The Role of Landscape Spatial Patterns on Childhood Obesity and Quality of Life

:A Study of Hispanic Children in Inner-City Neighborhoods

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PRESENTATION OUTLINE

I. Introduction

II. Methods

III. Results

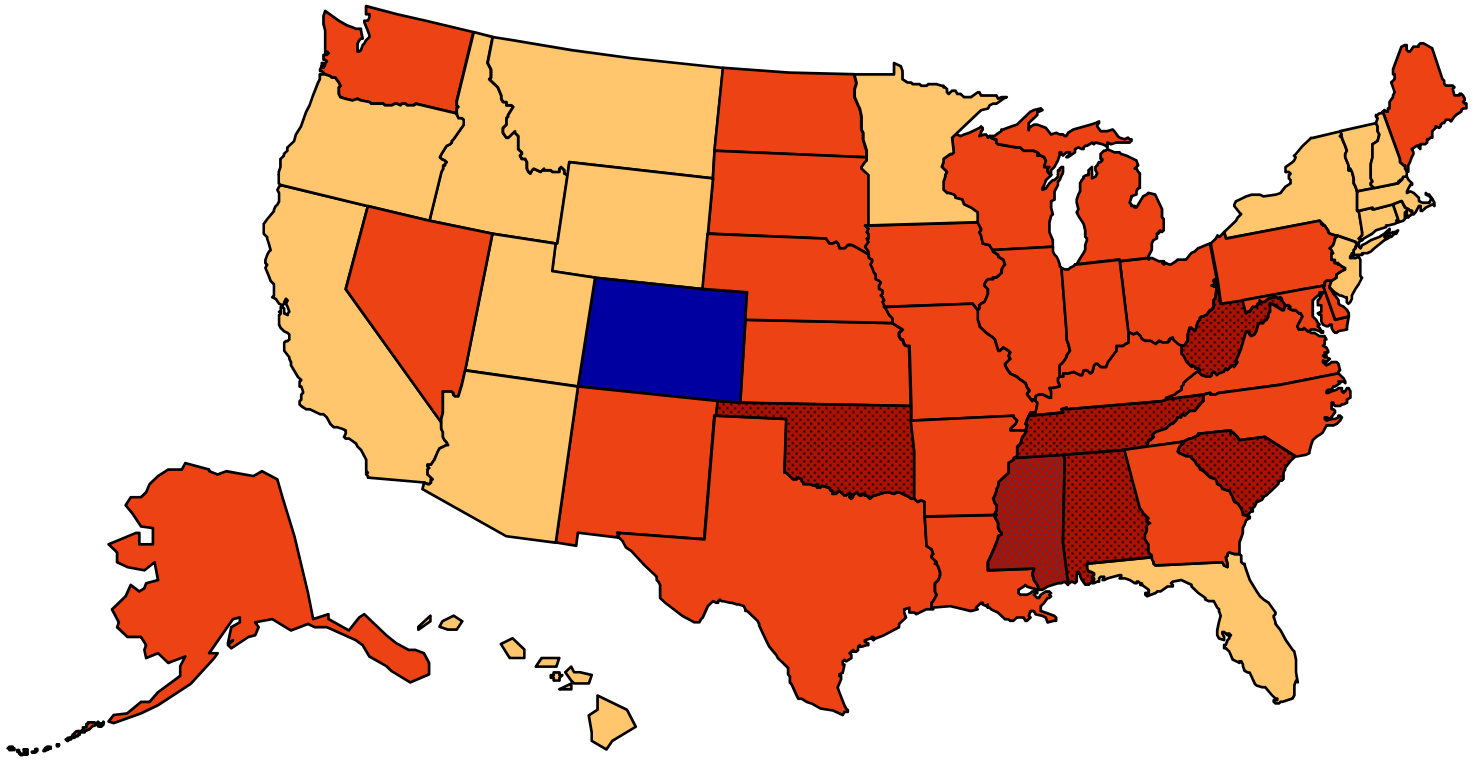
IV. Discussion and Conclusions

I. INTRODUCTION

Obesity Trends* Among U.S. Adults

BRFSS, 2008

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



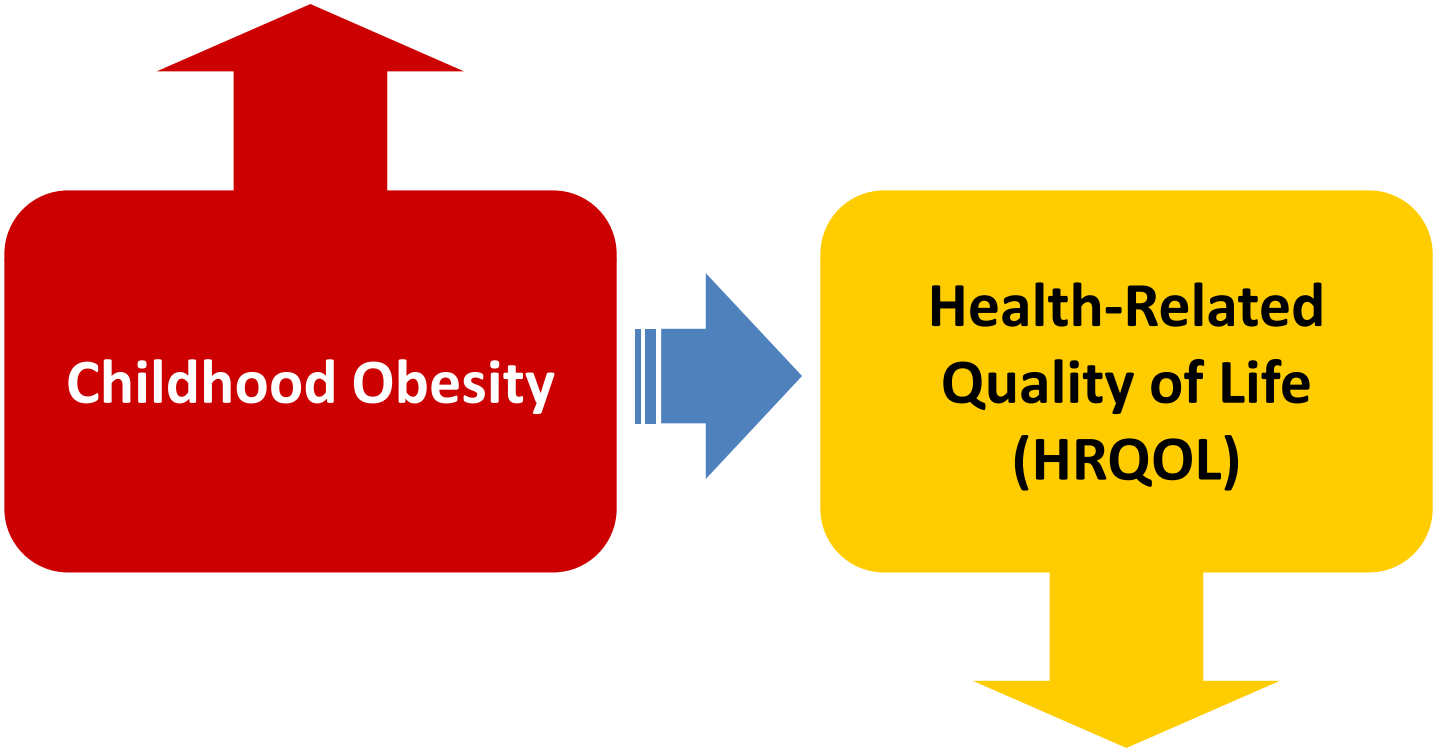
Source: CDC Behavioral Risk Factor Surveillance System.

