Physical Activity and Pediatric Obesity Prevention: Putting Science to Work
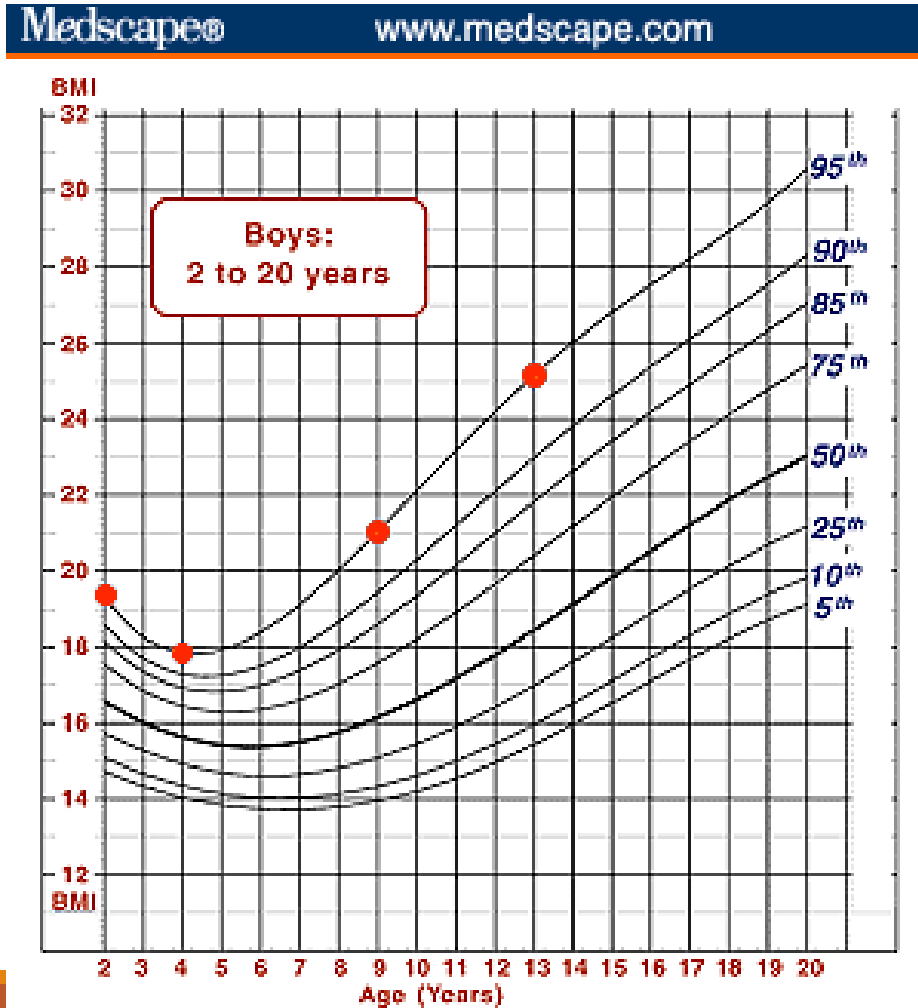
SHARI BARKIN, MD, MSHS

WILLIAM K WARREN FAMILY FOUNDATION CHAIR IN MEDICINE AND PROFESSOR OF PEDIATRICS

VANDERBILT UNIVERSITY SCHOOL OF MEDICINE

APRIL 14, 2015

The preschool period

Methods

➤ Data were collected from 50 children 3-5 years of age who were participating in a healthy lifestyle pilot study.

➤ Physical activity was assessed using an accelerometer.

➤ Validated threshold values were used to derive time spent in sedentary, light, moderate, and vigorous activity.[1]

**ActiGraph GT3X+ Accelerometer**

[1]Pate RR, Almeida MJ, McIver KL, Pfeiffer KA, Dowda M. Validation and calibration of an accelerometer in preschool children. *Obesity (Silver Spring). 2006;14(11):2000 –2006*

Demographics and Baseline Results

➢ On average, participants wore accelerometers for 23.4 (SD 0.4) hours a day for 6.7 (0.8) days.

➢ Children spent 14.5% (SD 3.5) of their wake-wear time in MVPA.

➢ N=24 girls, 21 boys
- Ethnicity: 51% black, 31% white, 13% biracial
- 28% had parents with a high school diploma/GED or less
- 54% from households with an annual income <$25K
- 74% normal weight, 26% overweight
- Average age: 4.4 years

