MOM, CAN I PLAY OUTSIDE?  
INFLUENCE OF DISADVANTAGED NEIGHBORHOODS ON PHYSICAL ACTIVITY AND OBESITY IN YOUTH

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The Pennington Biomedical Research Center Childhood Obesity & Public Health Conference  
October, 2015
Molecular and Social Determinants of Obesity in Developing Youth Study

(NIMHD) 5U54MDO08176-02; PI: Sothern, Estrada, Scribner (LSU Health Sciences Center), Affuso (University of Alabama at Birmingham).
Sedentary Indoor Lifestyles

- Obesity and metabolic disorder
- Asthma
- Vitamin D insufficiency
- Attention problems by age 7 years
- Attention-Deficit/ Hyperactivity Disorder (ADHD)
- Social and emotional problems

Children are not Little Adults

- Enjoy unstructured physical activity (play)
- Play fosters healthy emotional development
- Movement is required for cognitive development
- Unable to stay focused for long periods of time

Sothern, M. Profile of the Overweight Child, in Safe and Effective Exercise for Overweight Youth, CRC Press, 2014
U.S. Adolescents are Not Active

• Only 8% of adolescents in the U.S. meet the 60 minutes/day of moderate to vigorous physical activity (MVPA) guideline.

• Physical activity is significantly lower and physical inactivity significantly higher among:
  • Females and ethnic minorities
  • Children from:
    • non-English speaking households
    • metropolitan areas
    • socio-economically disadvantaged backgrounds
  • Compared to previous generations, less children are playing outdoors.

Troiano, et al., 2008; Steinberger et al., 2009; Burdette & Hill, 2008; Kimbro et al., 2011; Centers for Disease Control & Prevention, 2011; Hills, Anderson & Byrne, 2011
Outdoor play contributes to overall physical activity in Louisiana adolescents (Kepper, et al., unpublished data)

<table>
<thead>
<tr>
<th>Total MVPA</th>
<th>Weekend MVPA</th>
<th>MVPA After-School</th>
<th>Weekday MVPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total MVPA</td>
<td>Weekend MVPA</td>
<td>MVPA After-School</td>
<td>Weekday MVPA</td>
</tr>
</tbody>
</table>

*Relationships were similar for adolescent’s who reported play in a nearby driveway/alley and school-ground*
Social Ecological Perspective: Levels of Influence

**Societal**
local, state and federal policies

**Community**
Built environment, safety, greenspace, social capital

**Interpersonal**
parenting styles, constrained behavior

**Individual**
physical activity, obesity and metabolic disorders
Neighborhood: It’s the Context in Which Kids Play Outdoors

• Research in adults supports relationships between physical activity and:
  • SAFETY: crime, victimization, poorly lighted streets, traffic safety
  • ENVIRONMENT:
    • SOCIAL: concentrated disadvantage (CDI), social cohesion, social capital, social support, perceived collective efficacy.
    • PHYSICAL: access to parks/playgrounds, sidewalks, walkable destinations, incivilities
  • Relationships less established in youth populations
  • Inconsistent associations
    • Mode of measurement (perceived vs. objective) may impact results

SAFETY

- Children in unsafe neighborhoods had 12% lower odds of regular physical activity than their counterparts in safe neighborhoods.

- Children living in urban neighborhoods with the most unfavorable safety conditions were:
  - 50% more likely to be physically inactive
  - 52% more likely to watch television >2 hours daily
  - 65% more likely to engage in recreational computer use for >2 hours daily

- In neighborhoods with the most unfavorable conditions:
  - 20% of children were obese
  - 37% were overweight

- In neighborhoods with favorable conditions:
  - 14.7% of children were obese
  - 29.8% of children overweight

Singh et al., 2008; Singh, Kogan, Siahpush, Dyck, 2008
Specific Aims in Louisiana Preschoolers

1a. To determine the association between BMI z-score and the following variables:
   - Fruit & vegetable intake
   - Outdoor play
   - Frequency of fast food outlets and grocery stores
   - Ratio of fast food to grocery stores
   - Total crime index
   - Outdoor play

To determine the relationship between:

1b. Fast food outlets and grocery stores to fruit and vegetable intake.
1c. Crime density to outdoor play in concentric areas around the child's residence and pediatric obesity using geographic information system (GIS) fast food and convenience stores data from Dr. Scribner’s laboratory and recently collected data from Dr. Sothern and colleague’s NAP SACC randomized control trial in central and south Louisiana day care centers
NAPSACC: A Study in Louisiana Preschools