DUCTION

Childhood Obesity

- Growing concern on physical inactivity and obesity among children and adolescents
- Only 39% of children aged 9-13 years participated in regular physical activity (CDC, 2003).
- Hispanics of all ages show lower levels of physical activity than Caucasians and this difference arises in early childhood (McKenzie et al., 1992; McKenzie et al., 1997).

Childhood Obesity and Health-related Quality of Life



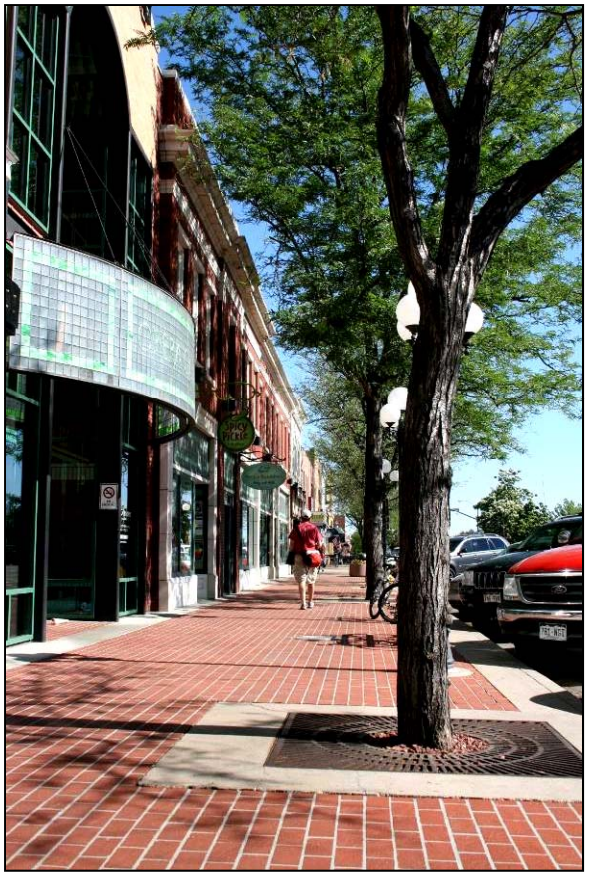
- Childhood Obesity has strong associations with poor quality of life and well-being (Schwimmer et al., 2003).

Nutrition Issues

THE QUESTION

Can the Built Environment Promote our Health?

I. INTRODUCTION



- Previous studies have recognized the importance of well-designed built environment, as a setting in which physical activity can be encouraged.

Walkable Streets

Access to facilities/places for physical activity

(Booth et al., 2000; Giles-Corti and Donovan, 2002a; Kirtland et al., 2003; Lee and Moudon, 2006)

Density, Land use mix, Neighborhood walkability

(Giles-Corti and Donovan, 2003; Saelens et al., 2003a; Saelens et al., 2003b)

Visual quality, Aesthetic features

(Ball et al., 2001; Giles-Corti and Donovan, 2002b; Humpel et al., 2004; King et al., 2000)

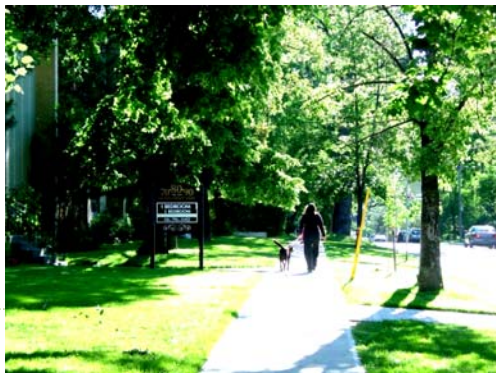
Infrastructure design

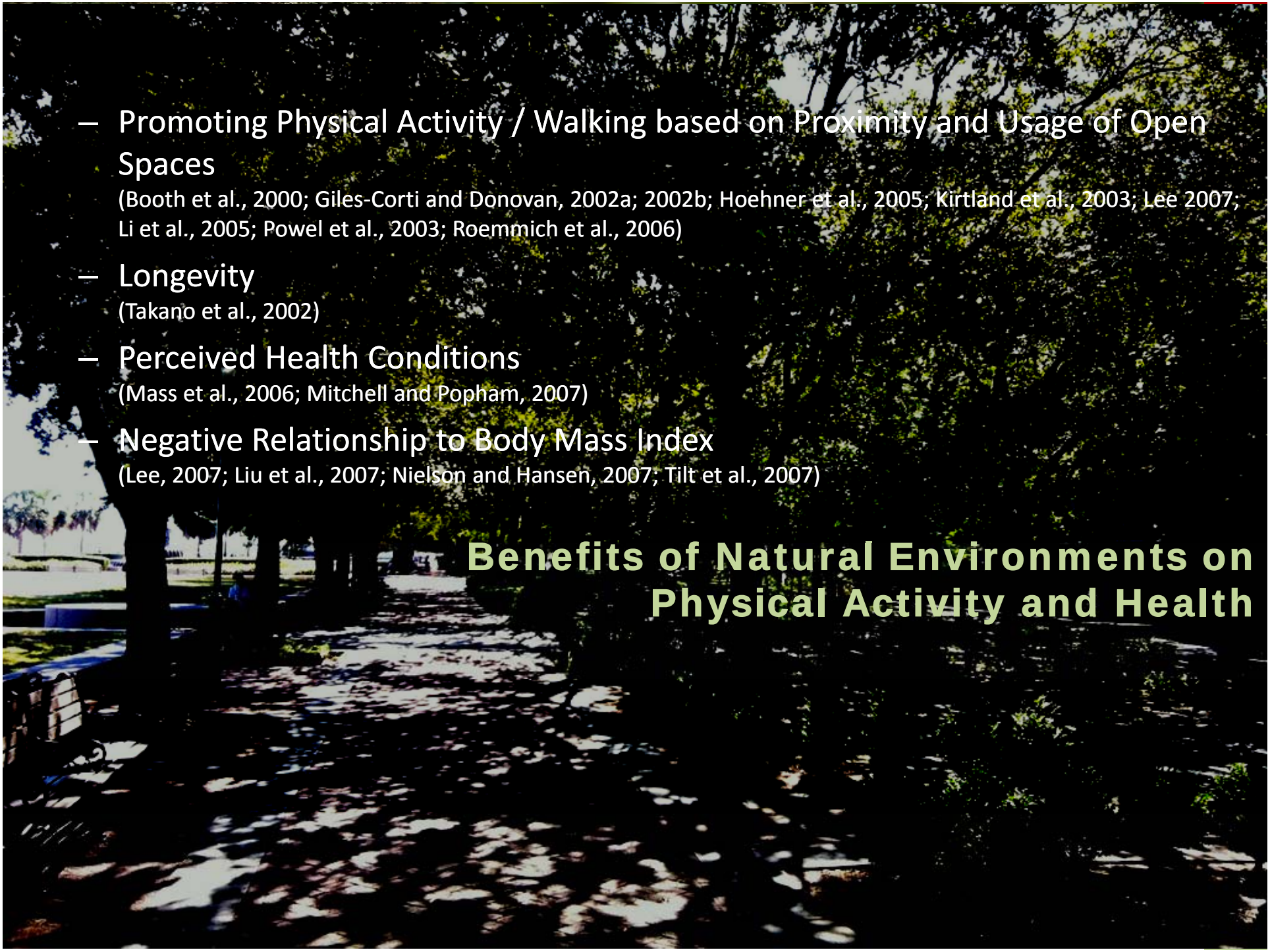
(Lee and Moudon, 2006; Moudon et al., 2006)