Sample 24-Hour Activity Recording
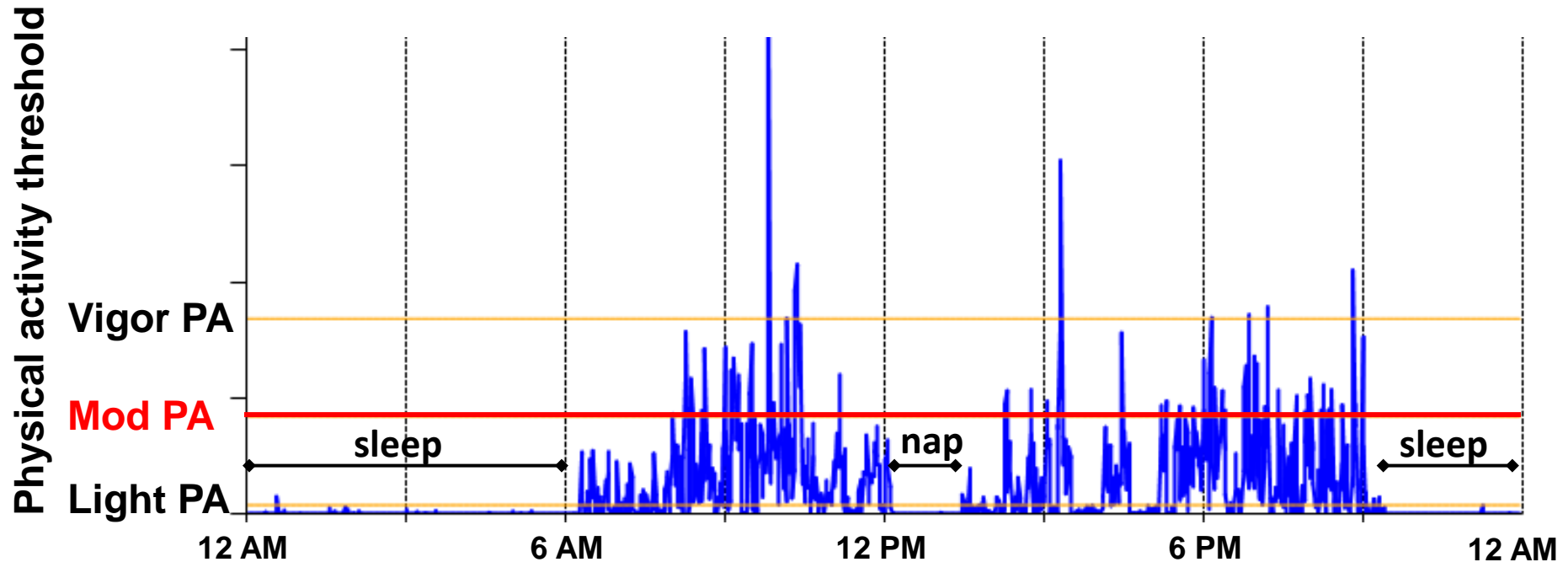
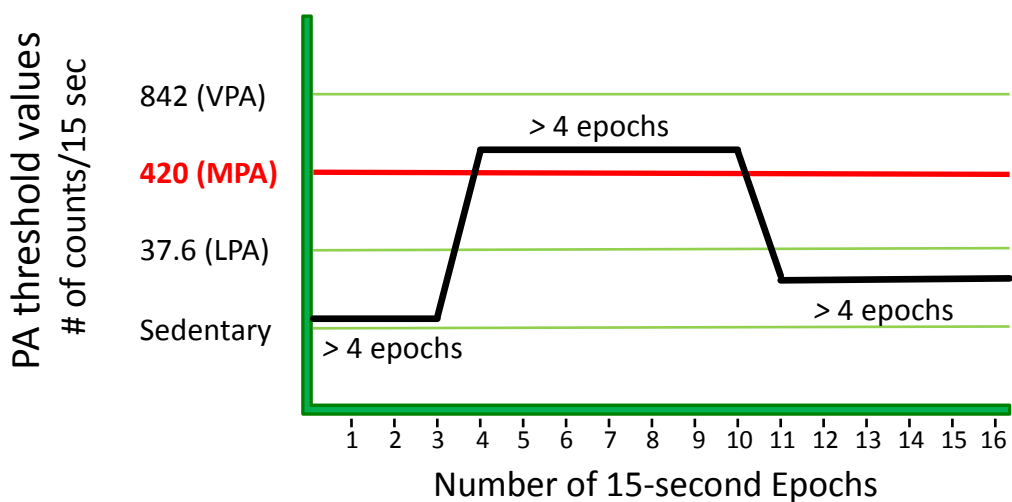**On average, children completed 90% of their daily MVPA in 11.3 hours (SD 1.3 hours).**

Young children are active throughout the majority of their waking hours.
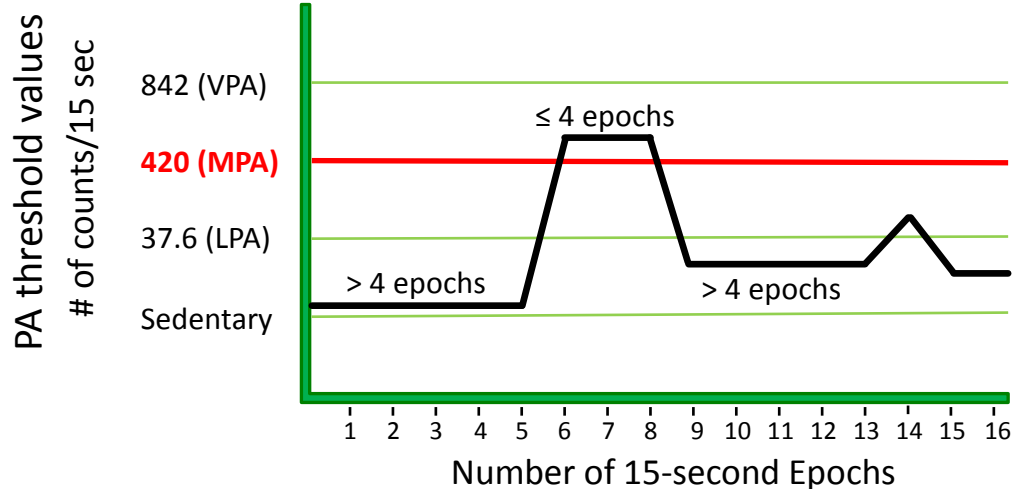
Isolated Spurt

*A **single** MVPA period **≤ 4** epochs in length with > 4 epochs of non-MVPA before and after it*
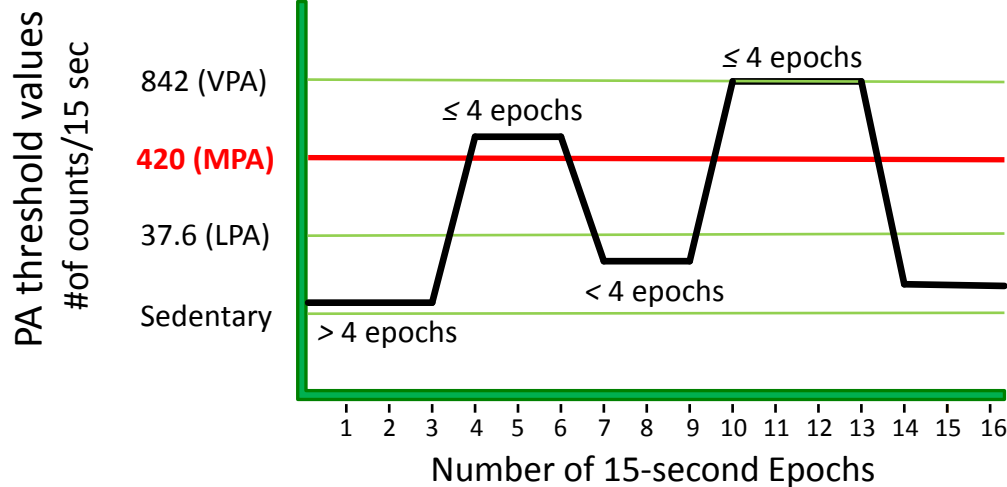***Example: Running to a parent***

