Comparing the Relationship between Fitness Score and the Built and Food Environment in Urban Latino Children Using Three Geographic Units.

The Modifiable Areal Unit Problem (MAUP)

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ESRI UC 2014
July 15, 2014
Outline

• Purpose
• Background
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Purpose

• Investigate the relationships between children’s level of fitness (FTs) and four components of the built environment (BE)

• Address the MAUP issue.

• 3 non-nested geographic units (GU).
Background

Features of the built environment (BE) are recognized as determinants of health (WHO, 2010)

• Physical Activity and Overweight
• Children
• Latinos
• Urban
• Streets, Parks, Food environment

Health Outcome: FATNESS vs. FITNESS
Where
Study Area
Method baseline

- Study Design: HAPPY Project
- Study Area: Inner City of Milwaukee
- Study population:
  Latino Children at BGCS (n=975 children K-8\textsuperscript{th})
  46% monolingual Spanish-speaking households
  52\% of them are overweight and/or obese
- Study participants:
  5th-8\textsuperscript{th} grade Latino children and their families
  - The baseline sample:
    - 279 Latino Children
    - Age 10-15 years-old.
Individual data

Spatial Data

composed by:

4 BE components
7 geographies
Method (2)

Individual data

• Home address
• D.V. Fitness score - PACER (# of 20m.laps)

Covariate (used in the final analysis) was collected through the HAPPY project were:

• Demographics - age - gender
• Ownership - owning a bike
• Anthropometrics - BMI
• Behavior - visit stores and/or buy from food stands around school more frequently before/after school time
Method (2)

Spatial data

- BE 4 components:
  - **Number of Intersections** (3-or-more ways)
  - **Density of Public Parks by size per GU**
  - **Density of Restaurants (8 cat.) per Km²**
  - **Density of Food Stores (7 cat.) per Km²**

- Geographic Units
Method (3)

Spatial data – geographies

Geographic Units

ZIP CODE

Geographic Scales
Method (3)

Spatial data – geographies

Geographic Unit: NEIGHBORHOOD

Geographic Scales
Method (3)

Spatial data – geographies

Geographic Unit: CENSUS

Geographic Scales
Census Tract
Method (3)

Spatial data – geographies

Geographic Unit: Street Network Buffer

Geographic Scales 400 m.
Method (3)

Spatial data - geographies

Geographic Units

3 Geographic Scales:

CBLK --> CBG --> CT

Nested with
Adjacent Boundaries
Method (3)

Spatial data – geographies

Geographic Units:
- Street Network Buffer

3 Geographic Scales:
- 400m. --> 800m. --> 1600m.

Nested with Overlapping Boundaries
Spatial data – 7 geographies

3 main Geographic Units:

- Neighborhood
- Census
- SNB

2 of which at Geographic Scales
3 - nested
Method (3)

Spatial data – geographies

3 non-nested Geographic Units:

- Neighborhood
- Census Block Group
- 400m. SNB
Aims

• To evaluate the relationship between Latinos children’ fitness score and the built and food environment.

• To compare variation in associations across the three selected geographic units

• To identify weather any geographic unit better predict the fitness score in Latinos 10-15 years-old living in an urban environment
Environmental Measures by GU

Neighborhood level of exposure
Environmental Measures by GU

Census Block level of exposure
Environmental Measures by GU

400 m. Street Network Buffer level of exposure
Analysis

1. Whether a one-to-one correlation exists between children’ FTs and each independent BE component differentiated by type, and if so, how it varies across the three GUs

2. How those relationships change, once the 4 BE components were tested combined, but undifferentiated by type

3. Identify which BE-category was more strongly associated with children’ fitness across GUs once the 4 BE components were tested combined and differentiated by type.

