
    - Profiles have practical significance due to the strong associations with health outcomes.

NEXT STEPS

Activity-supportive neighborhoods:

Examining combined effects of walkability and recreation environments for physical activity across the life span

Table 1. Summary of Original Studies' design and participant characteristics.

	SNQLS	NQLS	TEAN	NIK
Principal Investigator	King, Abby	Sallis, James	Sallis, James	Saelens, Brian
Funder	R01 HL077141 NHLBI	R01 HL067350 NHLBI	R01 HL083454 NHLBI	R01 ES014240 NIEHS
Sample Size (N)	728	2199	954	723
Study Design	Cross-sectional	Cross-sectional	Cross-sectional	2-yr Longitudinal
Enrollment dates	2005-2008	2001-2005	2008-2010	2007-2008
Sampling Regions	Seattle-King County, WA & Baltimore, MD/Washington DC	Seattle-King County, WA & Baltimore, MD/Washington DC	Seattle-King County, WA & Baltimore, MD/Washington DC	Seattle-King County, WA & San Diego, CA
Neighborhood Sampling	2 X 2 Matrix of lo/hi Walkability X lo/hi Income	2 X 2 Matrix of lo/hi Walkability X lo/hi Income	2 X 2 Matrix of lo/hi Walkability X lo/hi Income	2 X 2 Matrix of lo/hi Walkability & Parks X lo/hi Nutrition Environment
Age range (yrs)	66-97	20-65	12-16	6-11 (and their parents)
% Female	56.4%	48.2%	50.3%	48-55%[2]
% Non-white	29%	26%	34.4%	17-20%[2]
% Hispanic	2.8%	3.7%	6.8%	14-20%[2]
% Overweight/obese[1]	58.9%	57.0%	25.6%	24-32%[2]
Accelerometer data (% with ≥5 valid days)	95.6%	96.5%	95.0%	89.3%

[1]For youth, overweight is based on ≥85th percentile of BMI-for-age; [2]Ranges of estimates across 2X2 quadrants are reported;

- Examine whether profiles can be derived from objective BE measures

Collaborators

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THANK YOU

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Older Adults

Adams MA, Sallis JF, Conway T, Frank LD, Saelens BE, Kerr J, Cain KL, King AC. Neighborhood Environment Profiles for Physical Activity among Older Adults. *American Journal of Health Behavior*, (*in press*).

Younger Adults

Adams MA, Sallis JF, Kerr J, Conway T, Saelens BE, Frank LD, Norman GJ, Cain K. Neighborhood Environment Profiles Related to Physical Activity and Weight Status: A Latent Profile Analysis. *Preventive Medicine*, 2011;52(5):326-31.