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Assessing Impacts of Time Use on Children's Physical Fitness in Relation to Risk for Obesity and Diabetes

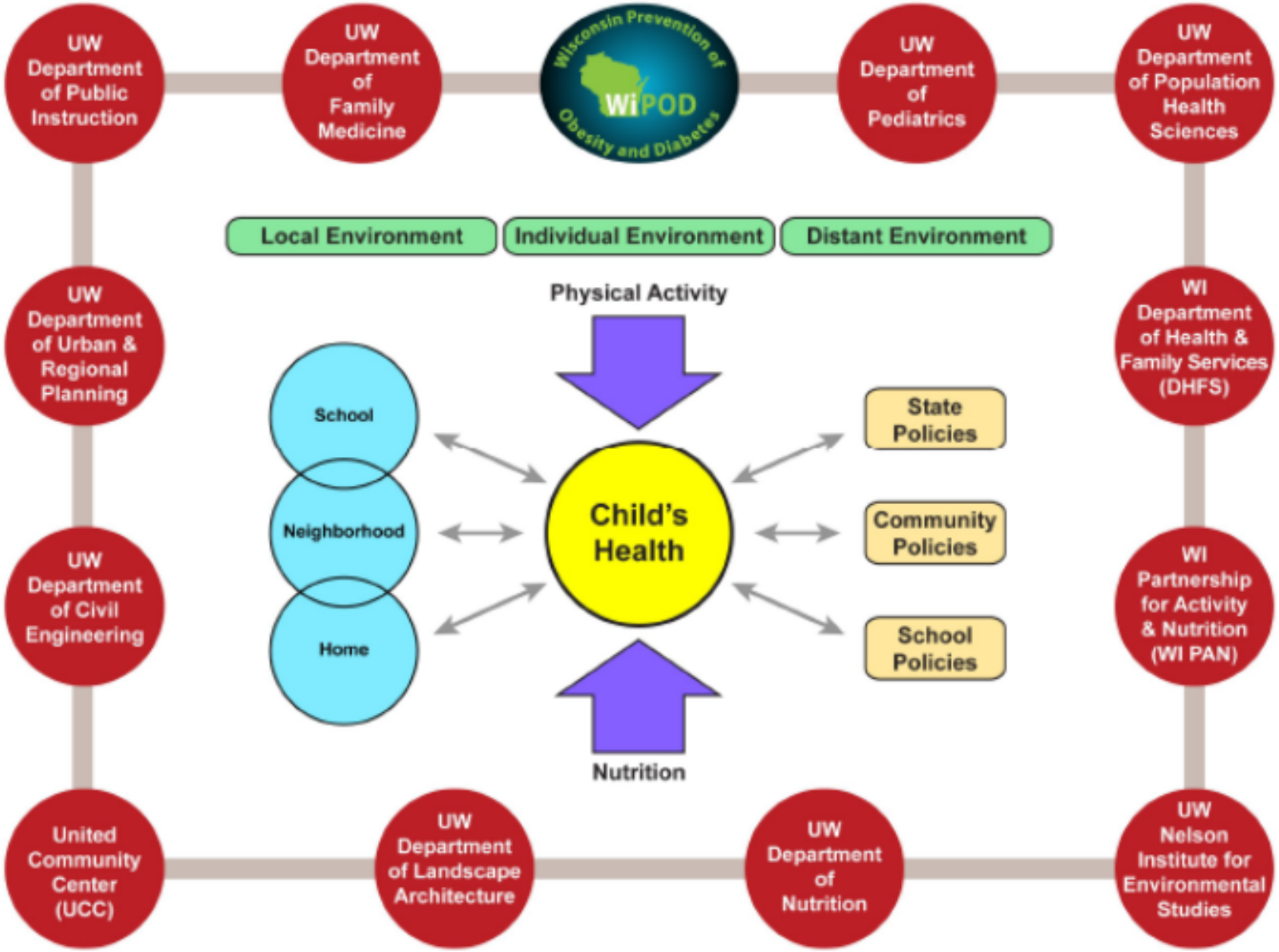
Jessica Guo
Parsons Brinckerhoff

ASSESSING IMPACTS OF TIME USE ON CHILDREN'S PHYSICAL FITNESS IN RELATION TO RISK FOR OBESITY AND DIABETES

April 25 2014

Jessica Guo, Parsons Brinckerhoff

Yuchen Cui, University of Maryland


UW Department of Public Instruction
UW Department of Family Medicine
Wisconsin Prevention of Obesity and Diabetes
WiPOD
UW Department of Pediatrics
UW Department of Population Health Sciences
Local Environment
Individual Environment
Distant Environment
UW Department of Urban & Regional Planning
Physical Activity
School
Neighborhood
Home
Child's Health
State Policies
Community Policies
School Policies
Nutrition
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UW Department of Civil Engineering
WI Partnership for Activity & Nutrition (WI PAN)
United Community Center (UCC)
UW Department of Landscape Architecture
UW Department of Nutrition
UW Nelson Institute for Environmental Studies

Overview

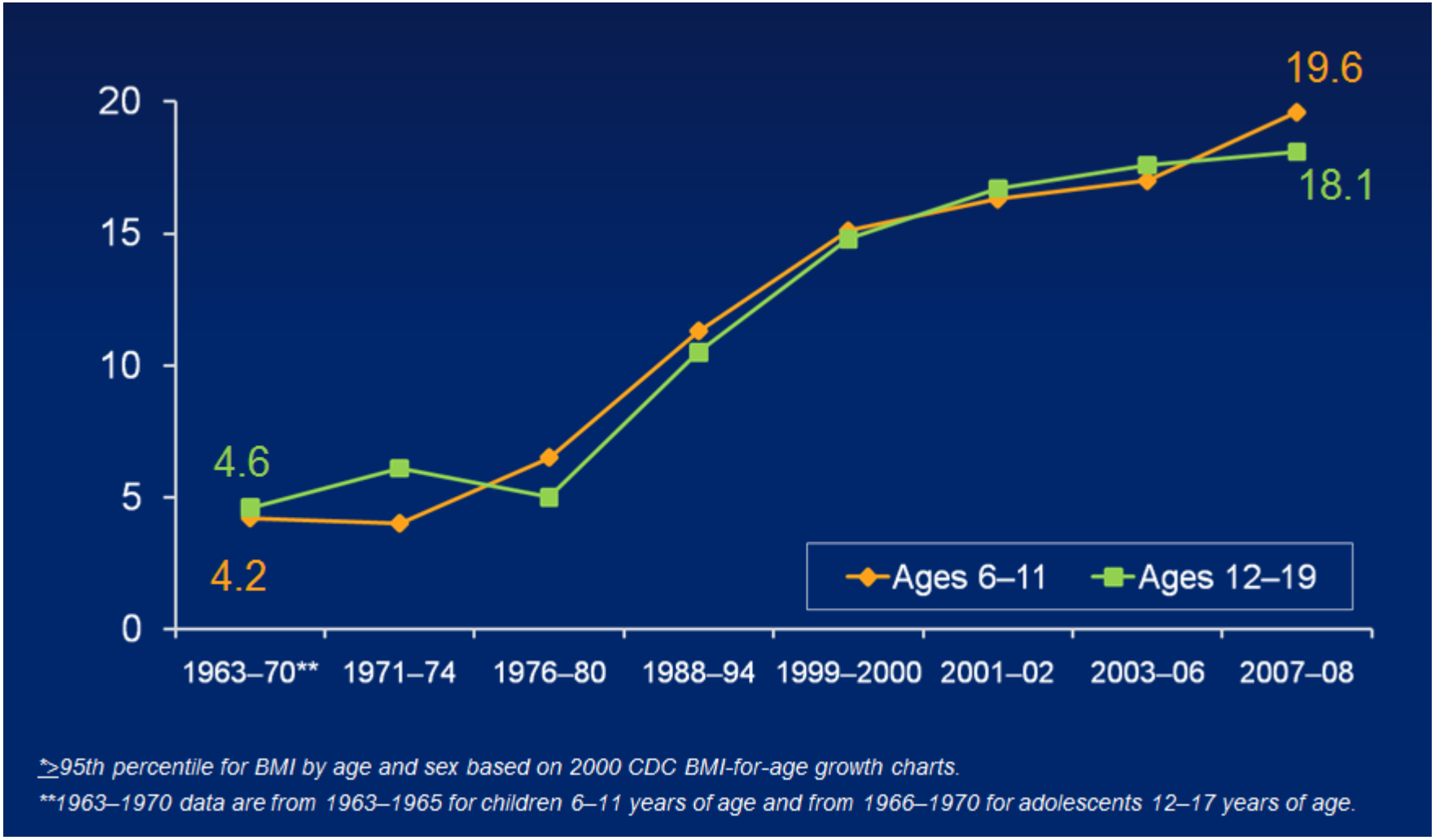
- Childhood Obesity & Diabetes – Facts/Concerns
- **H**ealthy **A**ctivities **P**artnership **P**rogram for **Y**outh
- Community Setting
- Data Collection, New Instrument
- Analysis and Findings
- Policy Recommendations
- Directions for Further Research