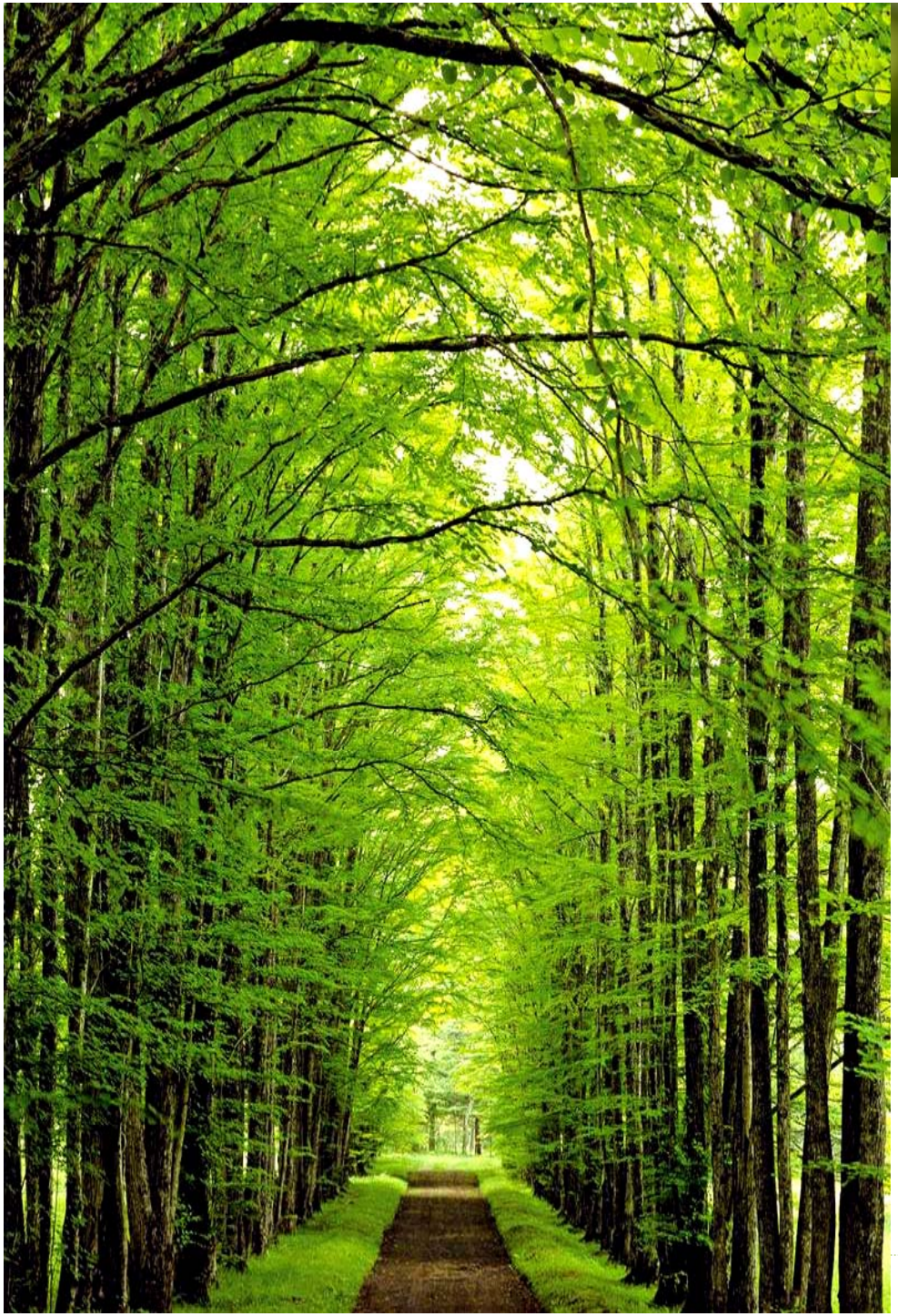

Quintara

I. INTRODUCTION

- As an important element of the built environment, urban nature can help deal with some of the problems of sedentary lifestyles by encouraging outdoor activities (e.g. Coley et al. 1997; Nowak and Dwyer 2007; Giles-Corti and Donovan 2002; Hoehner et al. 2005; Booth et al. 2000; Tilt et al. 2007)
- Urban nature can contribute to promote physical and psychological health by facilitating recovery from daily stresses (e.g. Hartig et al. 1991; King et al. 2002; Nowak and Dwyer 2007)
- Urban nature can bring many social, economic & ecological benefits to urban communities (e.g. Chenoweth and Gobster 1990; Dwyer et al. 1991; Kweon et al. 2006; Kuo and Sullivan,2001; Miles et al. 1998; Jorgensen et al. 2002; Anderson and Cordell 1988; Luttik 2000; Tyrväinen and Väänänen 1998; Nowak and Dywer 2007; Rydberg and Falck 2000)




– Promoting Physical Activity / Walking based on Proximity and Usage of Open Spaces
(Booth et al., 2000; Giles-Corti and Donovan, 2002a; 2002b; Hoehner et al., 2005; Kirtland et al., 2003; Lee 2007; Li et al., 2005; Powel et al., 2003; Roemmich et al., 2006)
– Longevity
(Takano et al., 2002)
– Perceived Health Conditions
(Mass et al., 2006; Mitchell and Popham, 2007)
– Negative Relationship to Body Mass Index
(Lee, 2007; Liu et al., 2007; Nielson and Hansen, 2007; Tilt et al., 2007)
Benefits of Natural Environments on Physical Activity and Health



I. INTRODUCTION

- Landscape spatial patterns have not been considered sufficiently in studies dealing with childhood obesity