4. Which of the three GUs better predict children’ FTs once adjusting for individual characteristics, behavior, and BMI
Conceptual Model

Street connectivity (Intersect. density)

Parks (by size)

Food environment - R (R density by type)

Food environment - FS (FS density by type)

Bike ownership

Family vehicle ownership

Behavior

BMI

FITNESS SCORE
Regression Model 1 (A - B - C - D)
Hierarchical Regression Model 2

4 Blocks - 4 independent variables

- SC
- PP (all)
- R (all)
- FS (all)

Ngb
CBG
SNB 4
Hierarchical Regression Model 3
4 Blocks – 19 independent variables

SC
5 Scales

PP
5 Scales

R
8 categories

FS
7 categories

Ngb

CBG

SNB 4

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Hierarchical Regression Model 4
7 Blocks – 8 independent variables

Gender - Own. Bike
SC
PP (all)
R (all)
FS (all)
Behavior
BMI

Ngb
CBG
SNB 4

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Results

Model # 1 (BE-by type independently tested):

Model 1B - Parks
• P-by scale Full model sig. $R^2$ 8.3% SNB4
  • PP-scale 2: (+) SNB4

Model 1D – Food Stores
• FS-by cat Full model sig. $R^2$ 13.3% Ngb
  • FS-Dollar stores: (-) Ngb and SNB4
Results (cont’d)

Model # 2:

BE components tested combined (no distinction by type)

4 Blocks – 4 independent variables

• PP (all) : (+) at CBG and SNB4

8.4% ↑ in FTs

For every addition park within SNB4

\[ R^2 \text{ across Gus: } 4.0\% \text{ at SNB4, } 3\% \text{ at Ngb, } 2.8\% \text{ at CBG} \]
Results (cont’d)

Model # 3:

BE component combined tested by type
4 Blocks – 19 independent variables

• PP full block: sig. $R^2$ 8.3%: (+) at SNB4
  - **PP-scale 2**: (+) SNB4 - 27% ↑ FTs
  - R-Fast-casual: (-) CBG
  - **R-Fast Food**: (+) SNB4 4.5%↑ FTs

• FS full block: sig. $R^2$ 9.7% at Ngb
  - **FS-Dollar stores**: (-)
    - Ngb 30% FTs
    - SNB4 10% FTs

$R^2$ across GUs: 17.4% at Ngb, 16.6% SNB4, 12.8% at CBG
Results (cont’d)

Model # 4:

BE component combined (no distinction by type)
7 Blocks – 8 independent variables

• **Female** average FTs: 25- 28% lower then Male across GU

• Parks and behavior: sig SBN4 [w/o BMI]

  † no BE sig. [w/BMI]

• **BMI** : (-) across GUs 4% ↓ FTs

Full model $R^2$ across GUs **w/o BMI**: 18% at SNB4, 17.6% at Ngb, 15.2% at CBG
MAUP Results

At SNB4:

• 27% increase in the average FTs for every additional public park scale 2 within 400m.SNB

• a 10.4% decrease in FTs for every additional Dollar Store per Km²

• After adjusting, with no BMI, the average FTs increasing 9.7% for every additional public park (of any size) within 400m.SNB

• a 46% higher average FTs for buying food after school time.
Strengths

• FTs as d.v.

• Ngb as a Novel geographic unit

• Analytical framework; planning and epidemiological criteria combined

• Behavior variable

• FE and P differentiation (quali-quantitative)

• BMI as confounder.
Limitation

- Sample size
- Lack of power to capture
- Lack of complete data for the covariate.
- Pairwise adjustment
- Multicollinearity between P scales
- Spatial autocorrelation among BE components and spatial dependence between FE
- Linearity assumption and linear results confirmed but .....threshold effect.
Conclusion

We identify the 400 meters Street Network buffer as the geographic unit that overall better predicts the level of fitness in Latinos 10-15 years-old living in an urban environment as determined by four components of their built environment.

Public health and urban planning efforts to improve Latino children’s level of fitness should focus on increasing access to Park 3,780 to 10,750 m² in size (Scale 2) and in reducing the density of Dollar Stores.
Acknowledge

• Sam Dennis Jr., PhD
• Alexandra Wells, MS
• Mari Palta, PhD
• Matt Heinzel
Citation

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Manuscript Submitted on June 30, 2014