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)

Milena Bernardinello, MS, MSUP

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Outline

- Purpose
- Background
- Method
- Analysis
- Results
- Strengths & Limitation
- Conclusion

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).

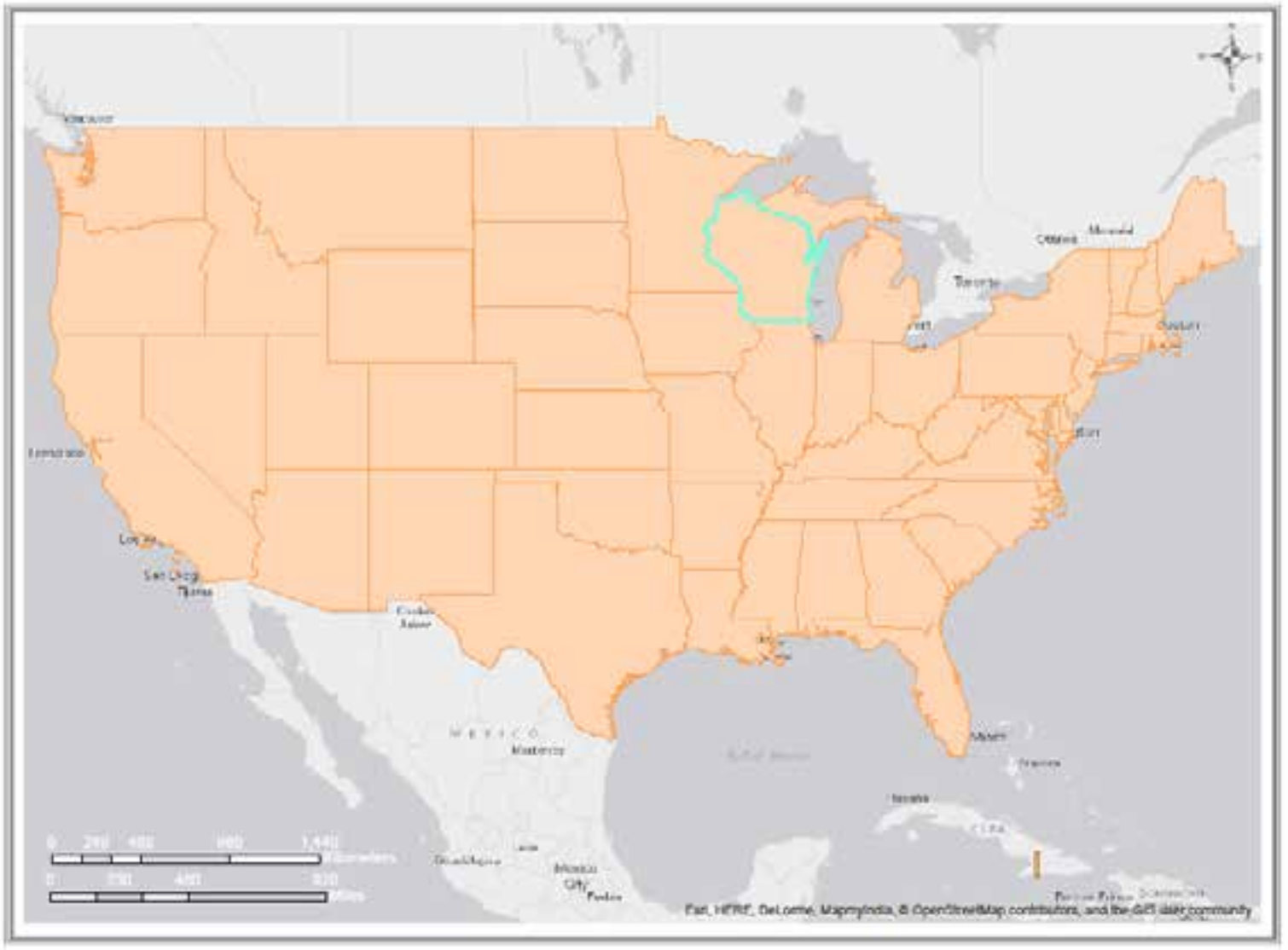
Background

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


Toronto
Miami
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Study Area


Wisconsin 72 Counties


Milwaukee County
Milwaukee
Lake Michigan

Method baseline

- Study Design : HAPPY Project
- Study Area: Inner City of Milwaukee
- Study population:

Latino Children at BGCS (n=975 children K-8th)

46% monolingual Spanish-speaking households

52% of them are overweight and/or obese

- Study participants:

5th-8th grade Latino children and their families

  - The baseline sample:
    - 279 Latino Children
    - Age 10-15 years-old.

Method (1)

Individual data **159**

10-15 y.

Spatial Data

composed by:

4 BE components

7 geographies

Method (2)

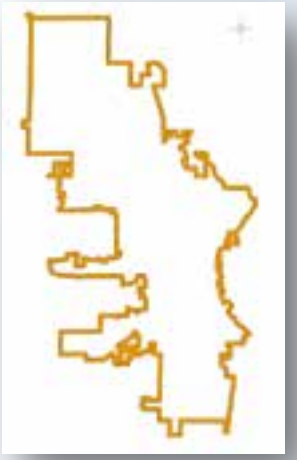
Individual data

- 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 - owing a bike
- Anthropometrics- BMI
- Behavior- visit stores and/or buy from food stands around school more frequently before/after school time

Method (2)

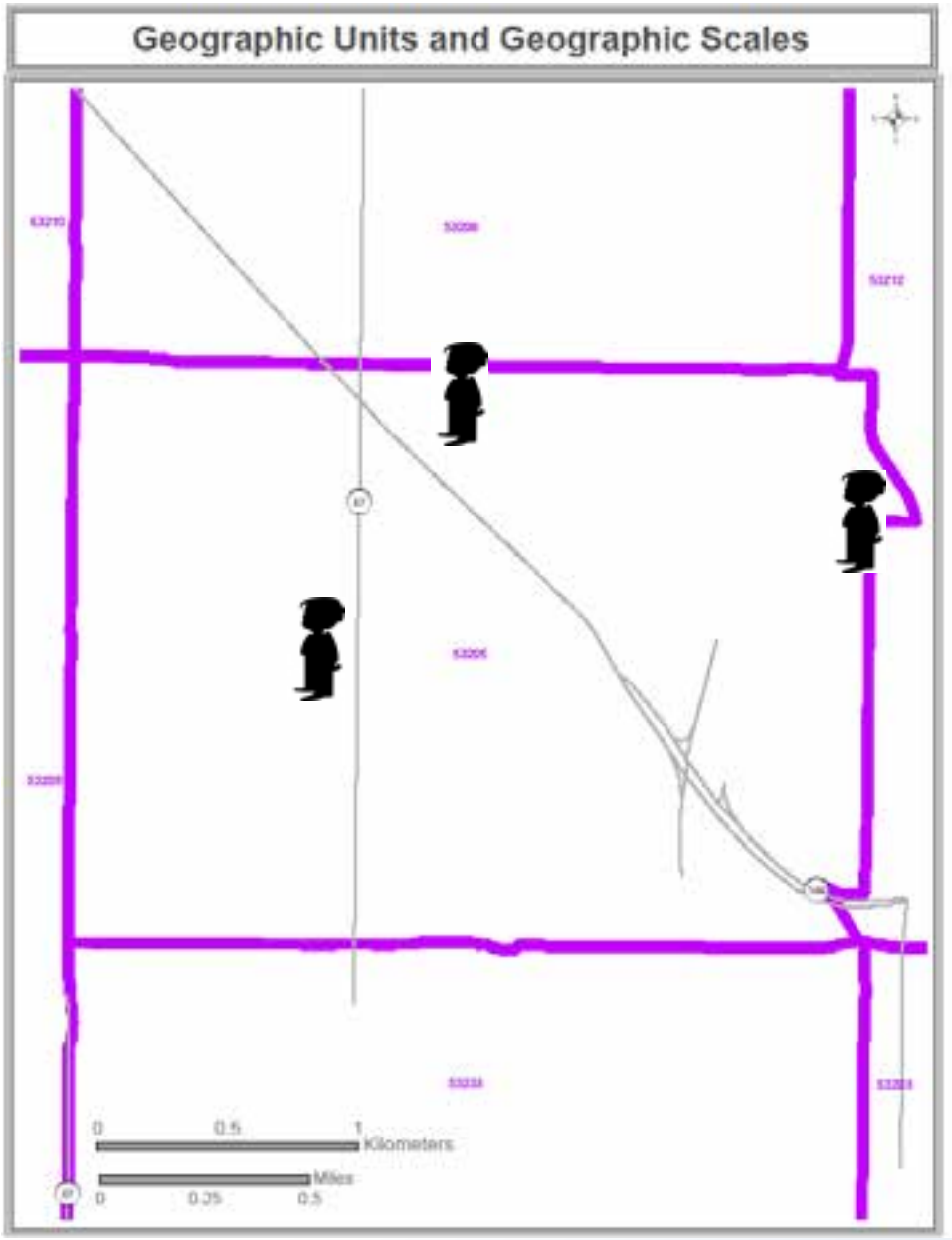


Spatial data

– BE 4 components:

- Number of Intersections (3-or-more ways)
- Density of Public Parks by size per GU
- Density of Restaurants (8 cat.) per Km^2
- Density of Food Stores (7 cat.) per Km^2

– Geographic Units



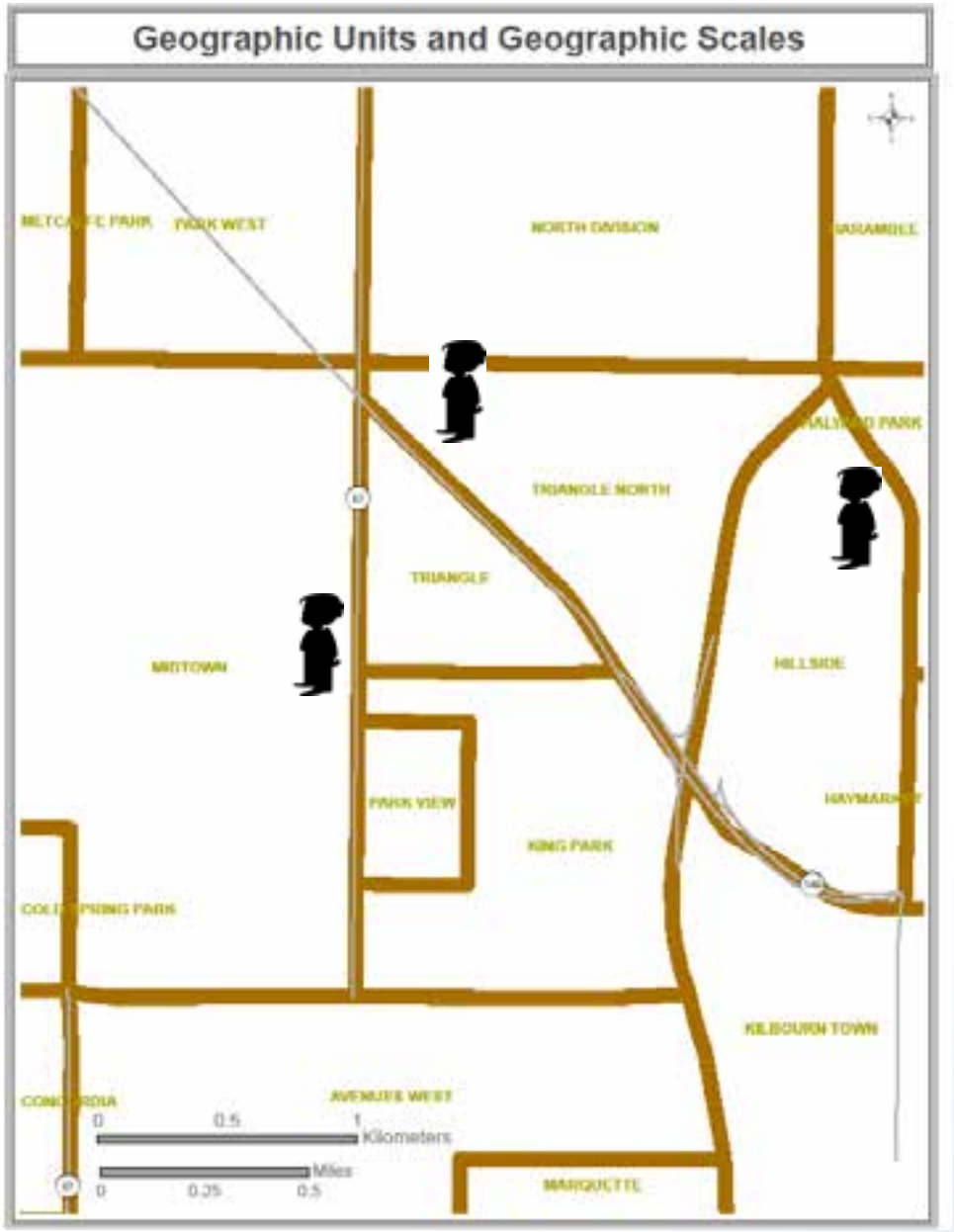
Method (3)

Spatial data – geographies

Geographic Units

ZIP CODE

Geographic Scales



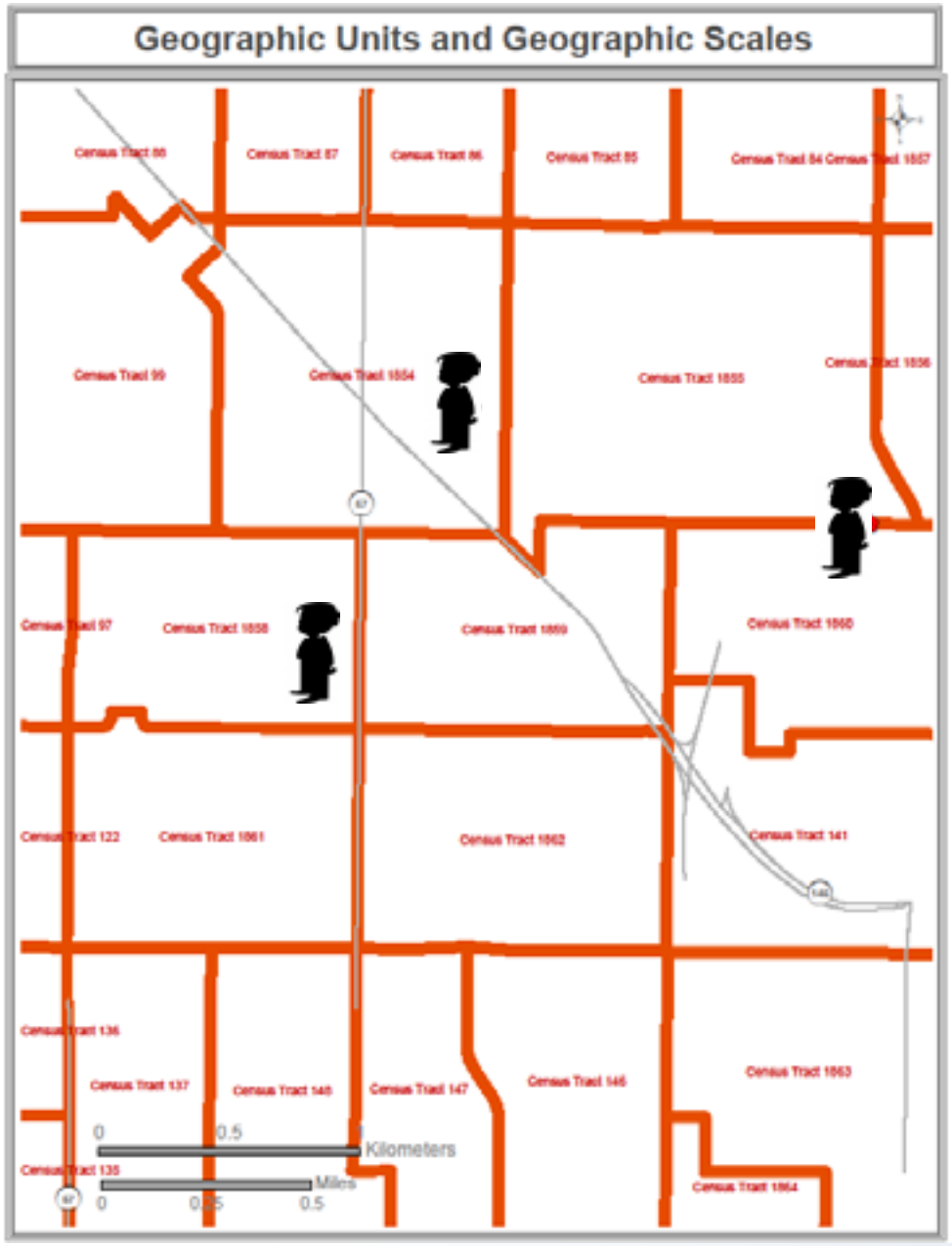
Method (3)

Spatial data – geographies

Geographic Unit:

NEIGHBORHOOD

Geographic Scales



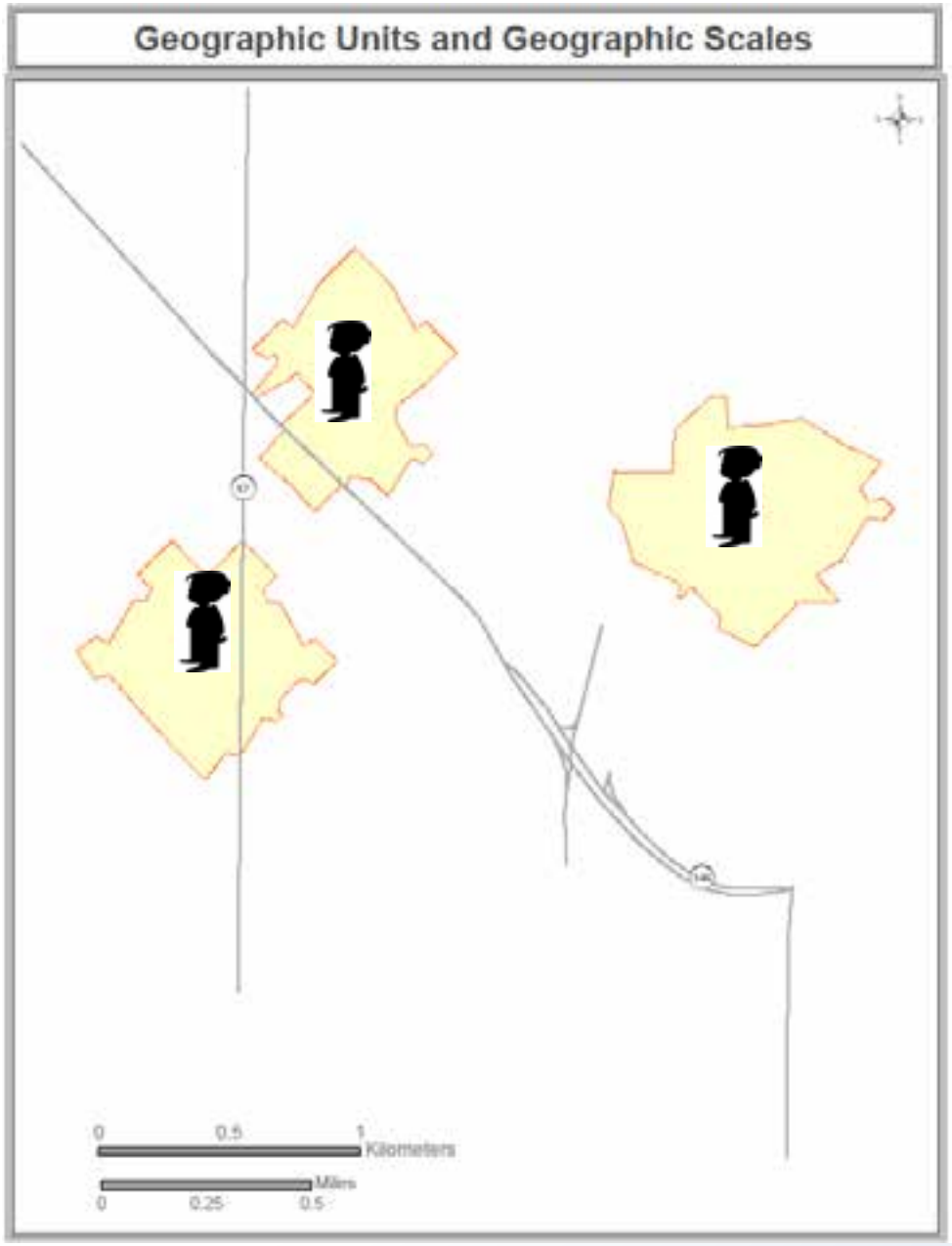
Method (3)

Spatial data – geographies

Geographic Unit: CENSUS

Geographic Scales

Census Tract



Method (3)

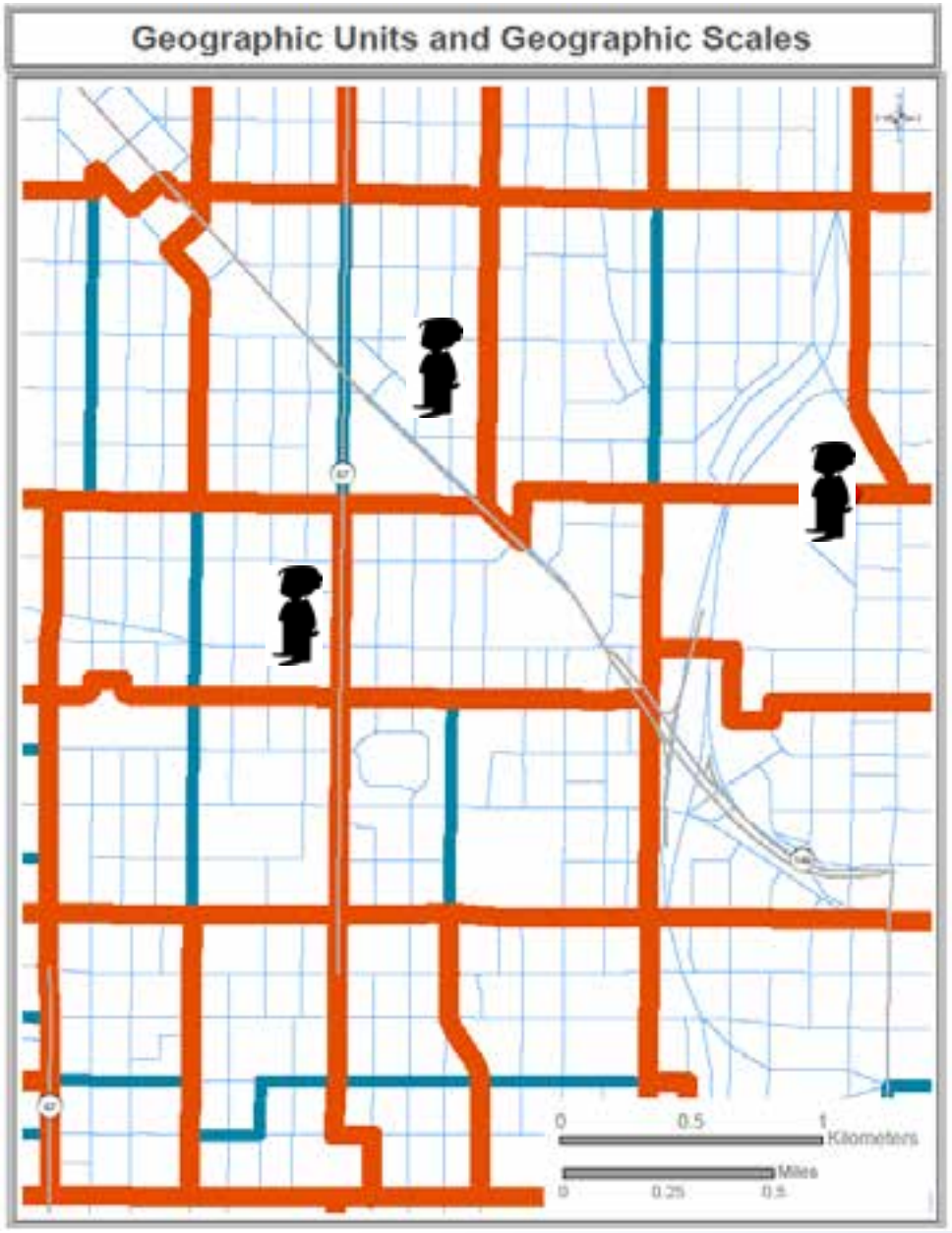
Spatial data – geographies

Geographic Unit:

Street Network Buffer

Geographic Scales

400 m.



Method (3)

Spatial data –

geographies

Geographic Units

CENSUS

3 Geographic Scales:

CBLK --> CBG--> CT

Nested with

Adjacent Boundaries

Method (3)

Spatial data –

geographies

Geographic Units :