Isolated Sustained Activity

*A **single** MVPA period **> 4** epochs in length with > 4 epochs of non-MVPA before and after it*
Example: Running after a dog
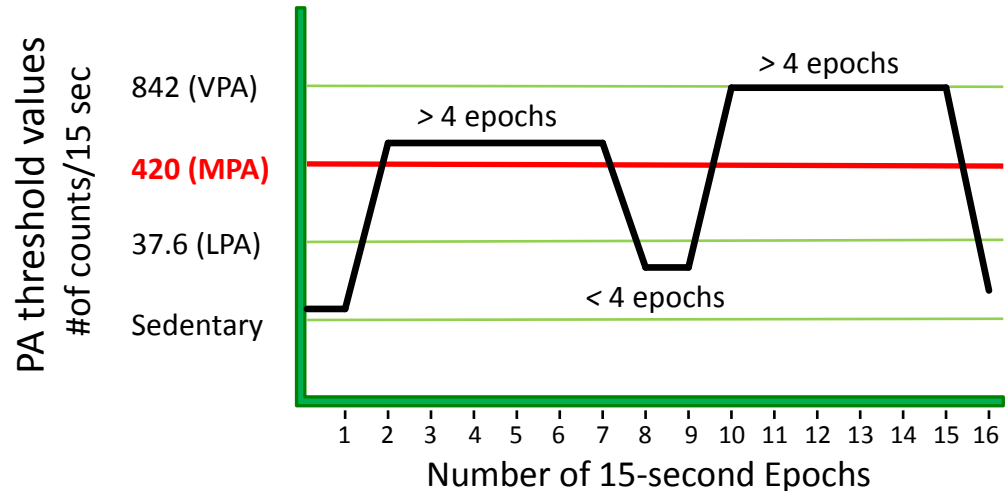
Clustered Spurt

*An event comprised of a **series** of MVPA periods that average **≤ 4** epochs, where there are no periods ≥4 epochs of non-MVPA*
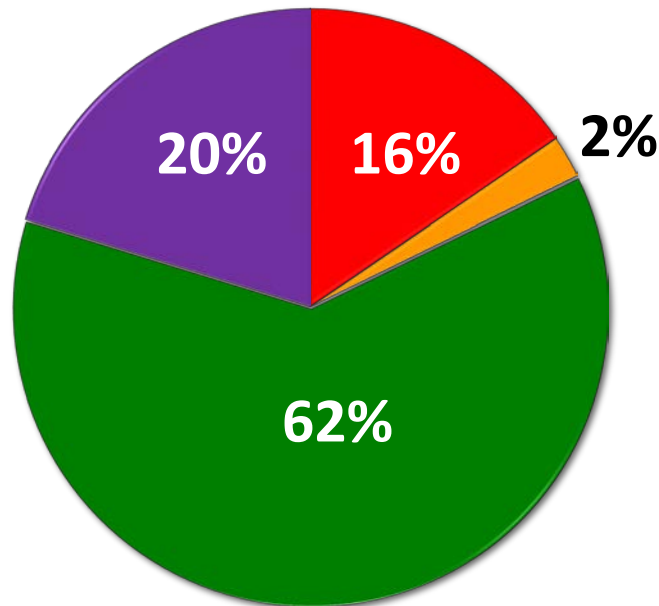
Example: Red light, green light

Clustered Sustained Activity

*An event comprised of a **series** of MVPA periods that average **> 4** epochs, where there are no periods ≥ 4 epochs of non-MVPA*

Example: Chasing games

MVPA Category Distribution

Average Percent of MVPA

MVPA Category Distribution as a Percentage of Total MVPA

	Girls % (SD)	Boys % (SD)	P-value[1]	95% CI[2]
🔴 Isolated Spurt	**16.9** (4.8)	**13.8** (2.9)	0.01	0.7, 5.42
🟡 Isolated Sustained Activity	2.6 (1.2)	2.0 (0.7)	0.08	-0.08, 1.14
🟢 Clustered Spurt	63.5 (5.5)	60.6 (7.7)	0.15	-1.09, 6.87
🟣 Clustered Sustained Activity	**17.1** (7.8)	**23.6** (8.7)	0.01	-11.43, -1.54