Obesity Defined

- **Overweight:** BMI ≥85th to <95th percentile
- **Obesity:** BMI ≥95th percentile
- **Energy Imbalance:**

Energy In >> Energy Out

Percentage of U.S. Children and Adolescents Classified as Obese, 1963–2008*



Source: www.cdc.gov/healthyyouth/npao/presentationslides.ppt

Prevalence of Childhood Obesity

- Differ by age (2011-2012)
  - 2~5-year-olds: 8.4% (declined from 13.9% in 2003-2004)
  - 6~11-year-olds: 17.7%
  - 12~19-year-olds: and 20.5%
- Differ by race (2011-2012)
  - Hispanics: 22.4%
  - Non-Hispanic black: 20.2%
  - Non-Hispanic white: 14.1%
  - Non-Hispanic Asian youth: 8.6%

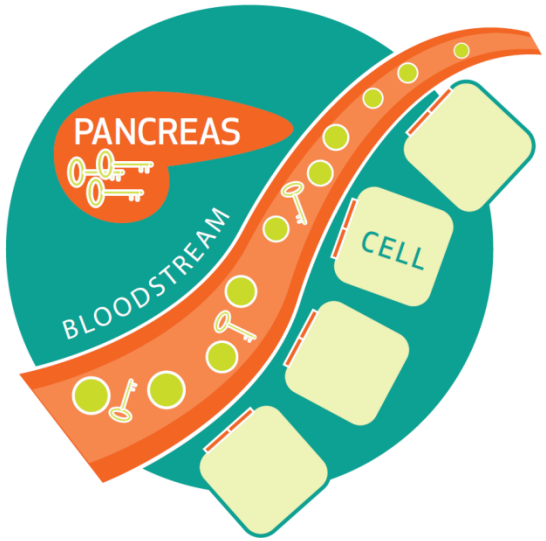
Health Concerns

- High Cholesterol
- Type 2 Diabetes/

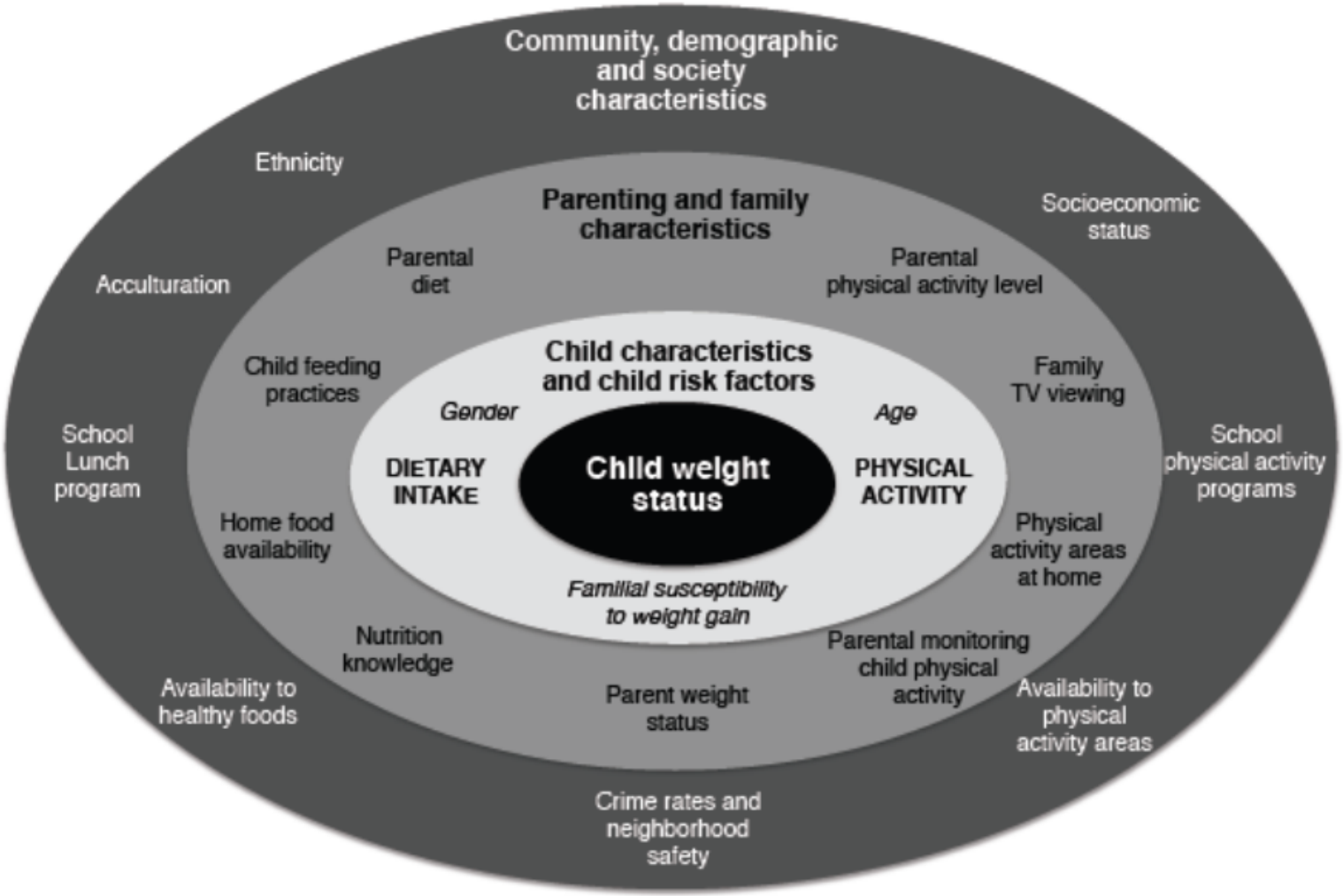
  Impaired Glucose Tolerance
- High Blood Pressure
- Sleep Disturbances
- Orthopedic Problems

Children and Diabetes

- Found in ~151,000 people under age of 20 years
- Type 2 diabetes usually diagnosed in adults aged over 40 years
- Now ~3,700 children and adolescents under age 20 are diagnosed per year with type 2 diabetes
- Diabetics diagnosed before the age of 15 have a life expectancy 27 years shorter than that of non-diabetics
- Association with obesity