Research Aims

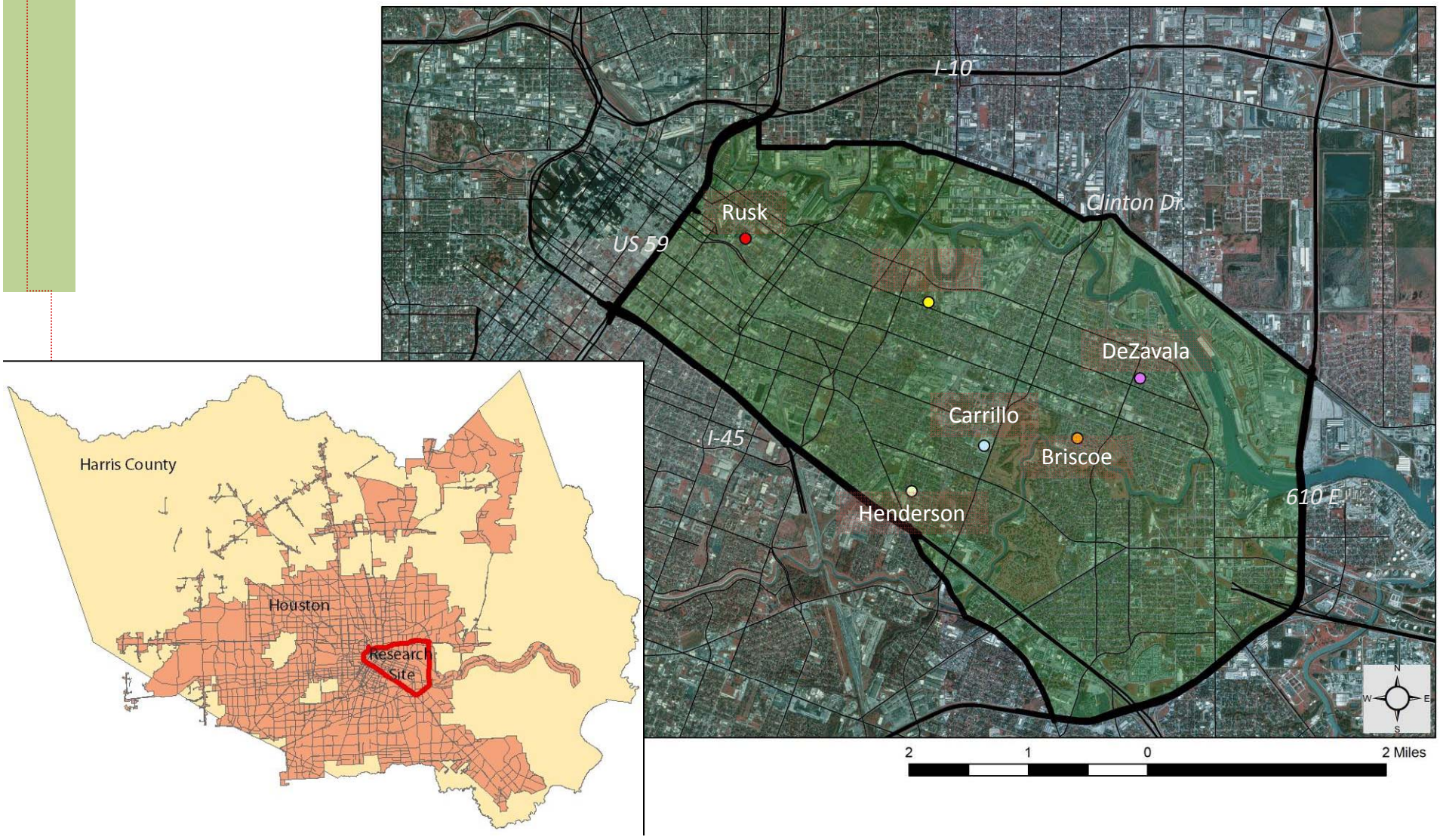
Primary Aims

- ***Primary Aim 1:*** To examine the association between landscape spatial patterns and childhood obesity among Hispanic kids
- ***Primary Aim 2:*** To examine the association between landscape spatial patterns and children's health-related quality of life (HRQOL)


II. METHODS

II. METHODS

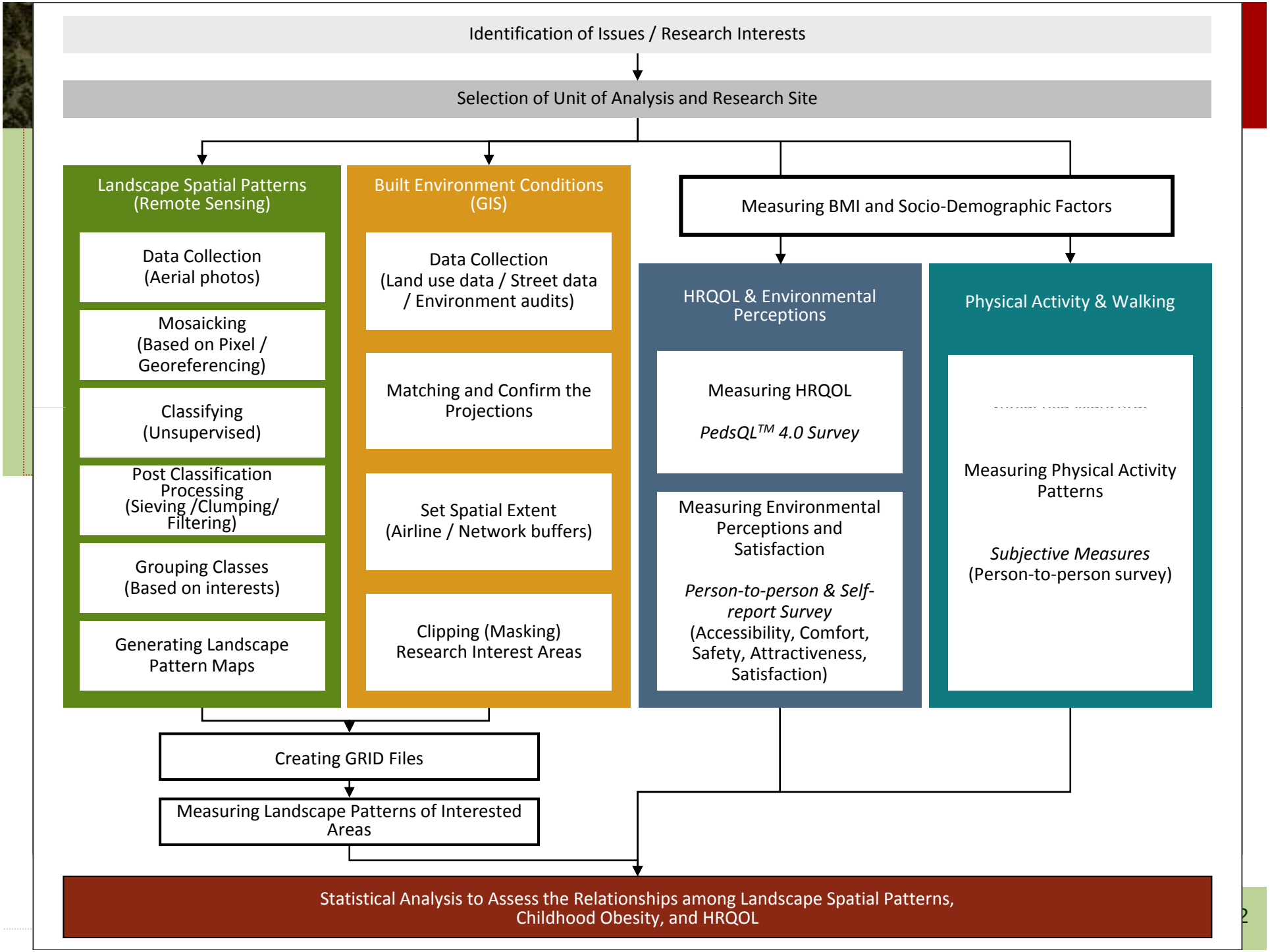
Study Location (The East End District, Houston, TX)



Study Population and Sampling

- Sixty-one Hispanic fourth and fifth graders and their mothers were recruited to participate in this research.

- The children's age range is from 9 to 12 years old.
  - They are at risk for declines in physical activity levels as they transition from elementary to middle school (CDC, 2006).
  - More reliable self-report data can be obtained from children 10 years of age and older (Welk et al., 2000).


Identification of Issues / Research Interests
Selection of Unit of Analysis and Research Site
Landscape Spatial Patterns (Remote Sensing)
Data Collection (Aerial photos)
Mosaicking (Based on Pixel / Georeferencing)
Classifying (Unsupervised)
Post Classification Processing (Sieving /Clumping/ Filtering)
Grouping Classes (Based on interests)
Generating Landscape Pattern Maps
Built Environment Conditions (GIS)
Data Collection (Land use data / Street data / Environment audits)
Matching and Confirm the Projections
Set Spatial Extent (Airline / Network buffers)
Clipping (Masking) Research Interest Areas
Measuring BMI and Socio-Demographic Factors
HRQOL & Environmental Perceptions
Measuring HRQOL
PedsQL™ 4.0 Survey
Measuring Environmental Perceptions and Satisfaction
Person-to-person & Self-report Survey (Accessibility, Comfort, Safety, Attractiveness, Satisfaction)
Physical Activity & Walking
Measuring Physical Activity Patterns
Subjective Measures (Person-to-person survey)
Creating GRID Files
Measuring Landscape Patterns of Interested Areas
Statistical Analysis to Assess the Relationships among Landscape Spatial Patterns, Childhood Obesity, and HRQOL

Measuring Health-related Quality of Life for Children

- Used the Pediatric Quality of Life Inventory (PedsQL) 4.0 generic core scale developed by James Varni (Varni et al., 1999; Varni et al., 2001).