[1]two-tailed t-test
[2]For difference between girls and boys

Daily Events of each MVPA Category
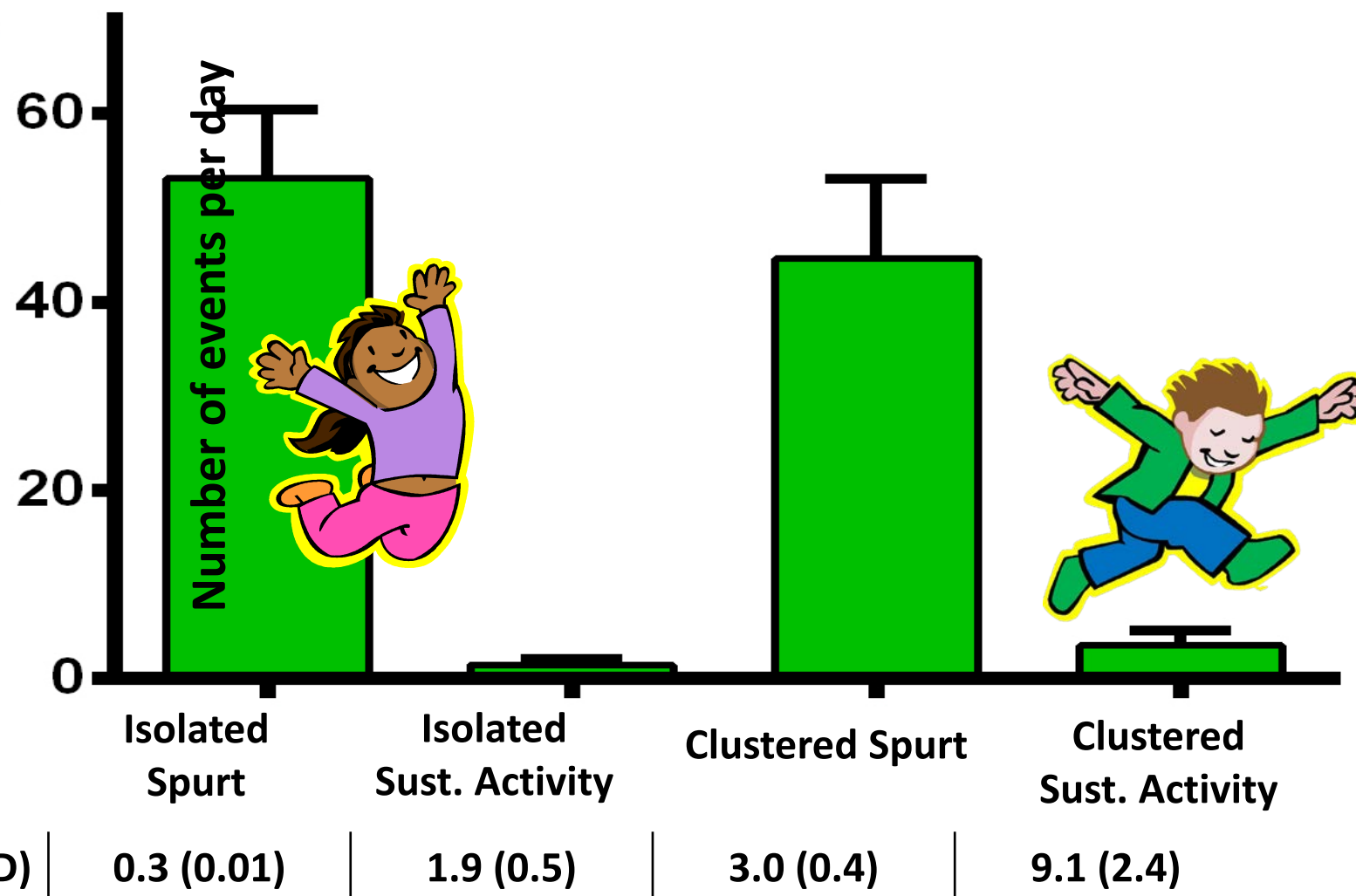
Ruiz, RM, Tracy, D, Sommer, EC, Barkin, SL. A Novel Approach to Characterize Physical Activity Patterns in Preschool-Aged Children, *Obesity, 2013*

AVG min (SD)	0.3 (0.01)	1.9 (0.5)	3.0 (0.4)	9.1 (2.4)

Author/Journal	Study	Target Population	Intervention	Outcome
Nyberg, G PLosOne 2015	Effectiveness of universal parental support programme to promote healthy dietary and physical activity	14 pre-school classrooms in Sweden 80% normal weight N=243	Classes randomized to either receive health information for parents and 10 teacher-led classroom activities for 6 year old children	No significant intervention effect in PA or BMI.
Reznik, M Childhood Obesity 2015	Classroom-based physical activity intervention for urban kindergarten and first-grade students	School based in two schools in New York for kindergarten and first-grade students 62-58% normal weight N=988	Intervention included audio CD of 10-minute education focused on aerobic activities led by teachers three times/day for 8 weeks	Intervention group students had increased number of steps than controls (2839 vs 2545, p= 0.005) Equally effective in gender, grade, and BMI subgroups.

| Author/Journal	Study	Target Population	Intervention	Outcome
Nemet, D Journal of Pediatric Endocrinology and Metabolism, 2011	Health promotion intervention in Arab- Israeli kindergarten children	Arab- Israeli Kindergartens (N= 342) Ages: 4-6 years 71% normal weight	Teachers trained in both a nutrition and PA program to be incorporated thorugh existing curriculum throughout the school year. PA included: 45 minutes/day (divided in three 15 minute sessions) six days/week. 80% running games and 20% endurance activities.	1. The change in BMI percentile in intervention group (-16.2 ± 1.2%) was significantly different from that in control group (-10.0 ± 1.3 %). 2. The change in fitness levels at the end of one year was significantly different (11.6 ± 1.4) from that in control group (−10.2 ± 1.6 shuttle run laps).
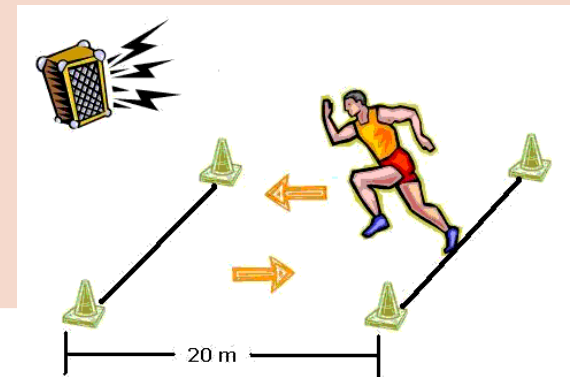
Fig.1 Test de Course Navette de Leger y Lambert
20 m

Effects on fitness and adiposity can be sustained one year post-intervention

LONG-TERM EFFECTS OF THE HEALTH PROMOTION INTERVENTION ON PHYSICAL FITNESS.
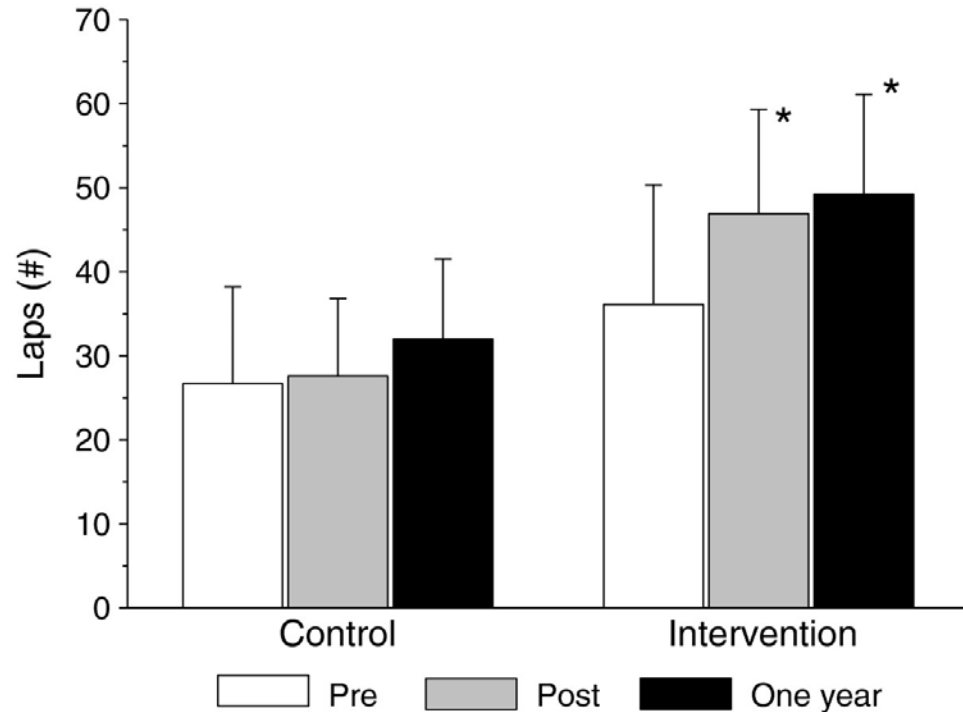
BMI PERCENTILE CHANGES FROM BASELINE IN THE INTERVENTION AND CONTROL, ONE YEAR FOLLOWING THE COMPLETION OF THE INTERVENTION.