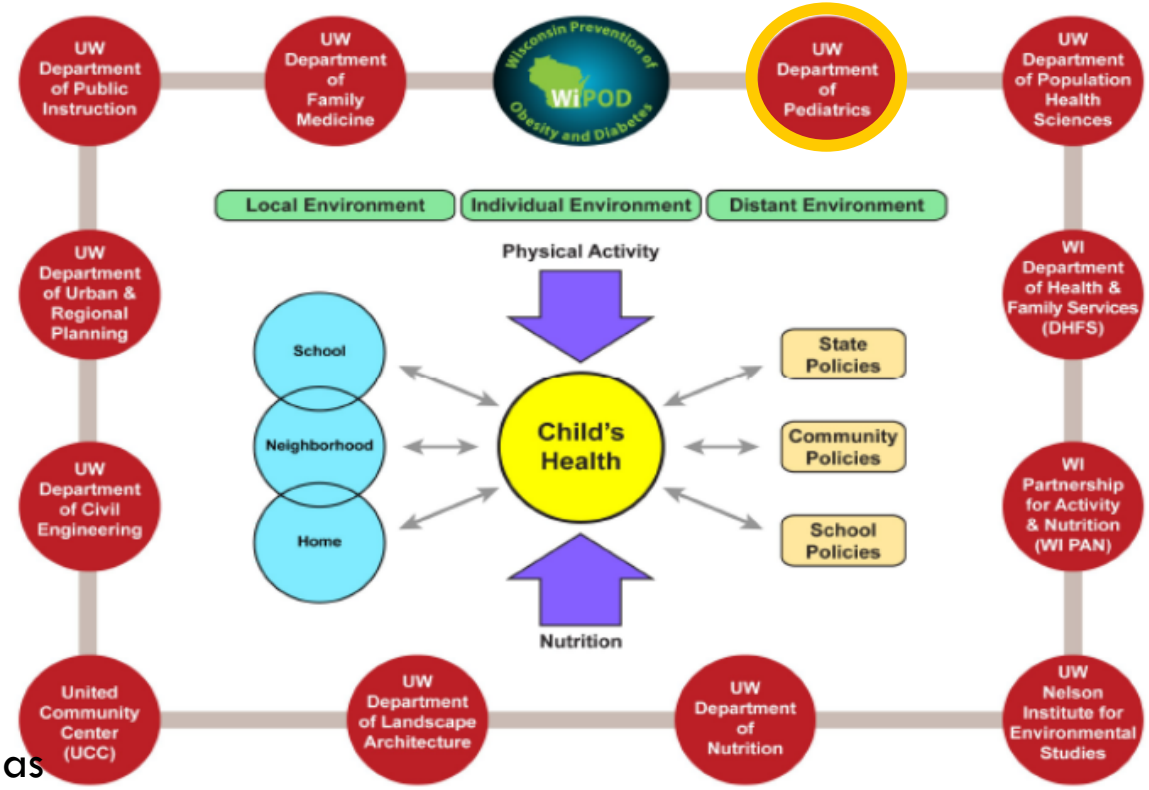


Factors Contributing to Obesity



Source: Santiago-Torres, M. (2014)

Healthy Activities Partnership Program for Youth



Alexandra Adams
Tara LaRowe

Aaron Carrel
David Allen

James LaGro

Jessica Guo
Yuchen Cui

Steve Ventura
Jeffrey Sledge

René Farias
Angelica Rolón-Delgado
Magdalisse González
Blanca Reyes

Samuel Dennis
Suzanne Gaulocher

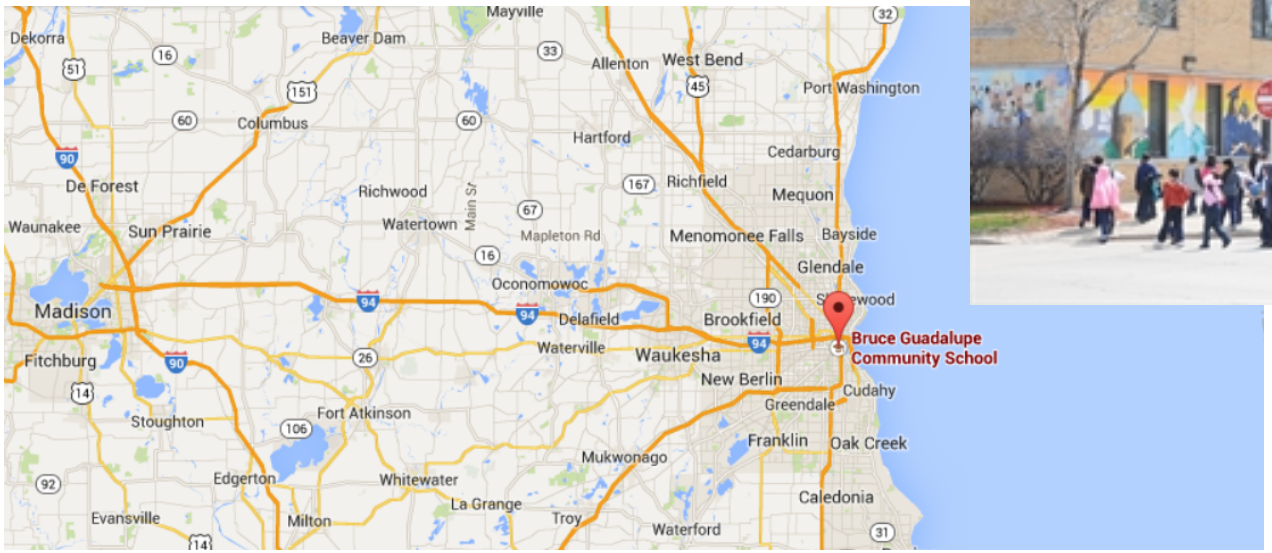
Dale Schoeller
Margarita Santiago-Torres