  - **Two parallel surveys**
    - **Child self-report survey**: to assess perceptions of internal states
    - **Parent proxy survey**: to reflect the child's observable behaviors

Measuring Landscape Spatial Patterns

Classification of Land Cover

- **GIS** and **ENVI**
- Classified into 40 classes using the unsupervised classification process based on spectral similarity
- Grouped into 3 land cover types
  - Trees/forests
  - Grass lands
  - Developed areas

Applying Landscape Indices

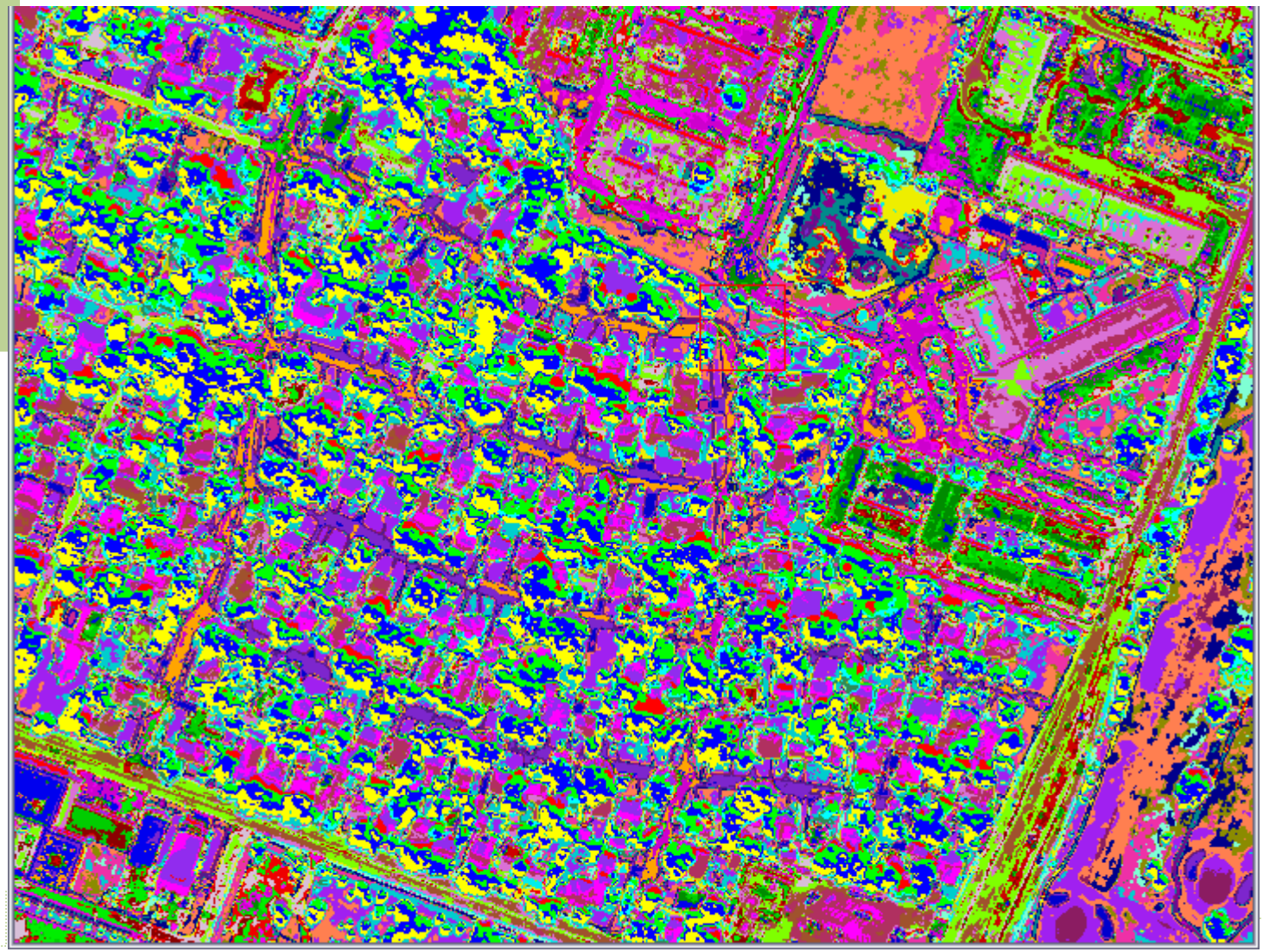
- FRAGSTATS 3.3
  - A spatial pattern analysis program developed by McGarigal and Marks (1995)

Measuring Landscape Spatial Patterns

The Original DOQQ (Digital Ortho Quarter Quads; Aerial Photo) Imagery

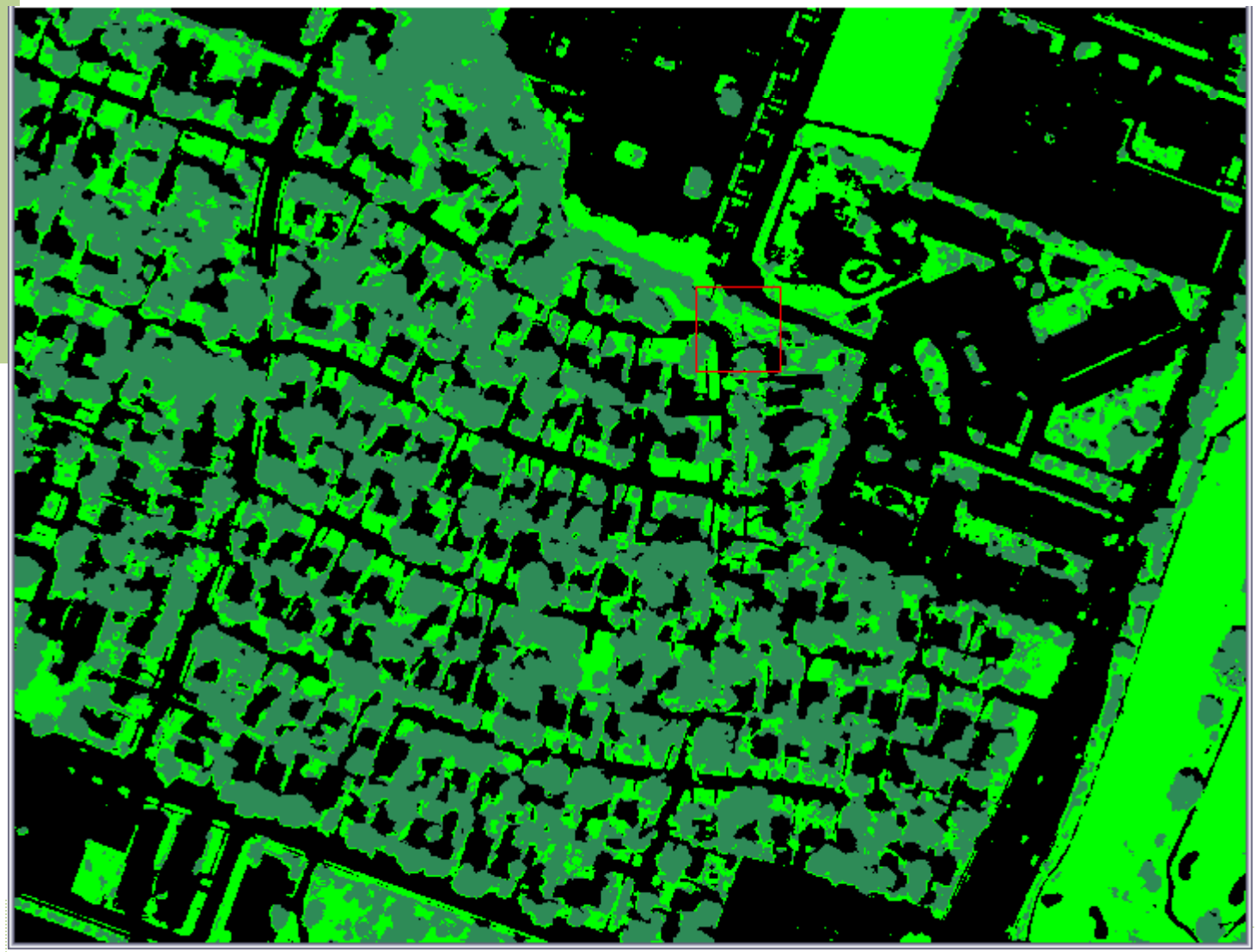
Color-infrared (*CIR*)