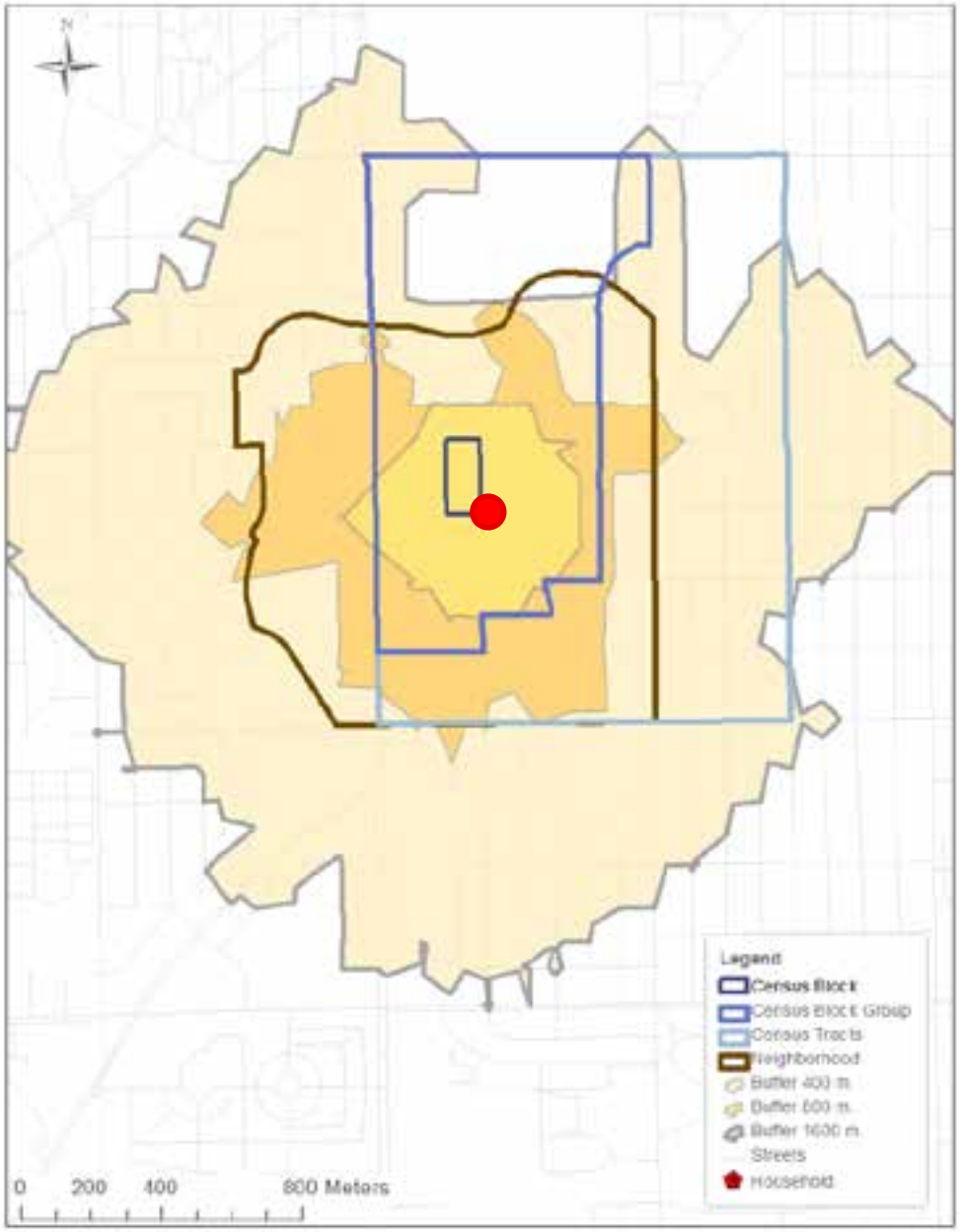
Street Network Buffer

3 Geographic Scales:

400m. --> 800m.--> 1600m.

Nested with

Overlapping Boundaries



Method (3)

Spatial data –

7 geographies

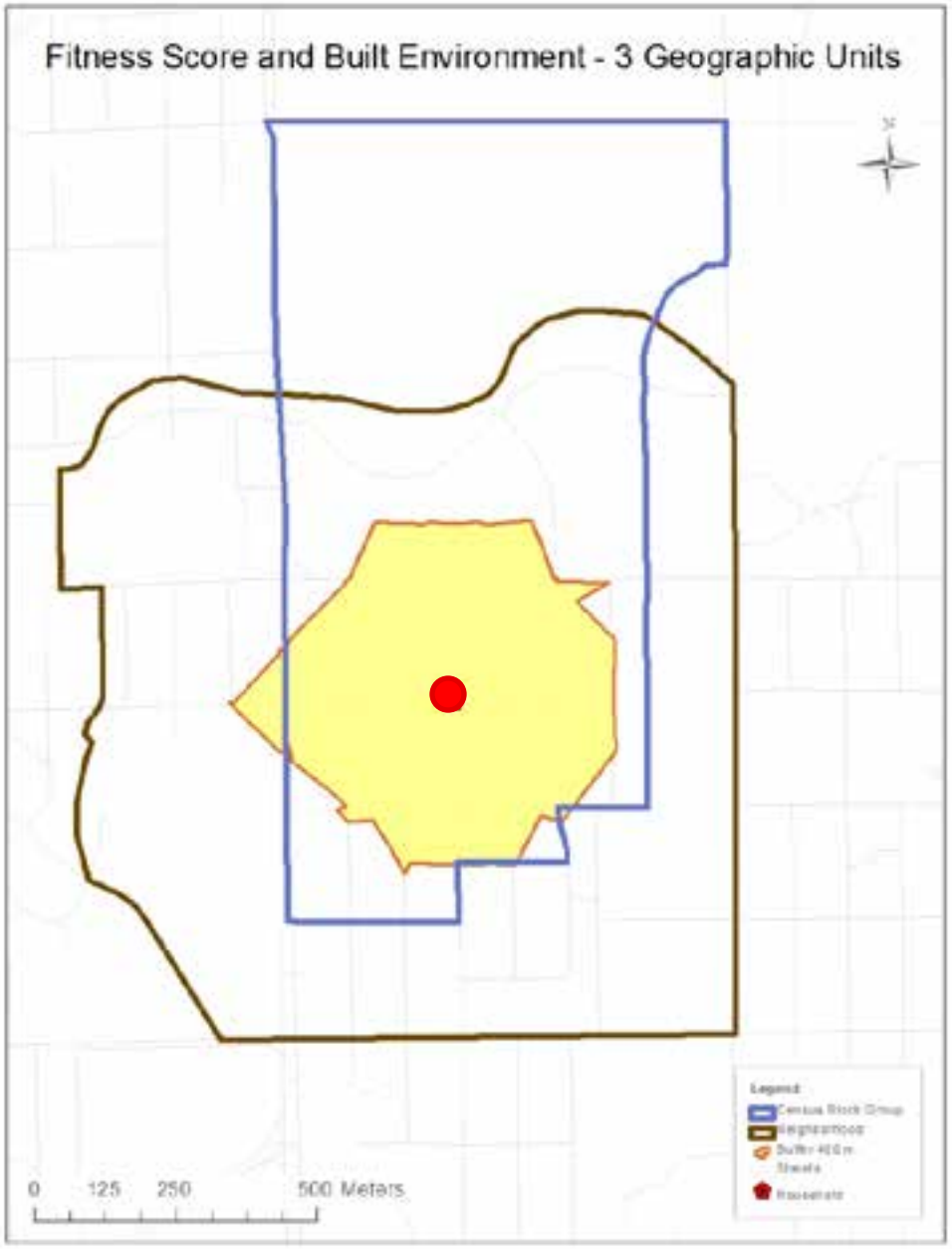
3 main Geographic Units:

- Neighborhood
- Census
- SNB

2 of which at

Geographic Scales

3 - nested



Method (3)

Spatial data – geographies

3 non-nested Geographic Units:

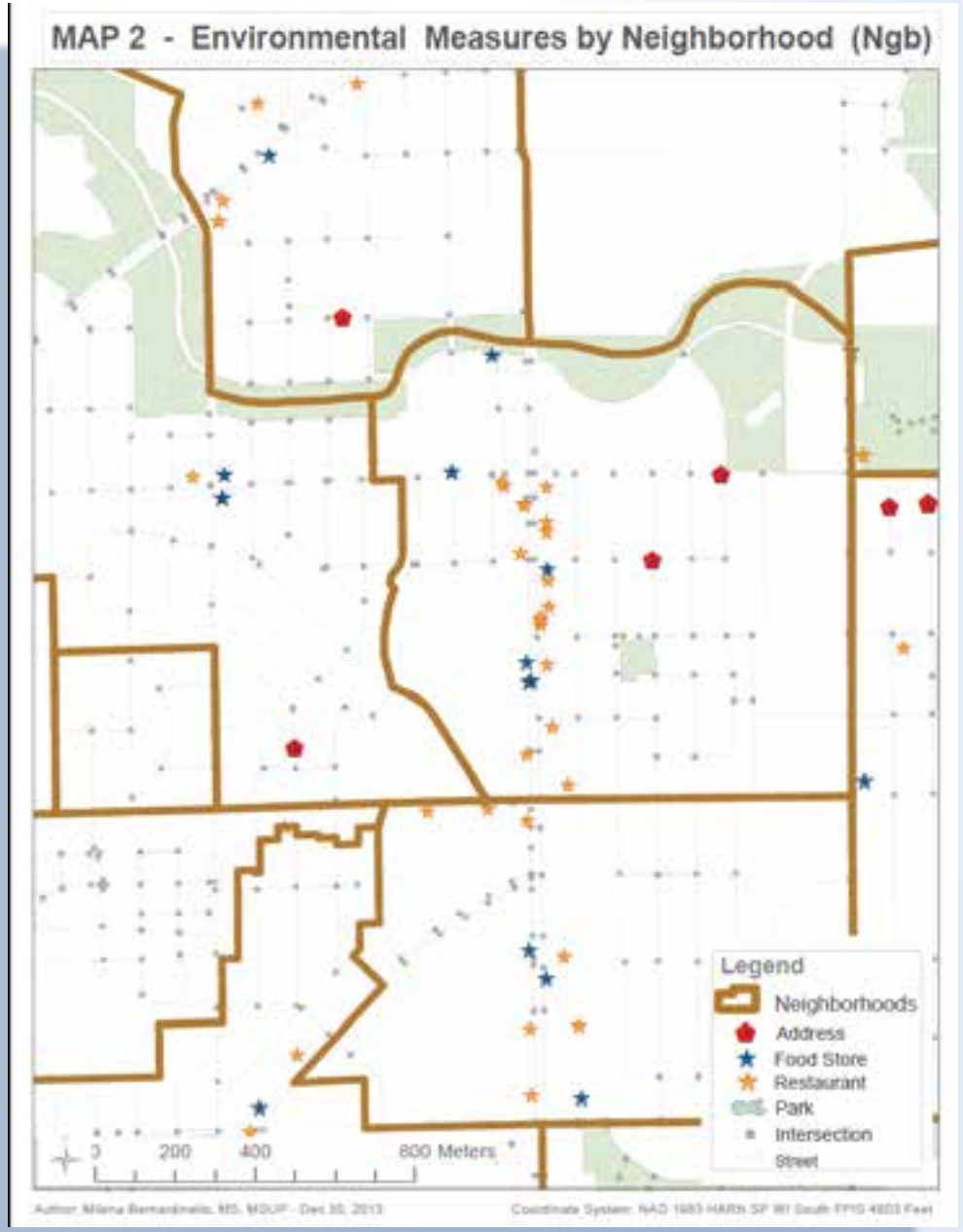
- Neighborhood
- Census Block Group
- 400m. SNB