HAPPY

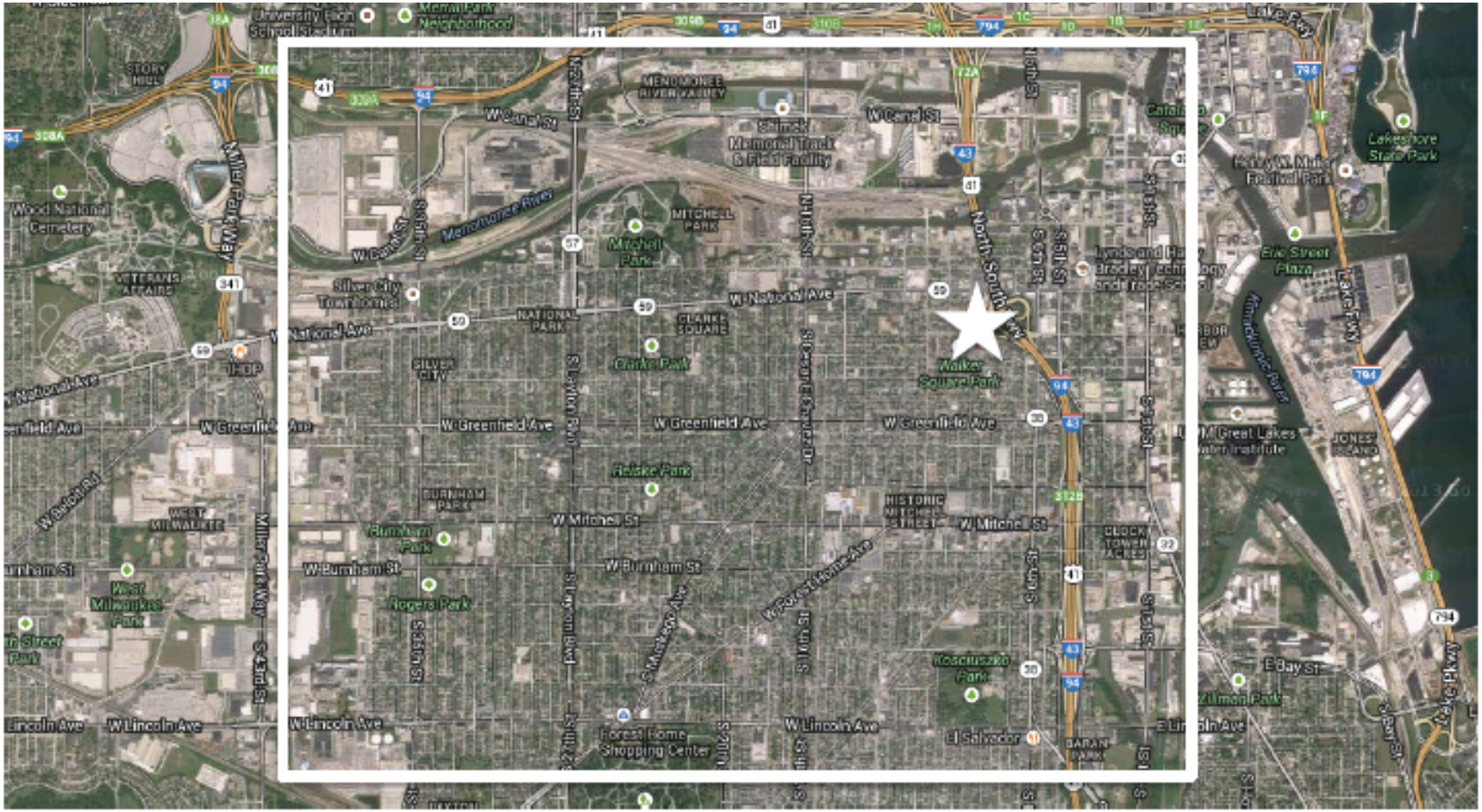
- Community-based participatory research (CBPR)
- Include knowledge and expertise from multiple disciplinary and campus/community entities
- Provide bidirectional and co-learning opportunities for all partners
- Regular meetings over 2 ½ years to work together in design, implementation, and dissemination

Community Partner

- United Community Center began in the late 1960s as an outreach program in Milwaukee, WI
- Operates Bruce Guadalupe Community School (BGCS)



Bruce Guadalupe Community School



HAPPY – Research Goals

- Identify prominent barriers to PA and healthy eating in urban Hispanic families in Milwaukee, WI
- Formulate evidence-based recommendations for community change to improve Hispanic children's overall health

HAPPY – Specific Aim 1

- **Assess children's built environment for energy requirements of movement, PA, and energy expenditure within those environments.**
  - Collect GPS-based movement data
  - Develop geospatial models for assessing energy expenditure
  - Assess built environment, air quality, noise levels, traffic patterns,…

HAPPY – Specific Aim 2

- **Assess children's social environment and nutrition choices within the built environment**
  - Document food/PA choices using Participatory Photo Mapping
  - Assess children's diet and PA patterns, home environment for PA and food, family socio-demographics through surveys

HAPPY – Specific Aim 3

- **Assess children's cardiovascular fitness, obesity, and insulin resistance**
  - Assess adiposity by BMI
  - Measure cardiovascular fitness (CVF) with the Progressive Aerobic Cardiovascular Endurance Run (PACER) test
  - Collect fasted blood sample to calculate insulin resistance ($HOMA_{IR}$).

HAPPY – Specific Aim 4

- **Develop a quantitative model linking data from the above three foci that describes the relationships among children's metabolic health and community.**
  - Collect data to better understand how children organize their days
  - Integrate all data for analysis
  - Estimate empirical models to test research hypotheses

Assessing Activity Patterns

- Good data = high validity + high reliability
- Particularly difficult in children due to
  - sporadic and intermittent activities
  - lower cognitive ability
- Objective measurements: accelerometers, pedometers, physiologic monitors, GPS trackers
- Subjective assessment tools: questionnaires, logs, diaries
- No single instrument is perfect
- Resource and time constraints

Existing Instruments

- 3DAR (Bouchard et al., 1983)
- 7DPAR (Sallis et al., 1993)

Hour \ Min.	0-15	16-30	31-45	46-60
0	2	2	2	1
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	3	4	3	4
10	5	5	5	5
11	5	5	5	5
12	5	5	5	2
13	2	2	5	5
14	5	5	5	5
15	5	5	2	2
16	2	2	2	2
17	2	2	4	2
18	2	2	4	4
19	2	2	2	2
20	2	2	2	2
21	8	8	8	4
22	4	4	2	2
23	2	2	2	1

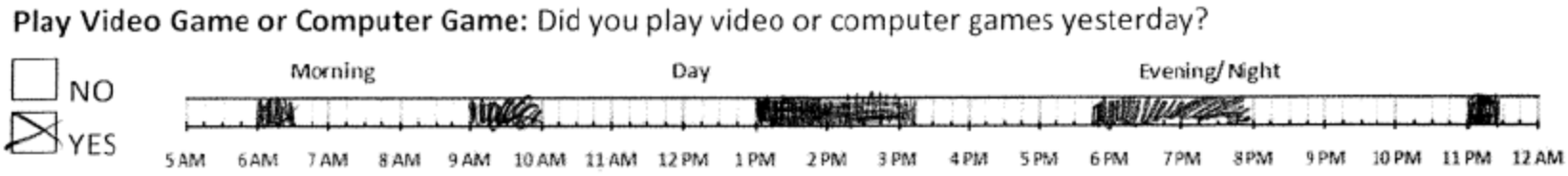
WORKSHEET

DAYS

		1 __	2 __	3 __	4 __	5 __	6 __	7 __
	SLEEP							
MORNING	Moderate							
	Hard							
	Very Hard							
AFTERNOON	Moderate							
	Hard							
	Very Hard							
EVENING	Moderate							
	Hard							
	Very Hard							
Total Min Per Day	Strength:							
	Flexibility:							

Graphs for Recalling Activity Time (GReAT)

- Use timeline charts to recall pervious day's activities
- One timeline per activity type to capture frequency, duration, and timing



- Sleep was assessed in text only
- 14 activity types

Name: _____ Date: _____

ACTIVITY DIARY

The purpose of this form is to collect information about the activities you did **yesterday** and the time of the day you did these activities.

For each of the activities described below:

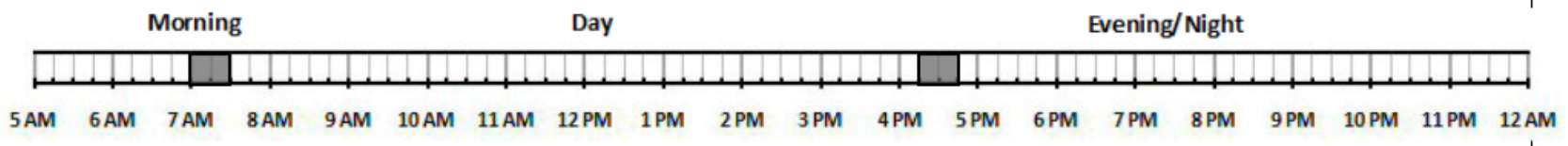
- If you **did not** spend any time on that activity **yesterday**, mark 'X' in the box next to **NO** and move on to the next activity.
- If you **did** spend some time on that activity **yesterday**, mark 'X' in the box next to **YES** and shade in the time of the day you did the activity on the timeline provided. Also, answer any follow up questions before moving on to the next activity.