Nemet *et al. BMC Pediatrics* 2013 **13**:45
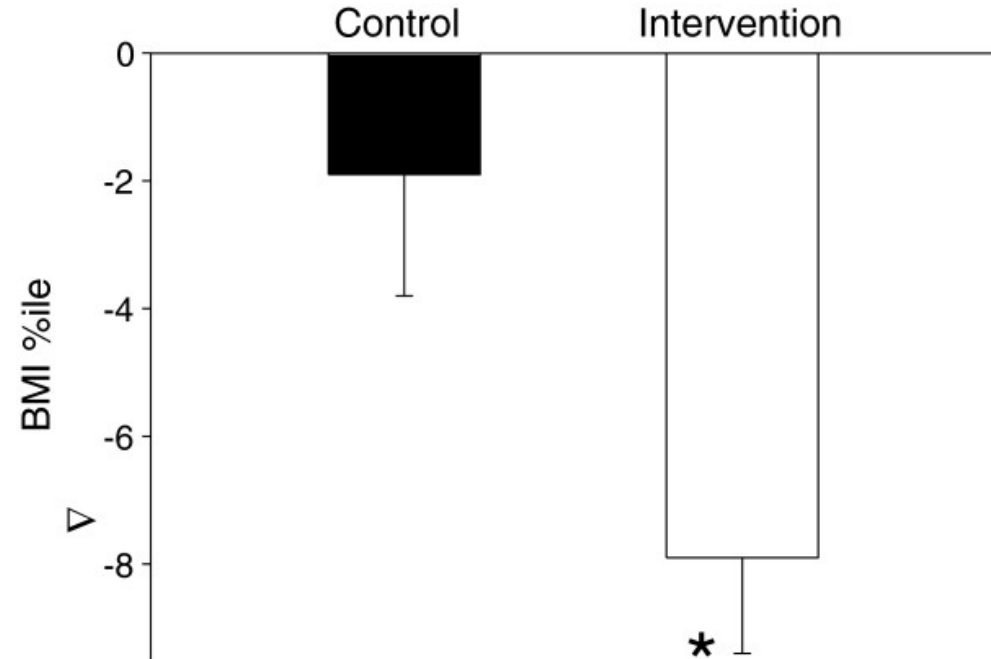
Salud con la Familia
(Health with the Family)

Funders: State of Tennessee; Vanderbilt Institute of Clinical and Translational Research; 2008-2010

- **Goal:** To examine a family-based, community centered intervention to prevent/treat obesity for Latino parent-preschool child pairs.

- Enrolled 106 Latino families with preschool-age children in 12 week sessions.

Salud Con La Familia Session Themes

- Intervention:

  Center Tour & Membership

  Parenting- appropriate limit setting

  Skills building in dyadic physical activity and nutrition in 12

  weekly, 90 minute sessions.

- Control:

  Library Tour & Membership

  Skills for Reading with Child

  Strategies for Bilingual Success

Baseline Demographic Characteristics of Latino Parent–Child Dyads (N = 75)

Characteristic	Control	Intervention
Child		
Age, mean (SD)	4.1 ± 0.9	4.2 ± 0.9
Gender, *n* (%) female	22 (55.0)	16 (45.7)
Absolute BMI, mean (SD)	17.2 ± 2.21	16.6 ± 2.35)
BMI category, *n* (%)		
Underweight (BMI <fifth percentile)	2 (5.0)	1 (2.9)
Normal wt (BMI ≥fifth to <85th percentile)	19 (47.5)	21 (61.8)
Overweight (BMI ≥85th to <95th percentile)	10 (25.0)	5 (14.7)
Obese (BMI ≥95 percentile)	9 (22.5)	7 (20.6)
Adult		
Age, mean (SD), y	31.9 ± 5.5	30.7 ± 6.0
Parental education, *n* (%)		
<High school	26 (65.0)	23 (65.7)
BMI, mean (SD)	30.3 ± 5.7	29.0 ± 5.3
BMI category, *n* (%)		
Normal (BMI ≥18.5 and <25)	7 (17.5)	7 (20.0)
Overweight (BMI ≥25 and <30)	14 (35.0)	16 (45.7)
Obese (BMI ≥30)	19 (47.5)	12 (34.3)

Preschool children mirror their parent's activity patterns

	Parent			Child			
	N	Mean	Std Dev	N	Mean	Std Dev	Prob *t*
Sedentary	89	82%	10%	83	70%	18%	< .001
Active	89	18%	10%	83	30%	18%	< .001

Parent-child correlation high : r= 0.60 sedentary activity; r= .90 mild activity;
r= 0.74 moderate activity

Ruiz R, Gesell SB, Buchowski MS, Lambert W Barkin, SL. The Relationship Between Hispanic Parents and Their Preschoolers-Aged Children's Physical Activity. *Pediatrics* 2011 May;127(5):888-95.