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

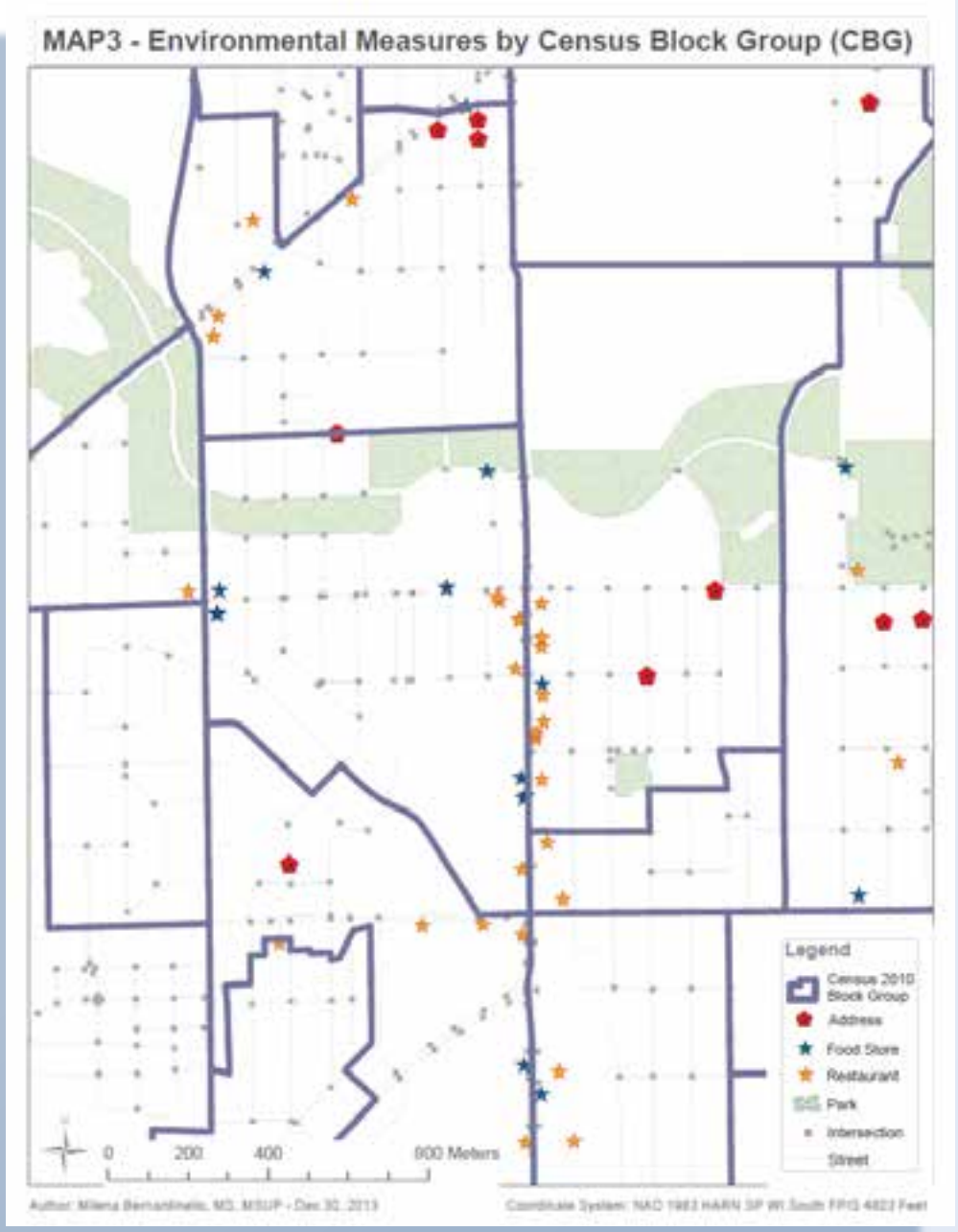
Environmental Measures by GU

Neighborhood level of exposure



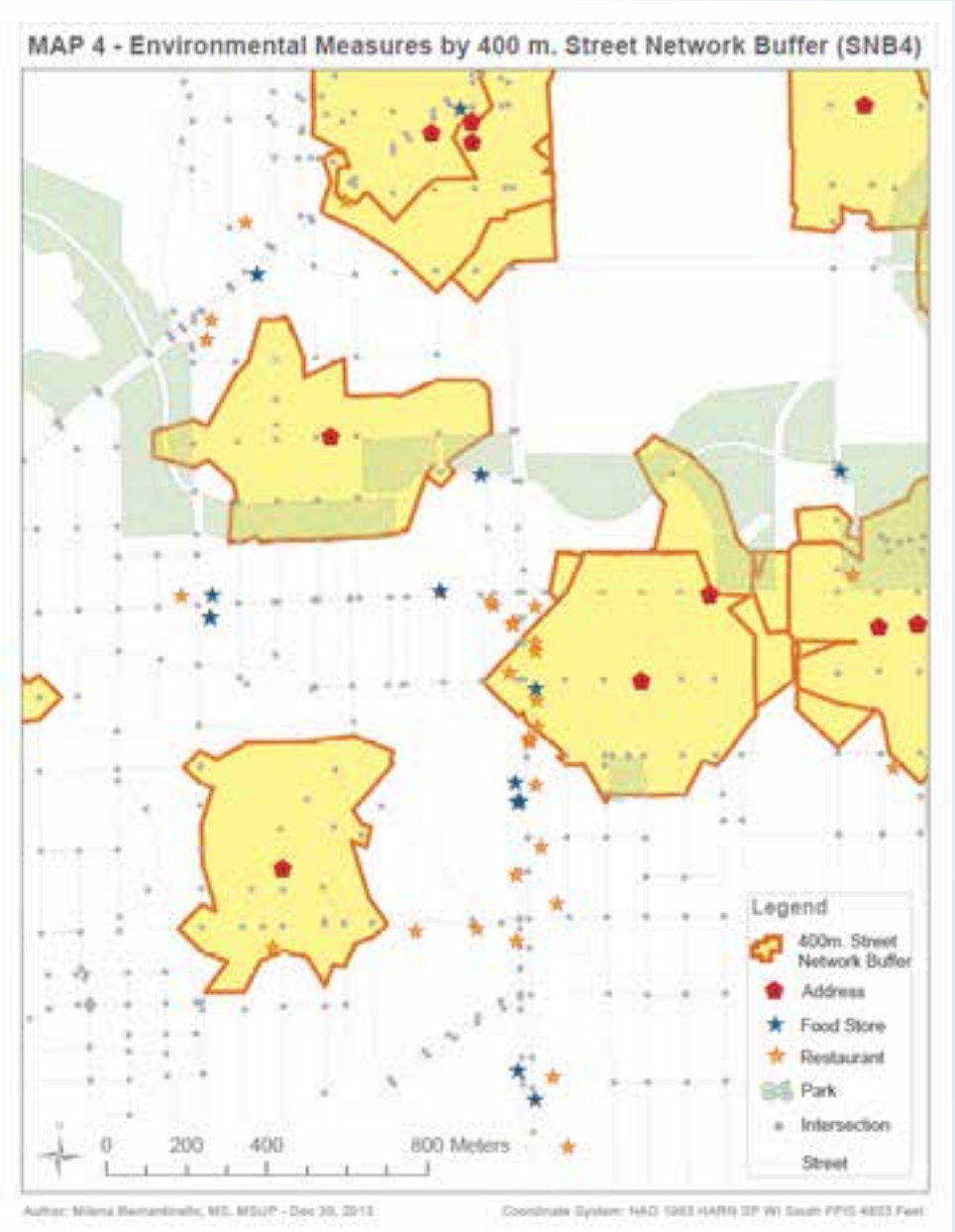
Environmental Measures by GU

Census Block level of exposure



Environmental Measures by GU

400 m.
Street Network Buffer level of exposure



Analysis

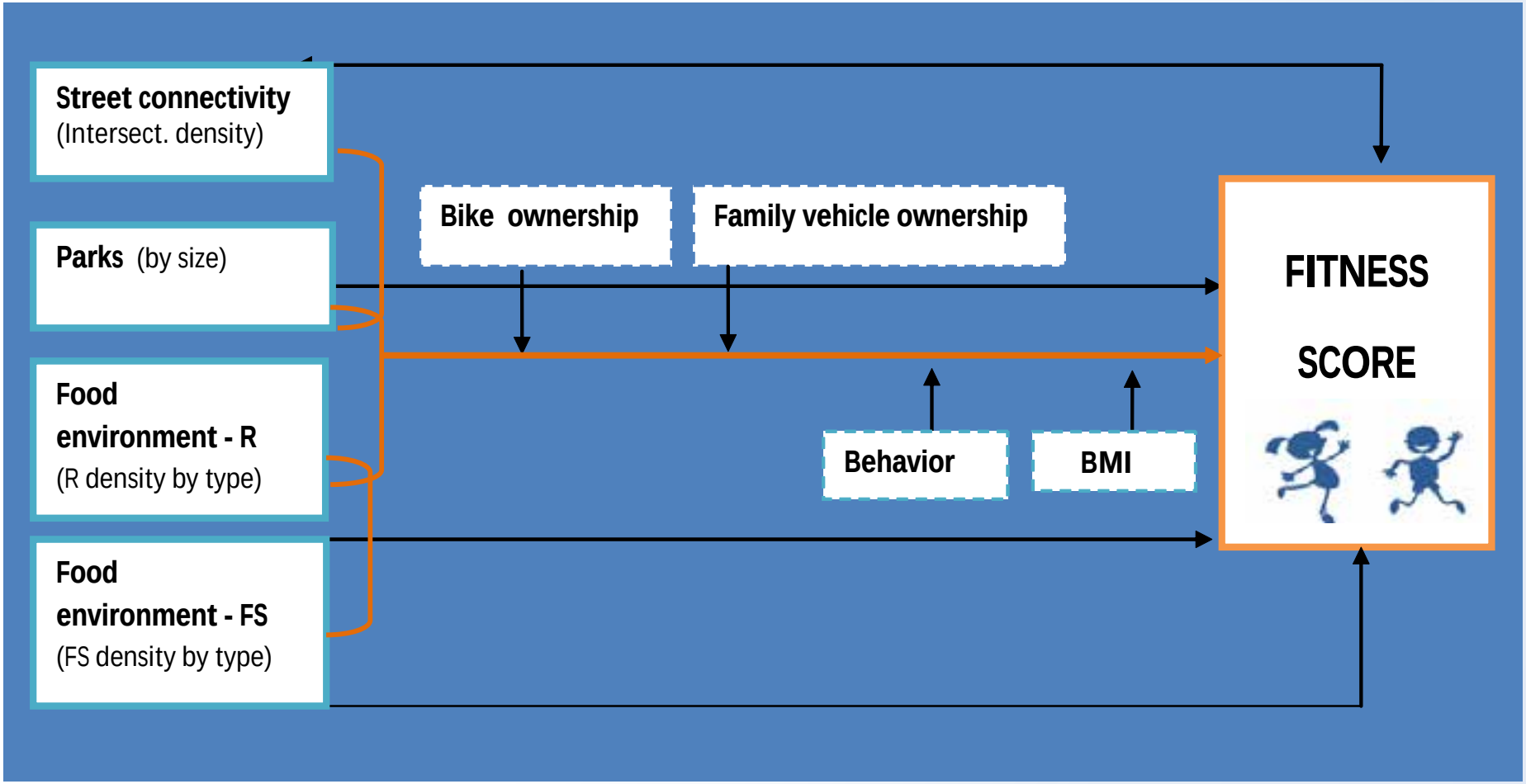