EXAMPLE:

This is an example showing how to fill out a timeline. Let's suppose that yesterday morning you left home at 7:00 AM, were driven in a car to school, and arrived at school at 7:30AM. In the afternoon, you left school in a bus at 4:15 PM and got home at 4:45 PM. You should then report the above information on the timeline for Motorized Travel as shown below:

Motorized Travel

☐ NO
☒ YES



==========START HERE==========

==========START HERE==========

GPS: Did you wear your GPS unit during most of yesterday? ☐ YES ☐ NO

If not, why?

☐ I left it at home ☐ I gave it to someone else

☐ I left it in the car ☐ Other reason: _____

Sleep:

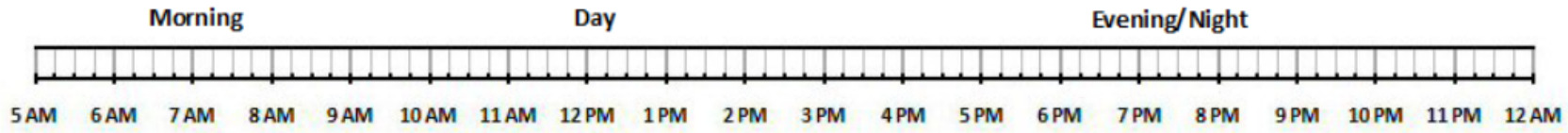
What time did you go to bed and turn the light off last night? _____:_____PM or AM

What time did you get up this morning? _____:_____PM or AM

Napping: Did you take any naps yesterday?

☐ NO

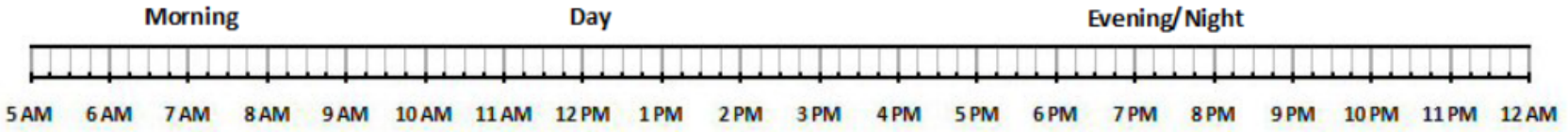
☐ YES



Study: Did you study yesterday? Include class time at school, homework time at home, and computer use for homework.

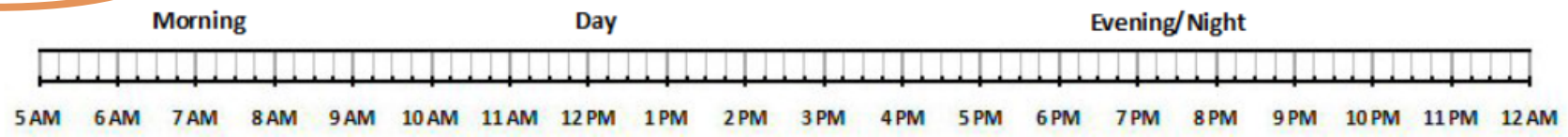
☐ NO

☐ YES



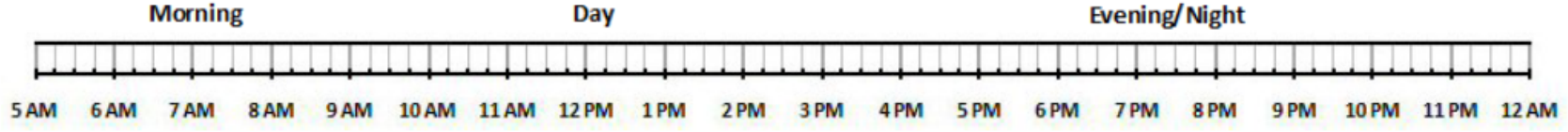
Motorized Travel: Did you go from one place to another by taking the bus or being driven in a car yesterday?

☐ NO
☐ YES



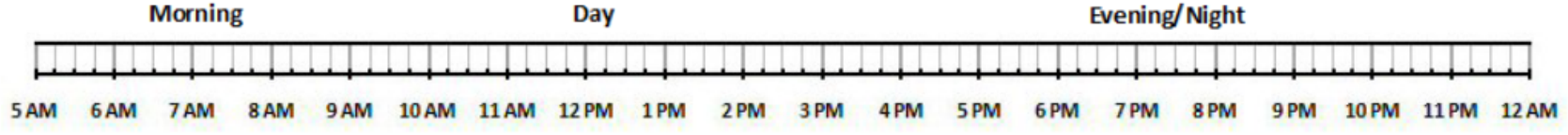
Non-Motorized Travel: Did you go from one place to another by walking, riding a bicycle/scooter/skateboard, rollerblading, or rollerskating?

☐ NO
☐ YES



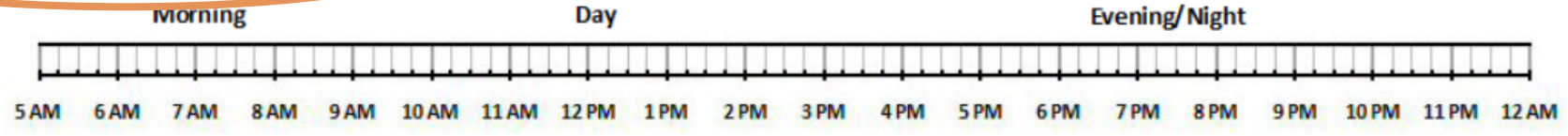
Watch TV: Did you watch TV yesterday? Include video or DVD watching.

☐ NO
☐ YES



Play Video Game or Computer Game: Did you play video or computer games yesterday?

☐ NO
☐ YES

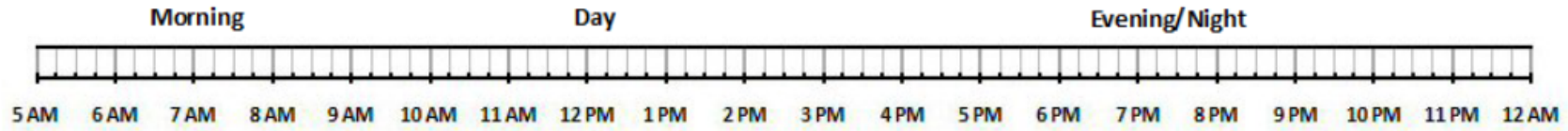


Who did you play the game with? ☐ myself ☐ someone in the house ☐ someone on line

What is (are) the name(s) of the game? _____

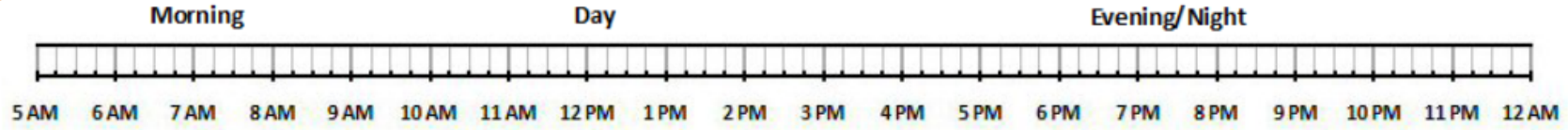
Other Non-Homework Related Computer Use: Did you spend time on the computer yesterday on other non-homework related activities such as emailing, internet surfing, and social networking?

☐ NO
☐ YES



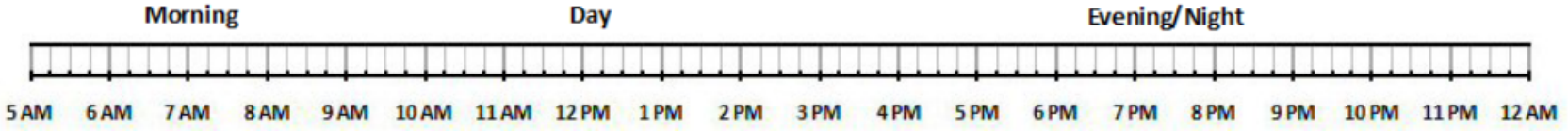
Phone Use: Did you spend time on the phone yesterday? Include talking and texting.