Measuring Landscape Spatial Patterns



Classified Imagery using the Unsupervised Classification Process (ISO Data)

Measuring Landscape Spatial Patterns



Final Output Categorized with Three Land Cover Types

Criteria of Selecting Landscape Indices

	Ecological Perspectives*	Health Perspectives**	Proposed Landscape Indices
Fragmentation	Unfragmented landscape structure	Existence of landscape structure	NP, PD, MPS, FMI
Size	Larger patch size	Size of landscape structure	TA, PLAND, TE
Shape	Irregular shaped boundaries of patches	Formal or artistic attribute of landscape structure	LSI, MSI
Isolation	Closer distance between single patches	-	MNN
Connectivity	Connectivity	Connectivity of landscape structure	COHESION

* Dramstad et al., 1996; Forman, 1995a; 1995b; Haines-Young and Chopping, 1996; Lee, 2002; Shafer, 1994

** Chenoweth and Gobster, 1990; Hartig et al., 2003; Jorgensen et al., 2002; Kweon et al., 2006; Ulrich, 1984; Maas et al., 2006b; Mitchell and Popham, 2007; Ulrich et al., 1991

Proposed Landscape Indices

	Landscape Indices	Formula	Unit & Range	Description
Fragmentation	**Number of Patches (NP)**	$NP = n_i$ n_i= number of patches in the landscape of patch type i	-None -NP≥1, without limit	NP is a simple measure to assess the extent of subdivision or fragmentation conditions. Since NP has no information about area, distribution, or density of patches, there are some limitations to interpret value as a single index.
	Patch Density (PD)	$PD = \frac{n_i}{A}(10{,}000)(100)$ A = total landscape area (m^2), n_i = number of patches in the landscape of patch type i	-Number per 100 hectares -PD > 0, without limit	PD equals the number of patches of the corresponding patch type (NP) divided by total landscape area, multiplied by 10,000 and 100 (to convert to 100 hectares).
	Mean Patch Size (MPS)	$MPS = \frac{\sum_{j=1}^{n} a_{ij}}{n_i}\left(\frac{1}{10{,}000}\right)$ a_{ij} = area (m^2) of patch ij, n_i = number of patches in the landscape of patch type i	-Hectares -MPS > 0, without limit	The range in MPS is limited by the grain and extent of the image and the minimum patch size in the same manner as patch area (AREA).

(Adapted and revised from McGarigal's website: *http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm*)

Proposed Landscape Indices

	Landscape Indices	Formula	Unit & Range	Description
Fragmentation	**Fragmen-tation Measure-ment Index (FMI)**	$FMI\left(\left\|\phi_f\right\|\right) = \sqrt{\alpha_f^2 + \beta_f^2 + \nu_f^2 + \delta_f^2}$ $\alpha = (a_{obs} - a_{\min})/(a_{\max} - a_{\min}) \times 100$ $\beta = (p_{\max} - p_{obs})/(p_{\max} - p_{\min}) \times 100$ $\nu = (n_{\max} - n_{obs})/(n_{\max} - n_{\min}) \times 100$ $\delta = (d_{\max} - d_{obs})/(d_{\max} - d_{\min}) \times 100$ a_{obs} : total habitat area, p_{obs} : total habitat perimeter, n_{obs} : number of patches, d_{obs} : patch isolation.	-None -0 ≤ FMI ≤ 200	FMI was developed by Bogaert et al (2000) to measure fragmented landscape pattern. Higher values (200) of FMI represent less fragmented patterns, while lower values (0) indicate more fragmented conditions.

(Adapted and revised from McGarigal's website: *http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm*)

Proposed Landscape Indices

	Landscape Indices	Formula	Unit & Range	Description
Size	**Total Area (TA)**	$TA = \sum_{j=1}^{a} a_{ij}\left(\frac{1}{10{,}000}\right)$ a_{ij} = area (m^2) of patch ij	-Hectares -TA>0, without limit	If TA value is closer to 0, the corresponding patch type is significantly rare in the landscape. If TA value is 100, the entire landscape is composed of a single patch type. TA is for measuring landscape composition. TA is used in computing for most class and landscape indices.
	Percentage of Landscape (PLAND)	$PLAND = P_i = \frac{\sum_{j=1}^{n} a_{ij}}{A}(100)$ P_i = proportion of the landscape occupied by patch type (class) I, a_{ij} = area (m^2) of patch ij, A = total landscape area (m^2).	-Percent -0<PLAND<100	If PLAND value is closer to 0, the corresponding patch type is significantly rare in the landscape. If PLAND value is 100, the entire landscape is composed of a single patch type. Since PLAND is a relative measure, it may be better in measuring landscape composition.
	Total Edge (TE)	$TE = \sum_{k=1}^{m} e_{ik}$ e_{ik} = total length (m) of edge in landscape involving patch type;	-Meters -TE≥0, without limit	TE is the sum of the total perimeters (m) involving the corresponding patch type. TE is an absolute measure of total perimeter and could compare landscapes of varying size.

(Adapted and revised from McGarigal's website: *http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm*)

Proposed Landscape Indices

	Landscape Indices	Formula	Unit & Range	Description
Shape	**Landscape Shape Index (LSI)**	$LSI = \frac{e_i}{\min e_i}$ e_i = total length of perimeter of class i in terms of number of cell surfaces; min e_i = minimum total length of perimeter of class i in terms of number of cell surfaces	-None -LSI≥0, without limit	LSI represents a simple measure of class aggregation. Higher values of LSI indicate more disaggregated landscape patterns.
	Mean Shape Index (MSI)	$MSI = \frac{\sum_{j=1}^{n}\left(\frac{0.25\,p_{ij}}{\sqrt{a_{ij}}}\right)}{n_i}$ p_{ij} = perimeter of patch ij , a_{ij} = area (m^2) of patch ij, and n_i = number of patches in the landscape of patch type i	-None -MSI≥1, without limit	MSI = 1 when all patches of the corresponding patch type are square (raster); MSI increases without limit as the patch shapes become more irregular.