1. Whether a one-to-one correlation exists between children' FTs and each independent BE component differentiated by type, and if so, how it varies across the three GUs

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

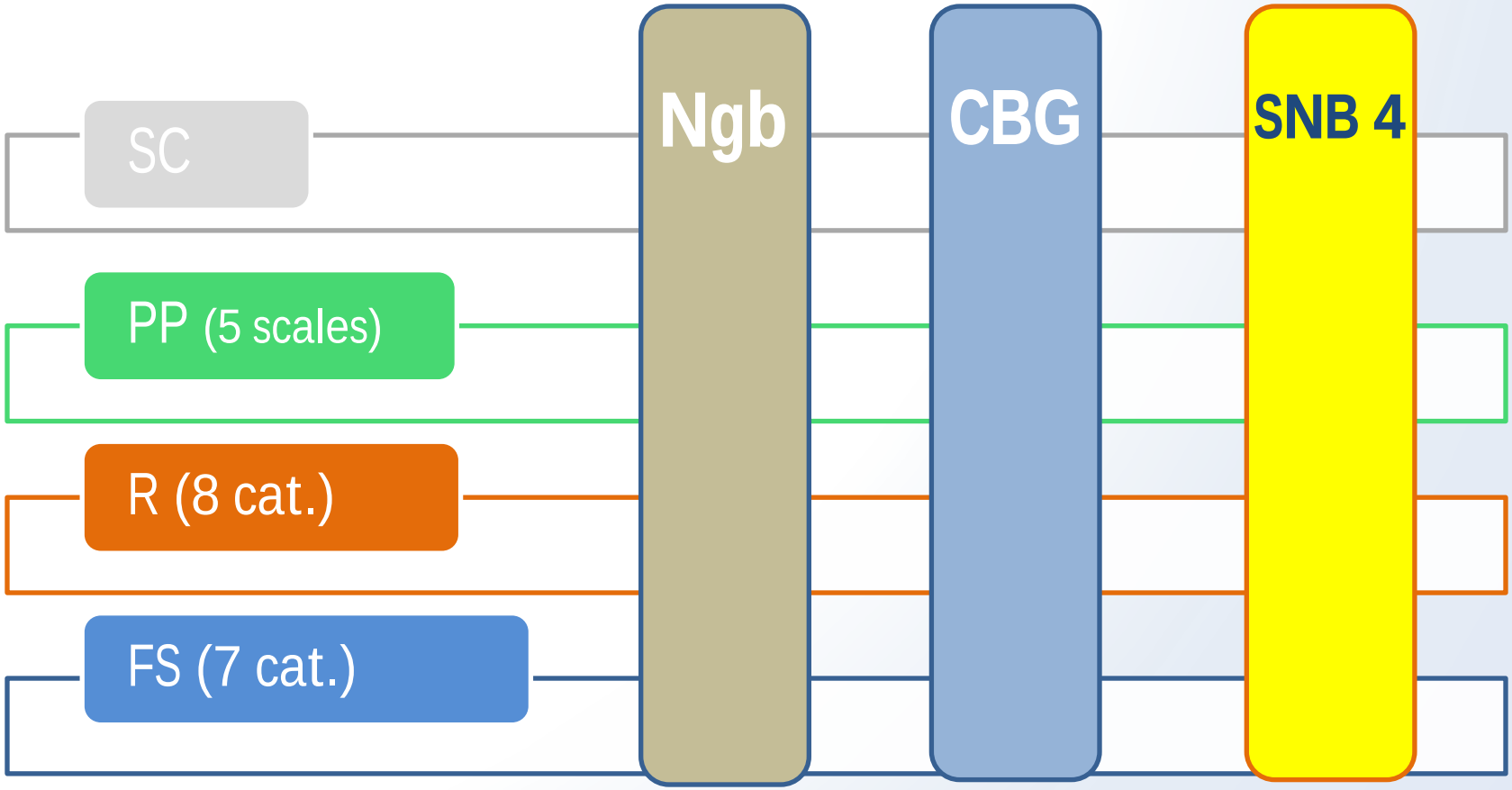
3. Identify which BE-category was more strongly associated with children' fitness across GUs once the 4 BE components were tested combined and differentiated by type.