Minutes and percent time spent in activity by intensity level in children and parents between 7 am and 8:59 PM in the Childhood Obesity Prevention and Treatment Research (COPTR) prevention studies (N=1004)

Variables	Children (N=1004)	Parents (N=1004)
Minutes in PA type		
Sedentary activity	410.5 (67.9)	442.4 (94.8)
Light physical activity	263.6 (50.5)	310.6 (80)
MVPA	98.2 (32.8)	18.0 (17.1)
Percent in PA type		
Sedentary activity	53.3 (7.4)	57.4 (10.4)
Light physical activity	34.0 (5.0)	40.3(9.4)
MVPA	12.7 (3.9)	2.3 (2.2)

Results: Weight trajectory change over time

➤ 41% of Latino preschoolers already overweight

➤ Those that participated in the intervention group were 2x as likely to change their weight category if overweight/obese.

➤ Those in the control group increased their BMI.

Figure 1: Change in Percentage of Children with Overweight
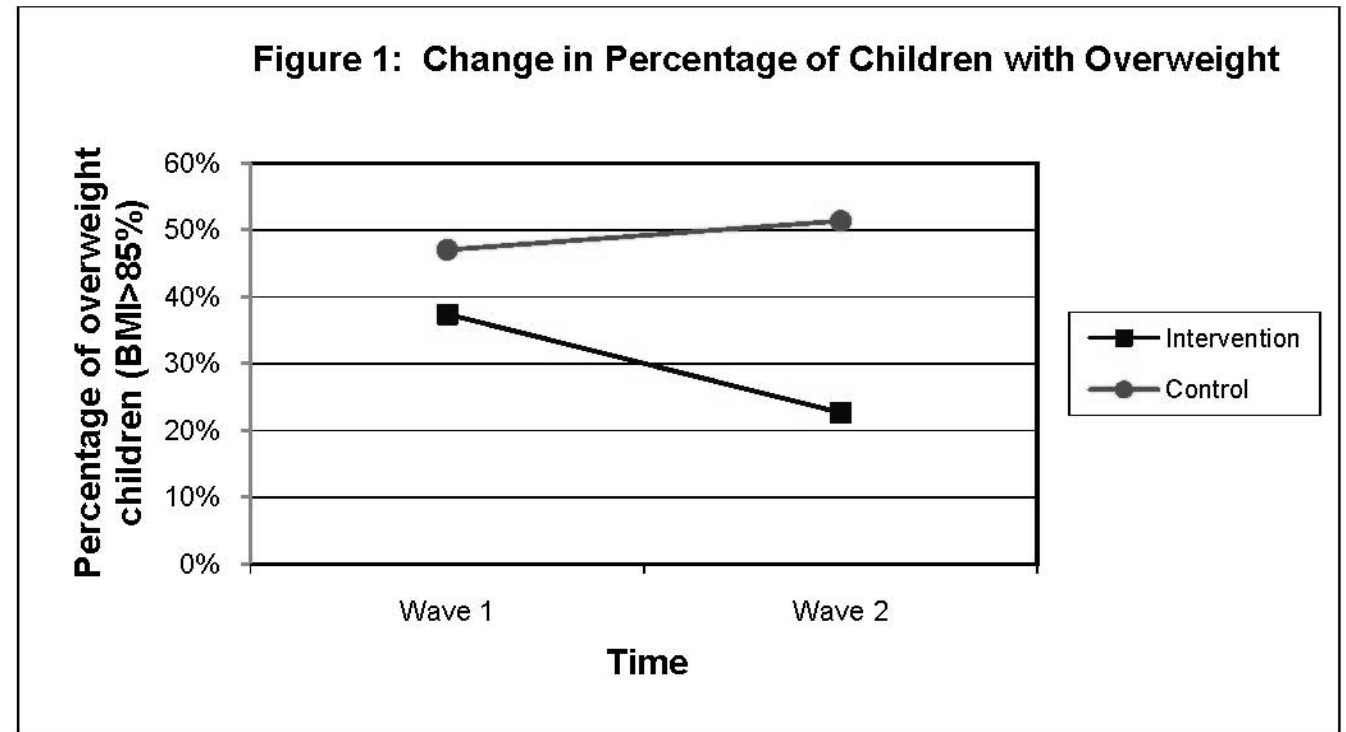
Barkin, SL, Gesell, S, Poe, E, Escarfuller, J, Tempesti, T. Culturally Tailored, Family-Centered, Behavioral Obesity Intervention for Latino - American Preschoolers, *Pediatrics* 2012 Sep;130(3):445-56. doi: 10.1542/peds.2011-3762. Epub 2012 Aug 6.

Community Context

Built environment: Neighborhood and community made infrastructure and environmental context that affects our interaction with the environment.

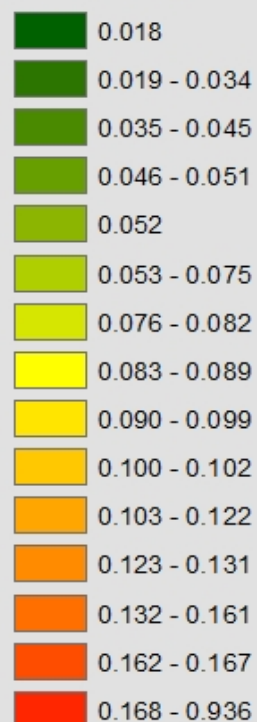- ◦ Green Space
- ◦ Sidewalks
- ◦ Traffic Density and Speed
- ◦ Crime

Crime Rates in GROW Zip Codes: 2011 - 2012
Number of crimes per person per zip code