Total Crime Index Surrounding the Child's Home Residence

Legend
- home address
tractfile
TOTCRIND00

- 0.000000 - 90.888627
- 90.888628 - 207.543463
- 207.543464 - 361.489150
- 361.489151 - 603.910887
- 603.910888 - 1255.043741

LSU Health New Orleans
Crime was not related to physical activity or obesity in Louisiana preschoolers, Kepper et al., Int’l J Ped Obesity, 2015

<table>
<thead>
<tr>
<th>Estimate Coefficient</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable Intake (servings/wk)</td>
<td>-0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Outdoor Play (mins/wk)</td>
<td>-0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Ratio of Fast Food Outlets to Grocery Stores (2 mi)</td>
<td>0.12</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**p < 0.10, marginally significant  
*p < 0.05, significant

Vegetable Intake (servings/week), outdoor play (minutes/week) and the ratio of fast food outlets to grocery stores in a 2 mile concentric areas around the child’s residence predicted weight status (BMI_z) (F value= 3.06, P value= 0.0346).
Social Environment: Concentrated Disadvantage Index

- Using Census Data from the American Community Survey an index score of each child’s residence was created using the following variables:

  - Percent of Individuals:
    - Below The Poverty Line
    - Receiving Public Assistance
    - Female-Headed Households
    - Unemployed
    - Less Than Age 18 Years of Age
    - Black
Study of Insulin sensitivity in Louisiana Low, High and Normal Weight Pre-pubertal Youth, 7-9 Years (SILLY)

African American
N = 200

- Low/High Birth Weight
- Normal Birth Weight

Caucasian
N = 200

- Low/High Birth Weight
- Normal Birth Weight

Social Disadvantage
Concentrated Index (CDI)
Inflammatory Adipokines
(IL8, TNF@, IL6, IL1B, etc)
Insulin Sensitivity
(FSIGTT)
Insulin Resistance
(HOMA)
Intramyocellular (IMCL) and Intrahepatic (IHL)
Lipids ($^{1}$H-MRS)
Visceral Obesity (MRI; waist)
Body Fat (DEXA)
Blood Pressure
Lipid Profile (TC, HDL, LDL)
Fat Oxidation via
Respiratory Quotient
(Indirect Calorimetry)
Physical Activity
(Accelerometry)

Research sponsor: U. S. National Institutes of Health/NICHD (HD41071; HD49046); NIDDK; NIMHD; LSUHSC Jim Finks Endowed Chair in Health Promotion.
Results: Concentrated Disadvantage Index (CDI) Kepper, et al., Obesity, in review

CDI was negatively associated with:

- \( z\text{-BMI} \) (-0.234, \( p=0.023 \))
- body fat (-0.228, \( p=0.028, \text{n}=95 \))
- VAT (-0.241, \( p=0.042, \text{n}=74 \))

*relationships remained significant in Caucasian children only after adjustment for race and \textbf{physical activity}*

Of the seven CDI variables the strongest predictors in Caucasian children only were:

- female head of households
- unemployed parents
- parents<18 years
Social Ecological Perspective: Levels of Influence

**Societal**
- local, state and federal policies
- healthy actions

**Community**
- Built Environment, safety, access to greenspace, social capital

**Interpersonal**
- parenting styles, constrained behavior

**Individual**
- physical activity, obesity and metabolic disorders
Interpersonal Level: Parenting styles/behaviors: and children’s MVPA

- Jago (2011) shows that parenting styles, and practices impact children’s MVPA.
  - Permissive parenting style was significantly related to more physical activity in girls.
  - Guiding support was significantly related to physical activity in girls.
  - Father support was significantly related to more physical activity in boys.
Parental Constrained Behavior

The act of restricting physical activity, which is categorized as either:

1. Avoidance Behavior
   - example: forbidding unsupervised play
2. Defensive Behavior
   - example: restriction of outdoor play to the backyard

Current research focuses on adults constraining their own physical activity due to crime and safety concerns.

Few studies focus on parental constraint of their children's physical activity and factors of the neighborhood social and physical environment that affect parent's constraint on their children's physical activity.

Carver et al., 2010; Ferraro et al., 1995; Foster & Giles Corti, 2008

Parenting Behaviors: Defensive Behavior

Please indicate your agreement with the following statements:

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My child must be supervised while playing outside</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. My child is learning/has learnt self-defense skills</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Carver et al., 2010; Ferraro et al., 1995; Foster & Giles Corti, 2008
Fig. 4. Perceived risk, constrained behaviour and physical activity: adolescent girls.