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

Conceptual Model

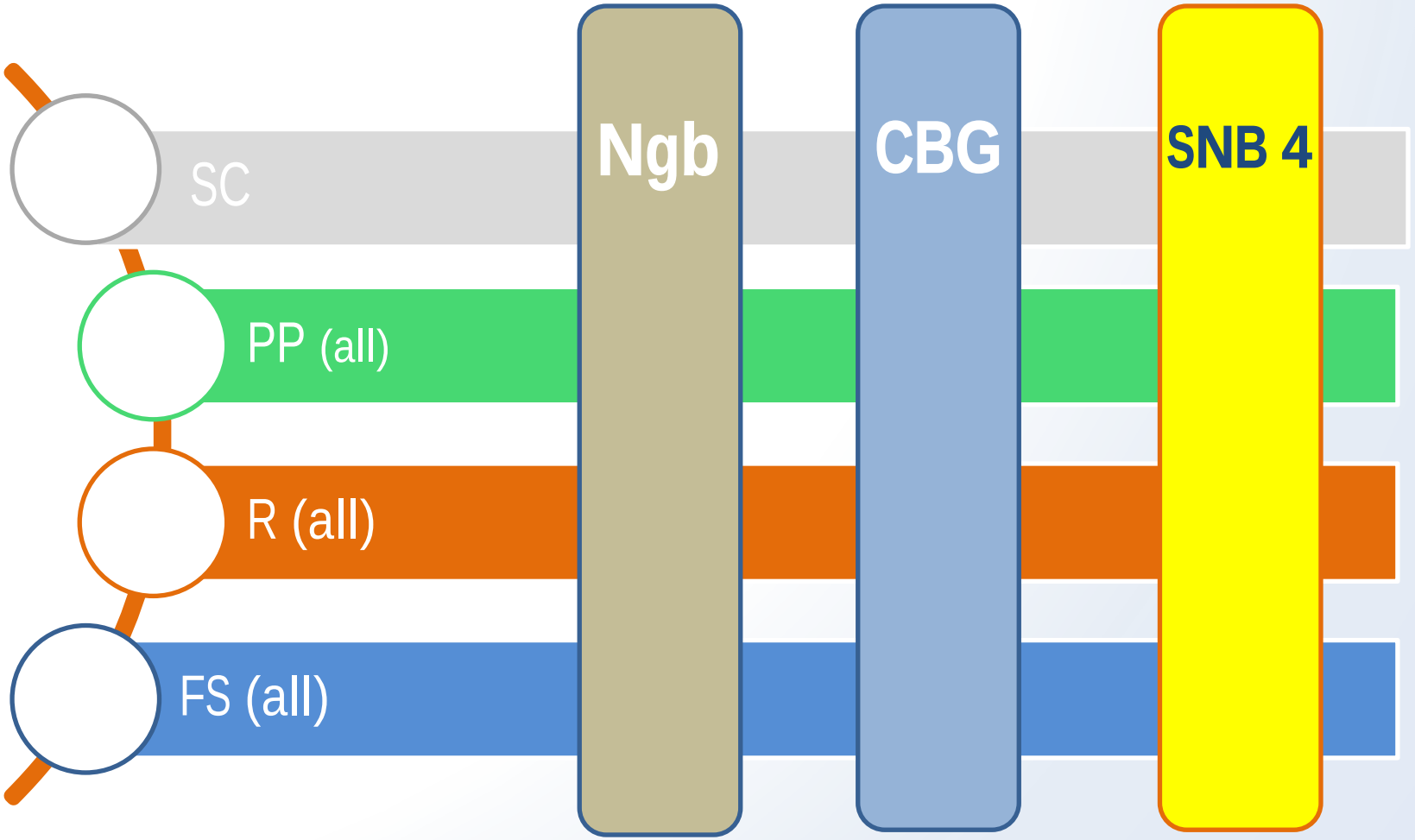


Regression Model 1 (A - B- C- D)