(Adapted and revised from McGarigal's website: *http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm*)

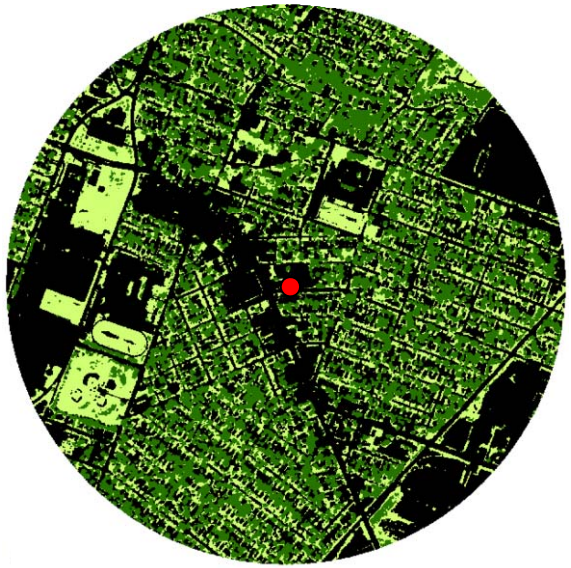
Proposed Landscape Indices

	Landscape Indices	Formula	Unit & Range	Description
Isolation	**Mean Nearest Neighbor Distance (MNN)**	$MNN = \frac{\sum_{j=1}^{n} h_{ij}}{n_i}$ h_{ij} = distance (m) from patch ij to nearest neighboring patch of the same type, based on edge-to-edge distance, n_i = number of patches in the landscape of patch type i	-Meters -MNN>0, without limit	MNN is defined as the distance from a patch to the nearest neighboring patch of the same type, based on edge-to-edge distance.
Connectivity	**Patch Cohesion Index (COHESION)**	$COHESION = \left[1 - \frac{\sum_{j=1}^{n} p_{ij}}{\sum_{j-1}^{n} p_{ij}\sqrt{a_{ij}}}\right]\left[1 - \frac{1}{\sqrt{A}}\right]^{-1}.(100)$ p_{ij} = perimeter of patch ij , a_{ij} = area (m^2) of patch ij, A = total landscape area (m^2)	-None -0 ≤ COHESION < 100	A lower percentage of patch cohesion (0 %) represents a less physically connected landscape pattern, whereas a higher percentage of patch cohesion (100 %) means a more physically connected landscape pattern.

(Adapted and revised from McGarigal's website: *http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm*)

Measuring Different Spatial Settings

A Half-mile Airline Buffer



A Half-mile Network Buffer

A Quarter-mile Airline Buffer

A Quarter-mile Network Buffer

Legend

- Non-woody
- Tree
- Grass
- Half mile buffer
- Quarter mile buffer
- Home

III. RESULTS

Respondent Characteristics (N=61)

Variables	Freq.	%	Variables	Freq.	%
Gender			**Country Born**		
Boy	24	39.3	**US**	46	75.4
Girl	37	60.7	Mexico	12	19.7
Age			Central America	3	4.9
9	10	16.4	**Guardians**		
10	32	52.5	**Mom and Dad**	46	75.4
11~12	19	31.1	Mom only	10	16.4
Grade			Dad only	0	0.0
3^{rd}~4^{th}	28	45.9	Parent and Step-parent	5	8.2
5^{th}	33	54.1	**Living with Siblings**		
Ethnicity			**Yes**	48	78.7
Hispanic	50	82.0	No	13	21.3
Don't know	11	18.0	**Household Size**	Mean = **5.09**	

Children's Obesity

BMI and BMI Percentile

	BMI	BMI Percentile
N	61	61
Mean	21.71	73.84
Std. Deviation	5.20	30.23

Weight Conditions

	Frequency (%)
Obese	21(34.4%)
Overweight	14 (23.0%)
Normal or underweight	26 (42.6%)

Children's Obesity by Gender

Children's BMI and BMI Percentile by Gender

	BMI		BMI Percentile	
	Boy	Girl	Boy	Girl
N	24	37	24	37
Mean	23.03	20.86	82.92	66.60
Std. Deviation	5.56	4.83	25.68	32.10

Children's Obese Conditions by Gender

	Frequency (%)	
	Boy (N=24)	Girl (N=37)
Obese	11 (45.8%)	10 (27.0%)
Overweight	7 (29.2%)	7 (18.9%)
Normal or underweight	6 (25.0%)	20 (54.1%)

PedsQL Scores by Children and Mothers

Children's HRQOL Assessed by the PedsQL Survey

		Mean PedsQL Score	Total PedsQL Score	Physical Health Summary Score	Psychosocial Health Summary Score
Child self-report report (N=95)	Mean	76.82	1766.84	640.26	1126.58
	Std. Deviation	14.07	323.57	124.27	224.85
Mother proxy report (N=66)	Mean	74.74	1718.94	587.50	1131.44
	Std. Deviation	16.47	378.89	185.03	239.92

Total of mean PedsQL score = 100, Total of the total PedsQL score = 2300, Total of the physical health summary score = 800, Total of the psychosocial health summary score = 1500

PedsQL Scores by Children and Mothers

Children's HRQOL by Gender

		Mean PedsQL Score		Total PedsQL Score		Physical Health Summary Score		Psychosocial Health Summary Score	
		Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Child self-report report (N=95)	N	38	57	38	57	38	57	38	57
	Mean	80.26	74.52	1846.05	1714.04	606.53	626.75	1185.53	1087.28
	Std. Deviation	14.47	13.43	332.86	308.95	128.75	120.44	224.18	218.46
Mother proxy report (N=66)	N	23	43	23	43	23	43	23	43
	Mean	70.09	77.22	1611.96	1776.16	510.87	628.49	1101.09	1147.67
	Std. Deviation	15.65	16.54	359.84	380.44	179.46	176.57	232.51	244.94

Total of mean PedsQL score = 100, Total of the total PedsQL score = 2300, Total of the physical health summary score = 800, Total of the psychosocial health summary score = 1500

Correlations between BMI and HRQOL

BMI and HRQOL (Mother Proxy PedsQL Scores)

Independent Variables in Simple Reg. Models	R^2	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
N=66						
Total Score	.063	-.004	.002	-.279	-2.234	**.023****
Physical Health Summary Score	.075	-.008	.003	-.273	-2.273	**.026****
Psychosocial Health Summary Score	.053	-.005	.003	-.230	-1.889	**.063***

Dependent Variable: Children's BMI

**: p-value < .10 **: p-value < .050 ***: p-value < .01*

Multiple Regression Models

	Airline Buffer	Network Buffer
Half-mile Buffer	Children Obesity: HA1 & HA2	Children Obesity: HN1
	HRQOL: HA3 & HA4	HRQOL: HN2
Quarter-mile Buffer	Children Obesity: QA1 & QA2	Children Obesity: QN1
	-	HRQOL: QN2

Multiple Regression Models

Model HA1 and QA1 (Airline Buffer)

Dependent Variable: Children's BMI Values

Landscape Indices: FMI, LSI, MSI, MNN, COHESION

Model HA2 and QA2 (Airline Buffer)

Dependent Variable: Children's BMI Values

Landscape Indices: PLAND, NP, MSI, MNN, COHESION

Model HA1 and QA1 (Airline Buffer)

Dependent Variable: Children's BMI Values

Landscape Indices: FMI, LSI, MSI, MNN, COHESION

HA1 (Half-mile Airline Model 1)			QA1(Quarter-mile Airline Model 1)		
Rank	Sign	Variables	Rank	Sign	Variables
1	+	Safety concern***	1	+	Child age**
2	+	Walking to school or not**	2	+	Total weekend PA times**
3	-	Mother's education**	3	+	Safety concern**
4	+	Child Gender**	4	+	Child gender**
5	**-**	**COHESION** (Well-connected → Lower BMI)**	5	-	Mother's education*
6	-	Accessibility to playable places near home***	6	-	Walking to park or not*
7	**-**	**LSI* (less aggregated → Lower BMI)**			
8	+	Total TV watching hours**			
9	+	Total weekend PA times**			
10	+	Mother's employment status*			
11	-	Walking to park or not*			

*: p-value < .10 **: p-value < .050 ***: p-value < .010

N=61 Sig.=.001 Adj. R^2=.322

N=61 Sig.=.002 Adj. R^2=.266

Model HA2 and QA2 (Airline Buffer)