☐ NO
☐ YES



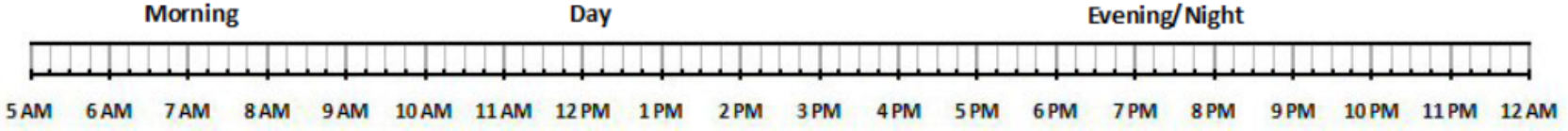
Sport: Did you play sports yesterday? For example, aerobics, gymnastics, track and field, baseball, softball, basketball, tennis, hockey, football, soccer, swimming, and choreographed dancing.

☐ NO
☐ YES



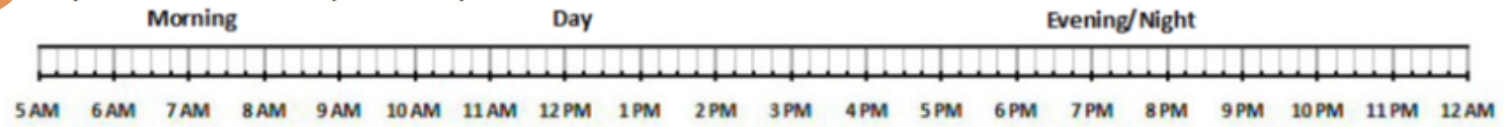
Play: Did you have active play time yesterday? For example, dodge ball, frisbee, climbing trees, trampoline, using playground equipment, rope jumping, playing with pets, playing with toys/dolls/action figures, wrestling with friends. Exclude gaming and sports.

☐ NO
☐ YES



Breakfast: Did you eat breakfast yesterday?

☐ NO
☐ YES



Did you have breakfast at home, at school or at a restaurant? ☐ Home ☐ School ☐ Restaurant

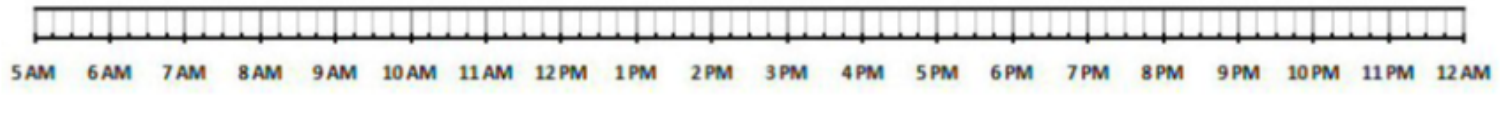
If you had breakfast at a restaurant, what is the name of the restaurant? _____

Did you eat/drink any of the following food items during breakfast yesterday? Mark all that apply.

- ☐ Soda; such as Coke or Sprite. (No diet sodas)
- ☐ Fruits; such as apple, bananas, oranges.
- ☐ Whole milk (No low fat or skim milk)
- ☐ Vegetables; such as carrots, tomatoes, corn.
- ☐ Cheese, dressing and/or butter
- ☐ Fried food; such as French fries or fried chicken
- ☐ Fruit juice; such as Kool-Aid, Hi-C, or Sunny D
- ☐ Cookies, ice cream, candy and/or potato chips

Lunch: Did you eat lunch yesterday?

☐ NO
☐ YES



Did you have lunch at home, at school or at a restaurant? ☐ Home ☐ School ☐ Restaurant

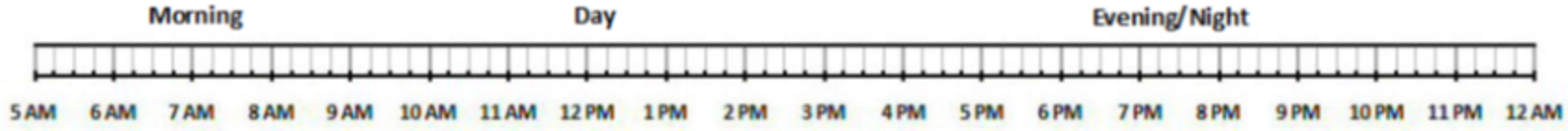
If you had lunch at a restaurant, what is the name of the restaurant? _____

Did you eat/drink any of the following food items during lunch yesterday? Mark all that apply.

- ☐ Soda; such as Coke or Sprite (No diet sodas)
- ☐ Fruits; such as apple, bananas, oranges
- ☐ Whole milk (No low fat or skim milk)
- ☐ Vegetables; such as carrots, tomatoes, corn
- ☐ Cheese, dressing and/or butter
- ☐ Fried food; such as French fries or fried chicken
- ☐ Fruit juice; such as Kool-Aid, Hi-C, or Sunny D
- ☐ Cookies, ice cream, candy and/or potato chips

Snacks: Did you eat any snacks yesterday? Including having drinks or food items such as soda, fruit drinks, potato chips, cookies, ice cream, and/or candy between meals.

☐ NO
☐ YES



Did you eat/drink any of the following food items during snacks yesterday? Mark all that apply.

- ☐ Soda; such as Coke or Sprite (No diet sodas)
- ☐ Fruits; such as apple, bananas, oranges
- ☐ Whole milk (No low fat or skim milk)
- ☐ Vegetables; such as carrots, tomatoes, corn
- ☐ Cheese, dressing and/or butter
- ☐ Fried food; such as French fries or fried chicken
- ☐ Fruit juice; such as Kool-Aid, Hi-C, or Sunny D
- ☐ Cookies, ice cream, candy and/or potato chips

Why did you have snack (s) during the day yesterday? Mark all that apply.

- ☐ I was hungry
- ☐ I was thirsty
- ☐ It was snack/meal time
- ☐ I was watching TV
- ☐ My friends were eating too
- ☐ My family was eating too
- ☐ I was bored and/or to pass time
- ☐ I was playing video games and/or using the computer

Who did you have snack (s) with yesterday? Mark all that apply.