GROW Zip Codes

Crime Rate
- 0.018
- 0.019 - 0.034
- 0.035 - 0.045
- 0.046 - 0.051
- 0.052
- 0.053 - 0.075
- 0.076 - 0.082
- 0.083 - 0.089
- 0.090 - 0.099
- 0.100 - 0.102
- 0.103 - 0.122
- 0.123 - 0.131
- 0.132 - 0.161
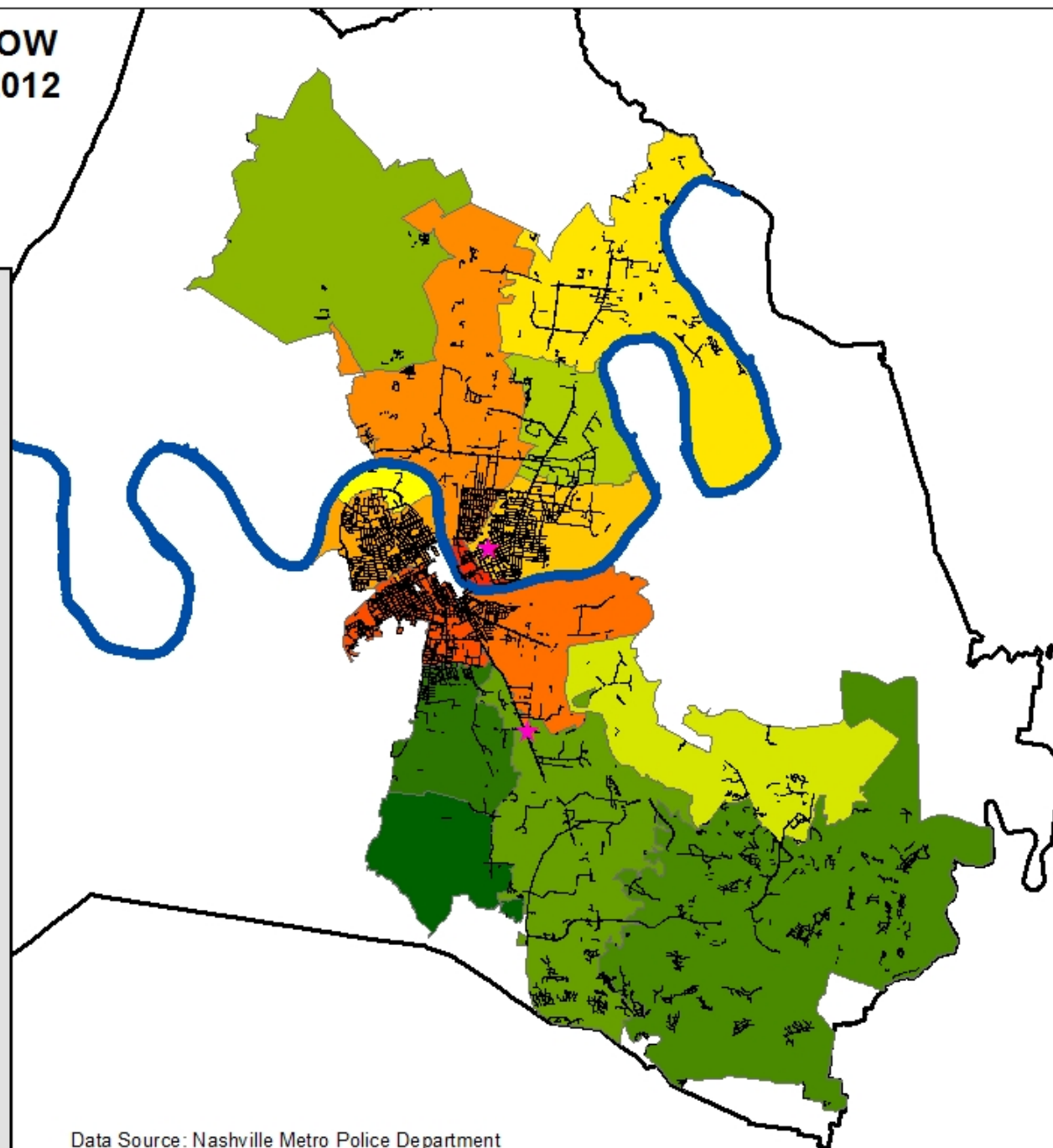- 0.162 - 0.167
- 0.168 - 0.936
- GROW Sidewalks
- ★ Recreation Centers
- Cumberland River
- Davidson County Border

Data Source: Nashville Metro Police Department

Number of Stray Dog Reports in GROW Zip Codes: 2011- 2012

GROW Zip Codes
Stray Dog Count

- 38
- 39 - 83
- 84 - 87
- 88 - 92
- 93 - 96
- 97 - 129
- 130 - 457
- 458 - 614
- 615 - 652
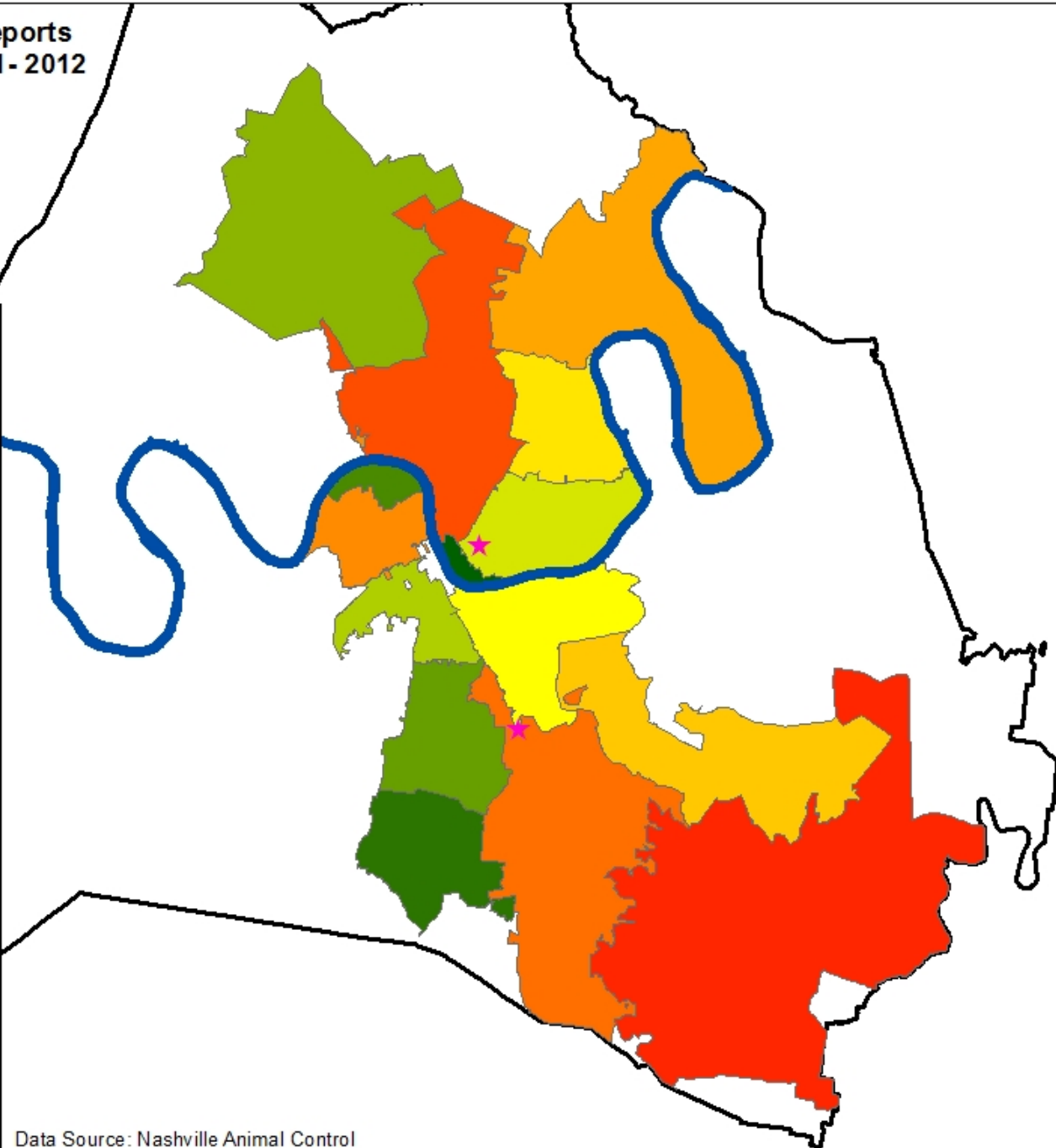- 653 - 742
- 743 - 776
- 777 - 1,002
- 1,003 - 1,510
- 1,511 - 2,251
- 2,252 - 4,186
- ★ Recreation Centers
- Cumberland River
- Davidson County Border
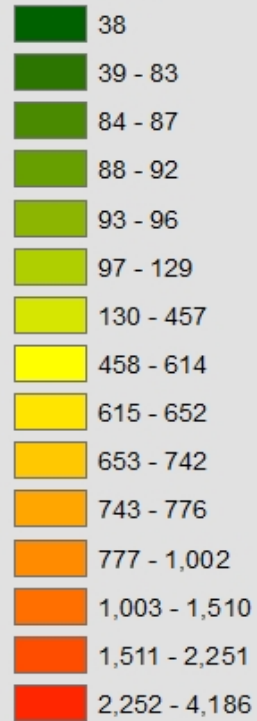
Data Source: Nashville Animal Control