Carver A, Timperio A, Hesketh K, Crawford D. Are children and adolescents less active if parents restrict their physical activity and active transport due to perceived risk? Social Science & Medicine, Volume 70, Issue 11, 2010, 1799–1805http://dx.doi.org/10.1016/j.socscimed.2010.02.010
Proposed Model in Louisiana Adolescents

Community-Level

Parental Perceptions of the Neighborhood Environment
Perceived Safety
Perceived Collective Efficacy

Interpersonal Level

Parenting Behaviors/Styles
Authoritative vs. Permissive Parenting Style

Parental Constrained Outdoor Play Practices
- Avoidance Behavior
- Defensive Behavior

Individual Level

Children’s Physical Activity

Obesity and Cardio-Metabolic Risk Factors
<table>
<thead>
<tr>
<th>Preliminary Descriptive Statics SILLY 2 Study</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD)</td>
<td></td>
<td>64 14.14, 1.16</td>
</tr>
<tr>
<td>Race</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>43</td>
<td>67.2</td>
</tr>
<tr>
<td>Black</td>
<td>15</td>
<td>23.5</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>9.39</td>
</tr>
<tr>
<td>Male</td>
<td>32</td>
<td>50.0</td>
</tr>
<tr>
<td>Household Income</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Low (&lt;29,000)</td>
<td>12</td>
<td>19.1</td>
</tr>
<tr>
<td>Medium (&lt;30,000-59,999)</td>
<td>16</td>
<td>25.4</td>
</tr>
<tr>
<td>High (&gt;60,000) (%)</td>
<td>35</td>
<td>55.6</td>
</tr>
<tr>
<td>Perceived Collective Efficacy (mean, SD)</td>
<td>63</td>
<td>3.93, 0.58</td>
</tr>
<tr>
<td>Constrained Behavior</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Avoidance Behavior</td>
<td>31</td>
<td>50.0</td>
</tr>
<tr>
<td>Defensive Behavior</td>
<td>32</td>
<td>51.6</td>
</tr>
</tbody>
</table>
Mean Minutes of MVPA per day among SILLY 2 Participants

- Total MVPA
- After School MVPA
- Non-school hours (weekdays) MVPA
- Weekend MVPA
Weight Status of SILLY 2 Participants

- Healthy/Underweight (< 85th percentile): 36%
- Overweight (85th to < 95th percentile): 20%
- Obese (≥ 95th percentile): 44%
Summary

- Outdoor play in children is associated with numerous health outcomes.
- Neighborhood factors affect outdoor play.
- Parenting behaviors have the ability to constrain children's outdoor play.
- Parents perceptions of the neighborhood influence parenting behaviors.
- More research is needed to understand these relationships in pediatric populations.
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Biomedical Research Center (PBRC)
QUESTIONS SLIDES
<table>
<thead>
<tr>
<th></th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>40 (51.28)</td>
</tr>
<tr>
<td>Male</td>
<td>38 (48.72)</td>
</tr>
<tr>
<td>White</td>
<td>42 (53.85)</td>
</tr>
<tr>
<td>Black</td>
<td>27 (34.62)</td>
</tr>
<tr>
<td>Other</td>
<td>9 (11.54)</td>
</tr>
<tr>
<td>Normal (BMI &lt; 85&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>60 (76.92)</td>
</tr>
<tr>
<td>Overweight (85&lt;sup&gt;th&lt;/sup&gt;≤ BMI &lt; 95&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>10 (12.82)</td>
</tr>
<tr>
<td>Obese (BMI ≥95&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>8 (10.26)</td>
</tr>
</tbody>
</table>

### NAPSACC Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>N= 78</th>
<th>Mean (+/-SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.49 (0.69)</td>
<td></td>
</tr>
<tr>
<td>BMI Z score</td>
<td>0.42 (0.97)</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>16.48 (1.79)</td>
<td></td>
</tr>
<tr>
<td>Fruit Intake (servings/wk)</td>
<td>14.36 (8.18)</td>
<td></td>
</tr>
<tr>
<td>Vegetable Intake (servings/wk)</td>
<td>17.59 (9.51)</td>
<td></td>
</tr>
<tr>
<td>Outdoor Play (mins/wk)</td>
<td>692.67 (1988.80)</td>
<td></td>
</tr>
<tr>
<td>Total Crime Index</td>
<td>85.21 (82.11)</td>
<td></td>
</tr>
<tr>
<td>Fast Food Count 1mile</td>
<td>5.47 (7.54)</td>
<td></td>
</tr>
<tr>
<td>Grocery Count 1mile</td>
<td>2.58 (3.07)</td>
<td></td>
</tr>
<tr>
<td>Fast Food Outlets to Grocery Stores 1 mile</td>
<td>2.59 (3.10)</td>
<td></td>
</tr>
</tbody>
</table>
1a. To determine the association between BMI z-score and the following variables:
- Fruit & vegetable intake
- Outdoor play
- Frequency of fast food outlets and grocery stores
- Ratio of fast food to grocery stores
- Total crime index
- Outdoor play