- ☐ Myself
- ☐ Family
- ☐ Neighbors
- ☐ Friends from school
- ☐ Other friends

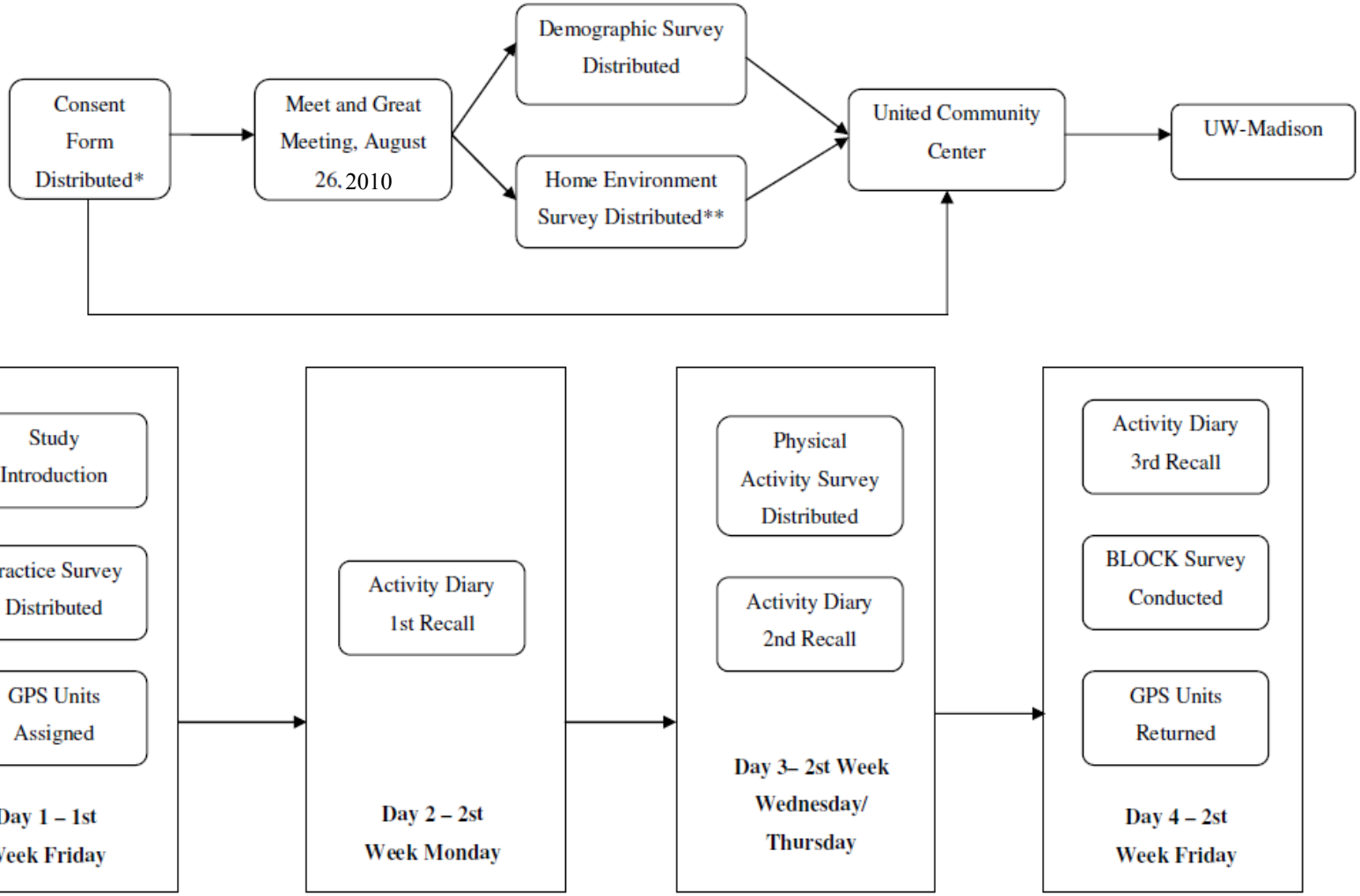
Yesterday did you spend more than 30 minutes on any other single activities that were not listed above? If so, please briefly describe these activities:

Deployment Considerations

- Children's understanding of time graphs
- Training
- 30 min a day
- Class participation
- Reliability
- Validity?

Activity Category	Type of Reliability Coefficients			
	Intraclass		Pearson	
	r	*P*	*r*	*P*
Sleep	0.913	0.000	0.920	0.000
Study	0.706	0.001	0.706	0.003
Non-active travel	0.801	0.000	0.830	0.000
Active travel	0.977	0.000	0.996	0.000
TV watching	0.857	0.000	0.858	0.000
Sport	0.950	0.001	0.952	0.001
Play	0.060	0.412	0.066	0.814
Meals	0.413	0.056	0.426	0.114

Overall Data Collection Process



Salient Sample Characteristics

	All	Boys	Girls
Sample Size	187	88	89
Age (years)	11.90 ± 1.37	11.99 ± 1.43	11.82 ± 1.33
BMI z-score	0.94 ± 0.94	1.01 ±0.98	0.88 ± 0.91
PACER z-score	0.36 ± 0.93	0.63 ± 0.97	0.11 ± 0.84**
PACER percentile categories			
Low fitness: < 33%	25 (15%)	6 (8%)	19 (22%)
Moderate fitness: ≥ 33% to <67%	69 (42%)	27 (34%)	42 (48%)
High fitness: ≥ 67%	72 (43%)	46 (58%)	26 (30%)
HOMA-IR [c]	0.54 ± 0.24	0.51 ± 0.28	0.56 ± 0.21