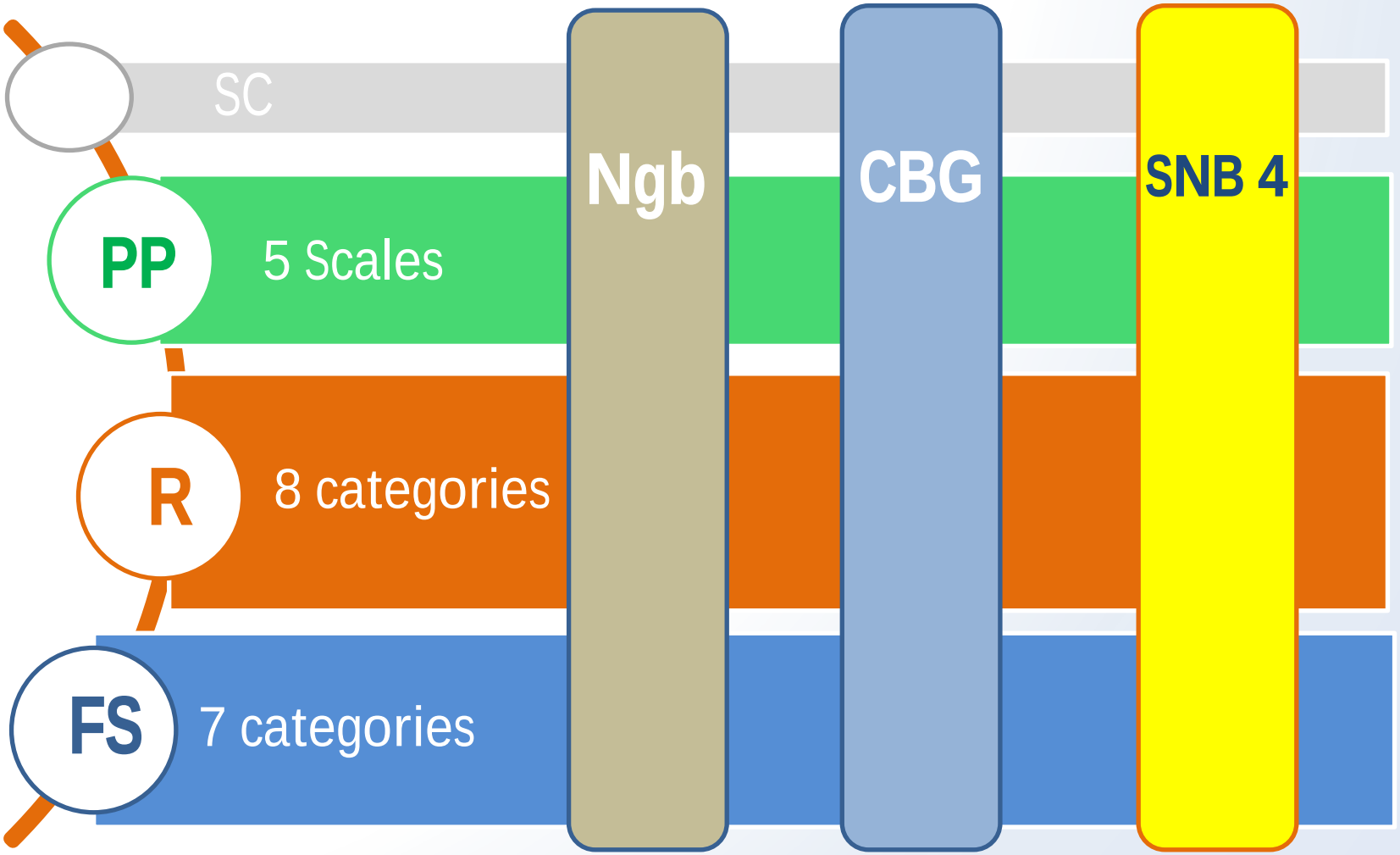
Hierarchical Regression Model 2

4 Blocks – 4 independent variables



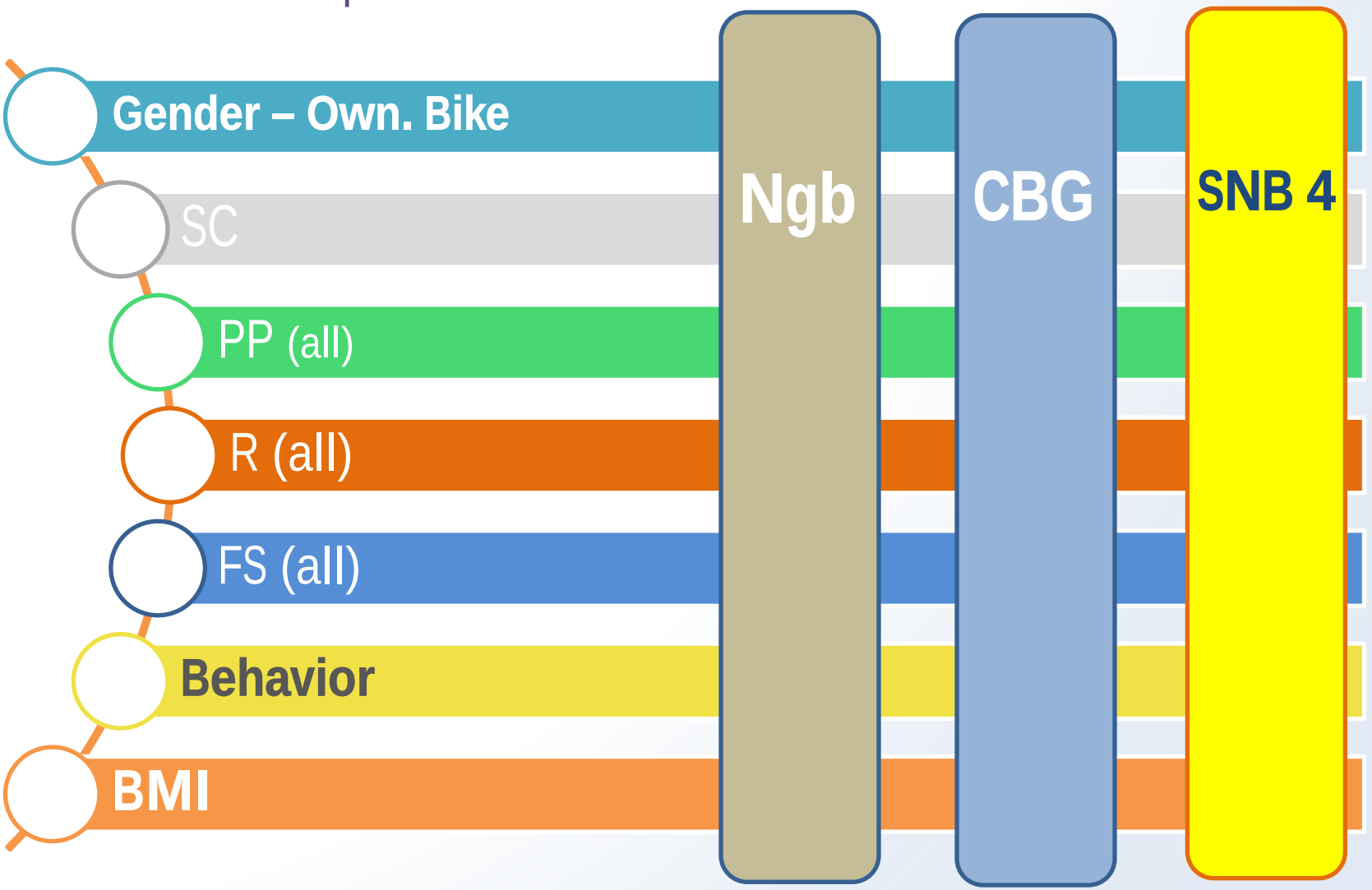
Hierarchical Regression Model 3

4 Blocks – 19 independent variables

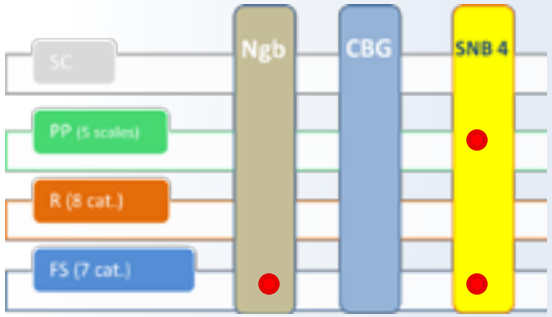


Hierarchical Regression Model 4

7 Blocks – 8 independent variables



Results



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

Model 1B - Parks

- P-by scale Full model sig. R^2 8.3% SNB4

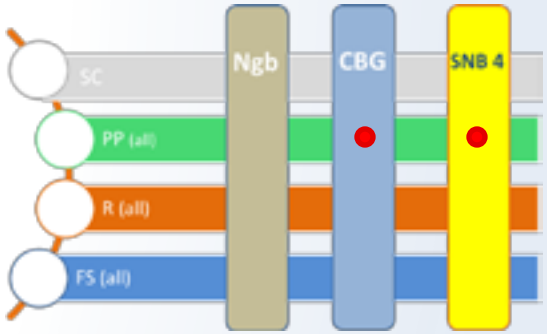
ü PP-scale 2: (+) SNB4

Model 1D – Food Stores

- FS-by cat Full model sig. R^2 13.3% Ngb

ü FS-Dollar stores: (-) Ngb and SNB4

Results (cont'd)



Model # 2:

BE components tested combined (no distinction by type)

4 Blocks – 4 independent variables

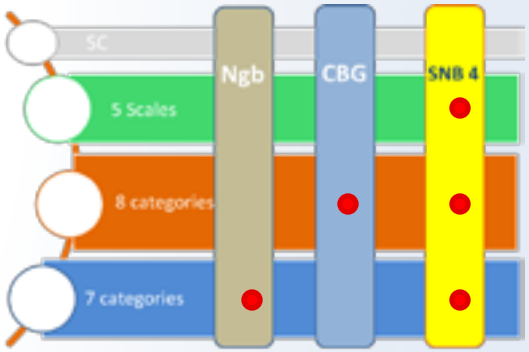
- PP (all) : (+) at CBG and SNB4

8.4% ⬆ in FTs

For every addition park within SNB4

R^2 across Gus: 4.0% at SNB4, 3% at Ngb, 2.8% at CBG

Results (cont'd)



Model # 3:

BE component combined tested by type

4 Blocks – 19 independent variables

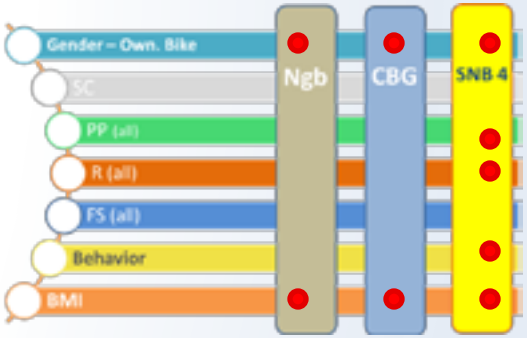
- PP full block: sig. R^2 8.3% : (+) at SNB4
  - ü **PP-scale 2**: (+) SNB4 - *27%* ⬆ *FTs*
  - ü R-Fast-casual : (-) CBG
  - ü **R-Fast Food**: (**+**) SNB4 *4.5%*⬆ *FTs*
- FS full block: sig. R2 9.7% at Nbg
  - ü **FS-Dollar stores**: **(-)**

    Ngb *30%* ⬇ *FTs*

    SNB4 10%

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]

  à 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 Km^2
- 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.

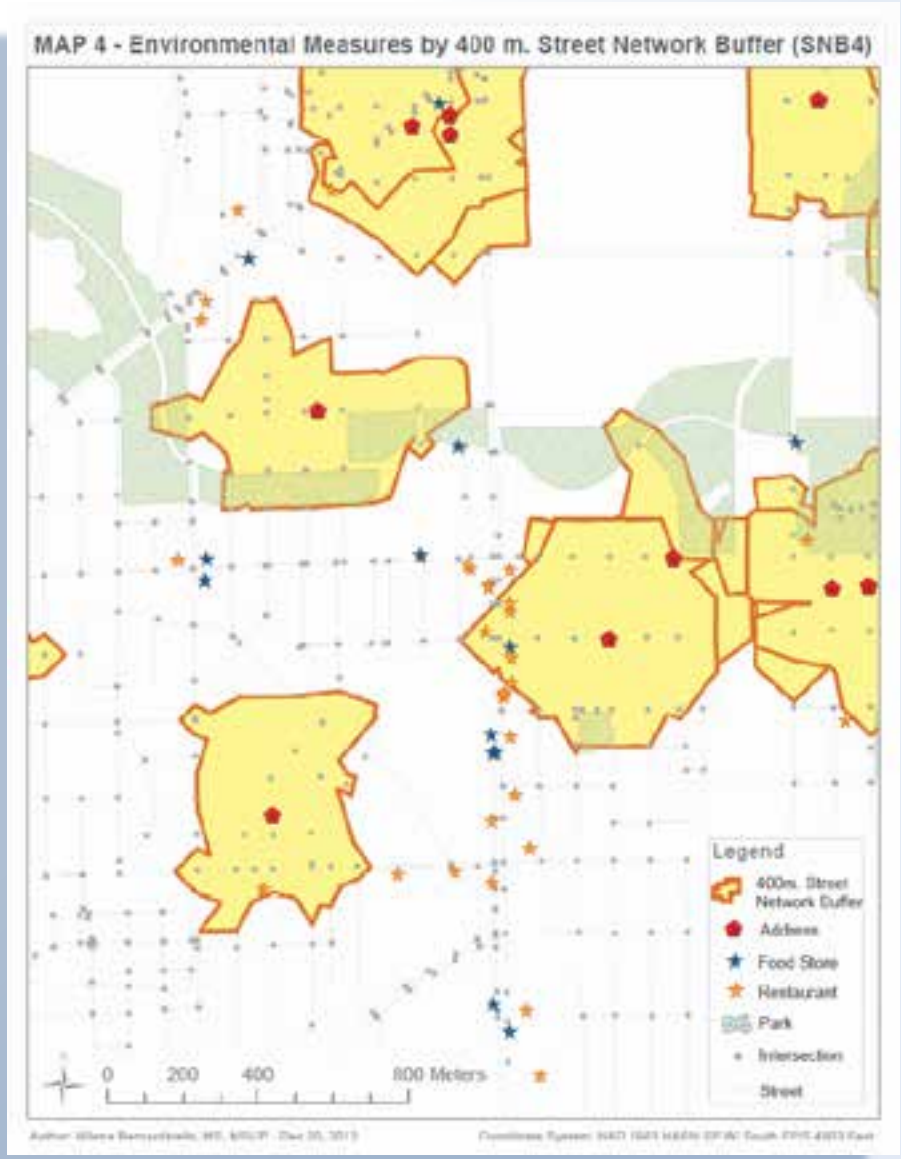
Limitation

- 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.



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Citation

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Milena Bernardinello MS, MSUP, Samuel Dennis Jr. PhD, Alexandra Wells, MS

a. Department of Urban and Regional Planning , University of Wisconsin, Madison WI 53706, USA
b. Department of Landscape Architecture, University of Wisconsin, Madison WI 53706, USA

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