Research Design

Development of a built environment composite scale

Multivariate analysis to predict use of environment for preschooler physical activity

Analysis from baseline data of an ongoing RCT (N= 500 families)
◦ variables included: parental perceived crime, traffic patterns, stray dogs, street lighting, walkability; and bike safety
◦ Parental reports of the use of the environment for preschooler physical activity

Composite Built Environment Scale
KR20=0.72

Built Environment Component	Unsafe N (%)
1. Unattended Dogs make it unsafe to go on walks	167 (29%)
2. The Crime Rate in my neighborhood makes it unsafe to go on walks	163 (33%)
3. The traffic in my neighborhood makes it difficult to walk or ride a bike	237 (42%)
4. My neighborhood streets are not well lit at night	171 (42%)
5. Many drivers exceed the posted speed limits while driving in my neighborhood	251 (44%)
6. Overall, my neighborhood is not a safe place to ride a bike	171 (30%)
7. Overall, my neighborhood is not a safe place to walk	292 (52%)

Study Demographics

Child	
Age, mean (SD)	4.33 (0.88)
Gender, No. (%)	
Female	262 (52)
Male	238 (48)
BMI (kg/m^2), mean (SD)	16.66 (0.78)
BMI Category, No. (%)	
Normal Weight (5%-84.9%)	325 (65)
Overweight (85%-94.9%)	170 (34)
Obese (≥95%)	5 (1)
Adult	
Age, mean (SD)	32.21 (6.78)
Gender, No. (%)	
Female	482 (97)
Male	17 (3)
BMI (kg/m^2), mean (SD)	29.64 (5.87)
BMI Category, No. (%)	
Underweight (<18.5)	1 (<1)
Normal Weight (18.5-24.9)	98 (20)
Overweight (25.0-29.9)	201 (40)
Obese (≥30.0)	200 (40)
Primary Caregiver Education, No. (%)	
12th grade or less	291 (58)

Logistic Regression Predicting Recreation Center Use by Latino Preschoolers: Perception of Built Environment Predicts Use of the Built Environment for Physical Activity

Variables	Odds Ratio	Standard error	95% CI	P-value
Built environment scale	1.3	0.09	1.12 , 1.51	0.0001
Child age	1.2	0.21	0.88 , 1.70	0.22
Child gender	1.2	0.36	0.64 , 2.12	0.6
Maternal education > HS	2.3	0.89	1.09, 4.93	0.03

Salud America!

Macro- Level: Use of Built Environment (Recreation Center)

Survey Results	Unexposed (n=65)	Exposed (n=66)
Adult Use (%)		
Once a month or less	66.15	34.85
More than once a month	33.85	65.15
Adult Use With Child (%)		
Once a month or less	75.38	37.88
More than once a month	24.62	62.12

Salud America!
Results: Use of Recreation Center by Latino families with their children

How often parents use the recreation center with their child	Unexposed (%)	Exposed (%)
Everyday	1.5%	1.5%
> 1/week	13.9%	24.2%
Once/week	7.7%	19.7%
>1/month	1.5%	16.7%
Once/month	4.6%	27.2%
Never	70.8%	10.6%

p<0.000* Chi-square test

Barkin, SL, Poe, E, Systematic Exposure to Recreation Center Increases Use by Latino Families with Young Children, *Childhood Obesity* 2012 Apr;8(2):116-23.

Conclusions

1. Physical activity patterns are spurt-like and sporadic in preschool age children and programs /policies should consider how to align with this developmental stage to reinforce early MVPA patterns.

2. Families with young children benefit from being taught the skills to use existing built infrastructure to support regular physical activity

3. The use of the existing built environment for regular physical activity is influenced by subjective as well as objective perspective

4. Routine physical activity for children is influenced by parental activity. Consider how to incorporate family changes, rather than one child at a time.