Dependent Variable: Children's BMI Values

Landscape Indices: PLAND, NP, MSI, MNN, COHESION

HA2 (Half-mile Airline Model 2)			QA2(Quarter-mile Airline Model 2)		
Rank	Sign	Variables	Rank	Sign	Variables
1	+	Safety concern***	1	+	Child gender**
2	**-**	**NP** (More tree patches → Lower BMI)**	2	-	Mother's education**
3	+	Walking to school or not**	3	+	Park existence*
4	**-**	**COHESION** (Well-connected → Lower BMI)**	4	+	Child age*
5	-	Mother's education**	5	+	Total weekend PA times*
6	+	Child Gender**			
7	-	Accessibility to playable places near home*			
8	+	Total weekend PA times**			
9	+	Total TV watching hours**			
10	-	Walking to park or not*			
11	-	Unattractiveness in walking conditions*			
12	+	Mother's employment status*			

*: p-value < .10 **: p-value < .050 ***: p-value < .010

N=61 Sig.=.002 Adj. R^2=.323

N=61 Sig.=.001 Adj. R^2=.289

The Rank provided based on the standardized coefficient (Beta) of each variable showing a significant correlation to the dependent variable

Correlations b/w Children's BMI and Landscape Spatial Patterns

Landscape Spatial Patterns the **Half-mile Airline Buffer**

- Connectivity (↑) – COHESION*
- Aggregation / Compactness (↓) – LSI*
- Number of urban forests and tree patches (↑) – NP*
- Irregularity of shapes of urban forests (↑) – MSI

* Significance

Childhood Obesity (↓)

Multiple Regression Models

Model HA3 and HA4 (Airline Buffer)

Dependent Variable: **Children's HRQOL**
(Child Self-report Total PedsQL Scores)

Landscape Indices:

HA3 – **FMI, LSI, MSI, MNN, COHESION**

HA4 – **PLAND, NP, MSI, MNN, COHESION**

Model HA3 (Airline Buffer)

Dependent Variable: Children's HRQOL
(Child Self-report Total PedsQL Scores)

Landscape Indices: FMI, LSI, MSI, MNN, COHESION

Model HA4 (Airline Buffer)

Dependent Variable: Children's HRQOL
(Child Self-report Total PedsQL Scores)

Landscape Indices: PLAND, NP, MSI, MNN, COHESION

HA3 (Half-mile Airline Model 3)			HA4 (Half-mile Airline Model 4)		
Rank	**Sign**	**Variables**	**Rank**	**Sign**	**Variables**
1	**-**	**COHESION*** (Well-connected → Lower HRQOL)**	**1**	**+**	**PLAND** (Larger forest areas → Higher HRQOL)**
2	-	Unattractiveness in walking conditions***	**2**	**-**	**COHESION**(Well-connected → Lower HRQOL)**
3	+	Total weekend PA times***	3	+	Total weekend PA times***
4	**+**	**FMI** (Less fragmented → Higher HRQOL)**	4	-	Unattractiveness in walking conditions***
5	-	Child age***	5	-	Child age**
6	**-**	**Children's BMI*****	**6**	**+**	**MNN** (Longer distance → Higher HRQOL)**
7	+	Park existence**	7	+	Park existence**
8	**-**	**LSI* (less aggregated → Lower HRQOL)**	8	-	Number of cars**
9	-	Number of cars*	9	+	Walking to park or not**
10	+	Mother's employment status*	10	+	Satisfaction of recreational facilities*
			11	-	Exposed to urban natural elements*
			12	-	Safety concern*

**: p-value < .10 **: p-value < .050 ***: p-value < .010*

N=61

Sig.=.000

Adj. R^2=.442

N=61

Sig.=.000

Adj. R^2=.442

The Rank provided based on the standardized coefficient (Beta) of each variable showing a significant correlation to the dependent variable

Correlations b/w Children's HRQOL and Landscape Spatial Patterns

Landscape Spatial Patterns the **Half-mile Buffer**

- Fragmented condition (↓) – FMI*
- Size of urban forests and tree patches (↑) – CA/PLAND*
- Longer distance b/w patches (↑) – MNN*
- Connectivity (↓) – COHESION*
- Aggregation (↑) – LSI*

* Significance

Childhood HRQOL (↑)

Multiple Regression Models

Model HN2 and QN2 (Network Buffer)

Dependent Variable: **Children's HRQOL**
(Child Self-report Total PedsQL Scores)

Landscape Indices:

FMI (PLAND), LSI (NP), MSI, MNN, COHESION

Model HN2 and QN2 (Network Buffer)

Dependent Variable: Children's HRQOL
(Child Self-report Total PedsQL Scores)

Landscape Indices: FMI (PLAND), LSI (NP), MSI, MNN, COHESION

HN2 (Half-mile Network Model 2)			QN2(Quarter-mile Network Model 2)		
Rank	**Sign**	**Variables**	**Rank**	**Sign**	**Variables**
1	+	Park existence***	1	+	Park existence***
2	+	Total weekend PA times***	2	+	Total weekend PA times***
3	-	Unattractiveness in walking conditions***	3	-	Unattractiveness in walking conditions***
4	-	Child age***	**4**	**-**	**Children's BMI****
5	**-**	**Children's BMI****	5	-	Child age**
6	+	Mother's employment status**	6	+	Mother's education**
7	-	Exposed to urban natural elements*	7	-	Exposed to urban natural elements**
8	+	Mother's education*	8	+	Mother's employment status*
9	+	Walking barriers*	9	+	Child gender*

**: p-value < .10 **: p-value < .050 ***: p-value < .010*

N=61
Sig.=.000
Adj. R^2=.423

N=61
Sig.=.000
Adj. R^2=.435

The Rank provided based on the standardized coefficient (Beta) of each variable showing a significant correlation to the dependent variable

IV. DISCUSSION and CONCLUSIONS

Discussion (BMI)

- Significant correlations between childhood obesity and landscape spatial patterns shaped by urban forests
- Well-connected landscape spatial patterns (COHESION) negatively associated with children's BMI
- More tree patches and less aggregated landscape patterns associated with lower BMI values
- Half-mile airline buffer appropriate for capturing landscape patterns for obesity.

IV. DISCUSSION AND CONCLUSIONS

Discussion (HRQOL)

- Significant correlations between obesity, physical activity, and HRQOL among Hispanic children
- Negative relationship between obesity and HRQOL
- Less connected, less fragmented landscape spatial patterns and larger areas of urban forests and tree patches associated with higher HRQOL.
- Half-mile airline buffer appropriate for capturing landscape patterns for quality of life purposes.

IV. DISCUSSION AND CONCLUSIONS

Limitations and Next Steps

- Only home neighborhoods considered → schools and other settings
- Cross-sectional study: No causal investigation
  → longitudinal study with quasi-experimental design
- External validity: Limited setting & population
  → Diverse populations in diverse environmental settings
- The DOQQ imagery's limitation: only 2D information
  → 3D information using advanced media, such as LIDAR
- No diet related questions
- Limited statistic power due to small sample size

Next Steps:

- Update with additional samples & objective walking and physical activity data from accelerometers, GPS units, and travel diaries
- Examine environmental perception variables & other GPS/GIS-derived built environmental variables
- Control key confounding & mediating variables using multivariate analysis

IV. DISCUSSION AND CONCLUSIONS

Conclusions

- Provided preliminary evidence linking landscape patterns with physical activity and obesity among high-risk children.
- Offers a conceptual basis and a methodological framework for adding ecological planning considerations to the existing literature and interventions aiming at reducing obesity and promoting walking / physical activity.
- Confirms the usefulness of landscape indices for estimating their interrelationships with various human activities, and for deriving more quantitative evidence. (Bogaert et al., 2000; Gustafson, 1998; Haines-Young and Chopping, 1996; Li and Wu, 2004; O'Neill et al., 1988; Riitters et al., 1995; Turner, 2005).
- Landscape patterns can not be captured or interpreted by a singe index; different indices or multiple indicates may be used depending on the target outcome variables.

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Thank you