To determine the relationship between:
1b. Fast food outlets and grocery stores to fruit and vegetable intake.
1c. Crime density to outdoor play

in concentric areas around the child's residence and pediatric obesity using geographic information system (GIS) fast food and convenience stores data from Dr. Scribner’s laboratory and recently collected data from Dr. Sothern and colleague’s NAP SACC randomized control trial in central and south Louisiana day care centers
### Estimated Effects of Fast Food and Grocery Stores within Concentric Areas Around Residential locations on Fruit and Vegetable Intake

#### Pearson Correlation Coefficients

Prob > |r| under H0: Rho=0

Number of Observations

<table>
<thead>
<tr>
<th>Fast Food Counts</th>
<th>Fruit Intake (servings/wk)</th>
<th>Vegetable Intake (servings/wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric Areas (miles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-0.09392</td>
<td>-0.07512</td>
</tr>
<tr>
<td></td>
<td>0.4134</td>
<td>0.5133</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>2</td>
<td>0.02181</td>
<td>-0.11219</td>
</tr>
<tr>
<td></td>
<td>0.8497</td>
<td>0.3281</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>0.11223</td>
<td>0.03889</td>
</tr>
<tr>
<td></td>
<td>0.3280</td>
<td>0.7353</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grocery Store Counts</th>
<th>Fruit Intake (servings/wk)</th>
<th>Vegetable Intake (servings/wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric Areas (miles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.21870</td>
<td>0.17111</td>
</tr>
<tr>
<td></td>
<td>0.0544**</td>
<td>0.1342</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>2</td>
<td>0.23246</td>
<td>0.08878</td>
</tr>
<tr>
<td></td>
<td>0.0406*</td>
<td>0.4395</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>0.24878</td>
<td>0.12522</td>
</tr>
<tr>
<td></td>
<td>0.0281*</td>
<td>0.2747</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

**p < 0.10, marginally significant**

*p < 0.05, significant**
Relationship Between Increased Availability of Grocery Stores with varying distances around Child's Residence and Fruit Intake

Mean Counts of Grocery Stores vs. Significance P Value

- 1 mile
- 2 mile
- 4 mile
Mean minutes of MVPA by frequency of outdoor play in a nearby schoolground

Mean minutes of MVPA by frequency of playing outdoors in a driveway/alley
Table 1: Mean (standard deviations) minutes for moderate-to-vigorous physical activity (MVPA) by neighborhood type.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Safe</th>
<th>Unsafe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total MVPA</td>
<td>35.83(13.28)</td>
<td>29.56(14.93)</td>
<td>22.30(10.75)</td>
</tr>
<tr>
<td>After School</td>
<td>19.94(14.87)</td>
<td>26.77(18.24)</td>
<td>13.48(6.18)</td>
</tr>
<tr>
<td>Non-school hours</td>
<td>21.44(14.49)</td>
<td>28.24(17.61)</td>
<td>15.01(6.14)</td>
</tr>
<tr>
<td>(weekdays)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekend Days</td>
<td>17.09(15.21)</td>
<td>16.24(12.56)</td>
<td>17.72(17.30)</td>
</tr>
</tbody>
</table>

*p<0.05 Independent samples t-test- significant difference between perceived safe vs. unsafe neighborhoods.

Table 2: Mean (standard deviations) scores for avoidance behaviour, defensive behaviour and perceived collective efficacy by neighborhood type.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Safe</th>
<th>Unsafe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidance behaviour</td>
<td>-6.63(1.00)</td>
<td>-0.30(0.79)</td>
<td>0.25(1.10)</td>
</tr>
<tr>
<td>Defensive behaviour</td>
<td>7.16(1.00)</td>
<td>-0.29(0.87)</td>
<td>0.24(1.05)</td>
</tr>
<tr>
<td>Perceived collective</td>
<td>3.93(0.578)</td>
<td>3.77(0.56)</td>
<td>4.06(0.56)</td>
</tr>
<tr>
<td>efficacy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05 Independent samples t-test- significant difference between perceived safe vs. unsafe neighborhoods.
References