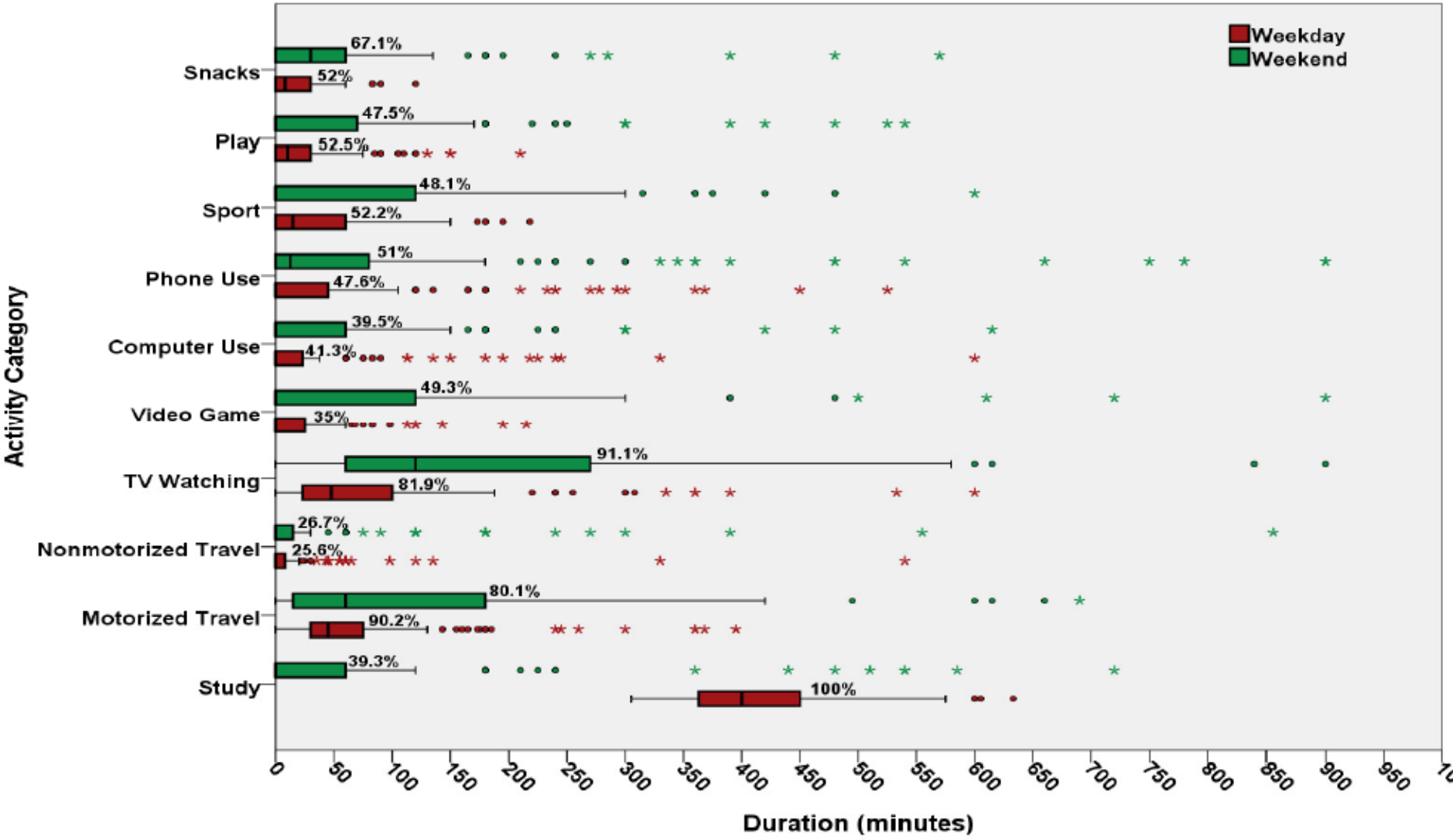
Salient Sample Characteristics

Parental Weight Status	
Father's BMI (kg/m^2)	29.0 ± 4.9
Healthy weight: BMI ≥ 18.5 to 24.9	9 (10%)
Overweight: BMI ≥ 25.0 to 29.9	55 (61%)
Obese: BMI ≥ 30.0	26 (29%)
Mother's BMI (kg/m^2)	28.0 ± 5.5
Healthy weight: BMI ≥ 18.5 to 24.9	39 (33%)
Overweight: BMI ≥ 25.0 to 29.9	42 (35%)
Obese: BMI ≥ 30.0	39 (32%)
Family Income ($/year)	
$0 to <23,000	56 (38%)
$23 to <35,000	41 (28%)
$35 to <50,000	27 (18%)
≥ $50,000	23 (16%)

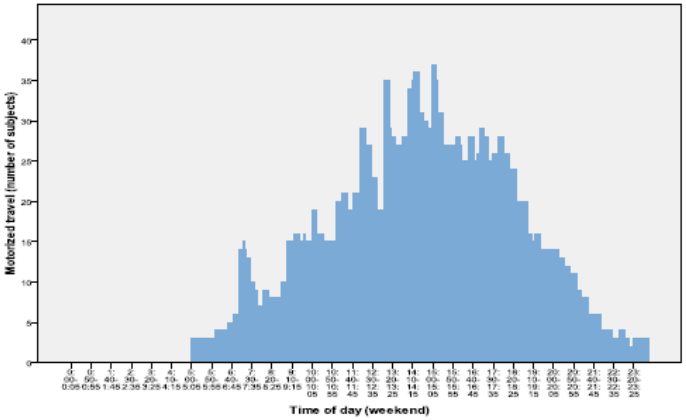
Salient Sample Characteristics

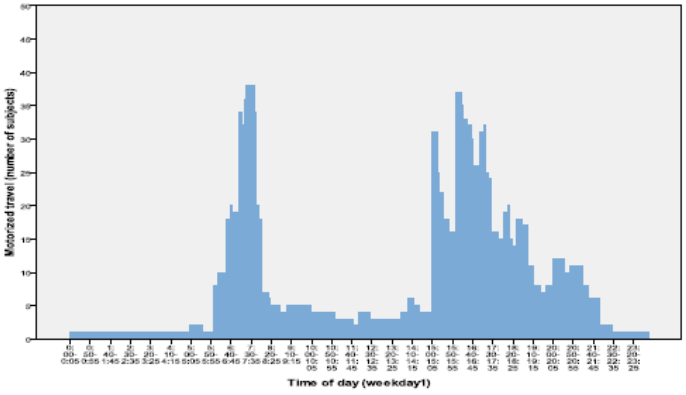
Reported PA areas and equipment available in the home	63 (41%)
Inside playroom/area	50 (32%)
Exercise room	129 (82%)
Outside nearby play-area/yard	136 (87%)
Bicycle, rollerblades/skates, skate board/scooter, jump rode, etc.	107 (69%)
Basketball, baseball, tennis, or other sports equipment	50 (32%)
Winter sports equipment (ice skates, sled, skis, snowboard, hockey stick)	
Reported parental PA (≥ 2 times per week)	85 (54%)
Exercising	57 (37%)
Heavy work	116 (75%)
Moderate housework	121 (79%)
Light cleaning	101 (66%)
Slow walking	10 (6%)
Relaxing exercise (i.e., Yoga or Pilates)	60 (39%)
PA with your child	

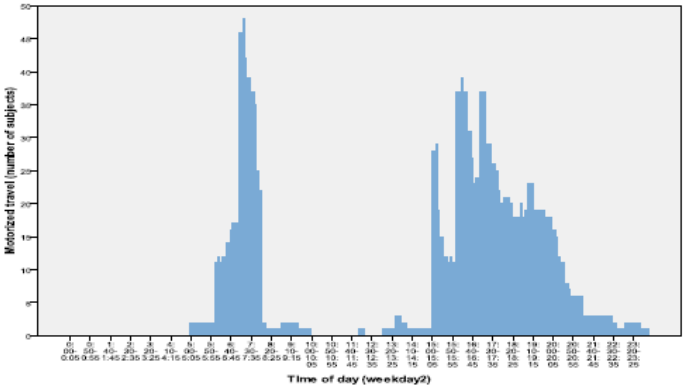
Findings on Time Use



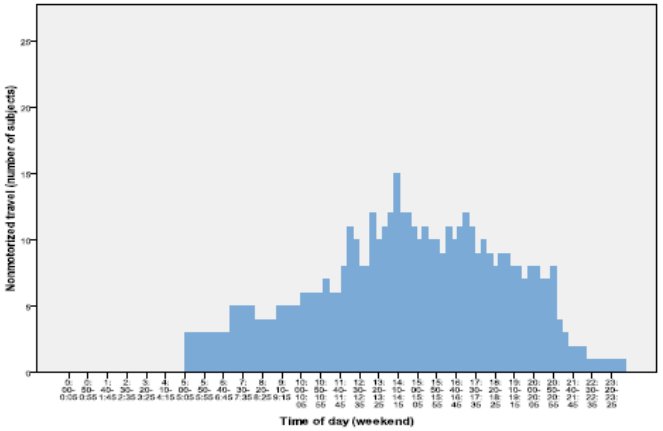
Motorized Travel

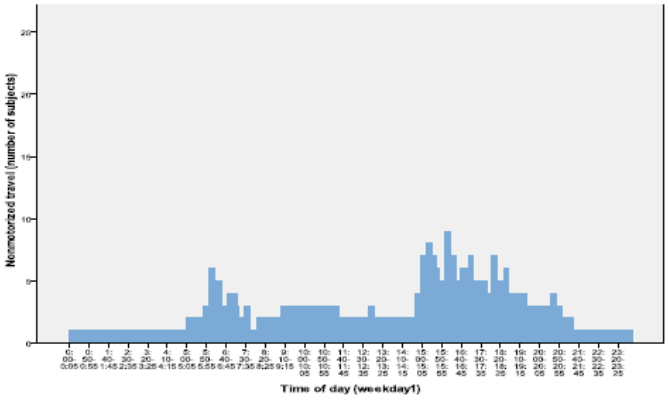


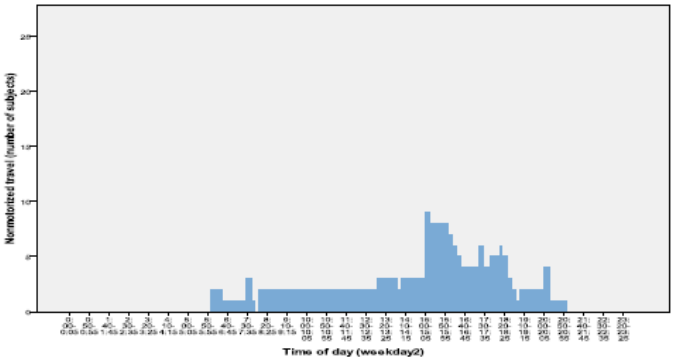




Non-Motorized Travel



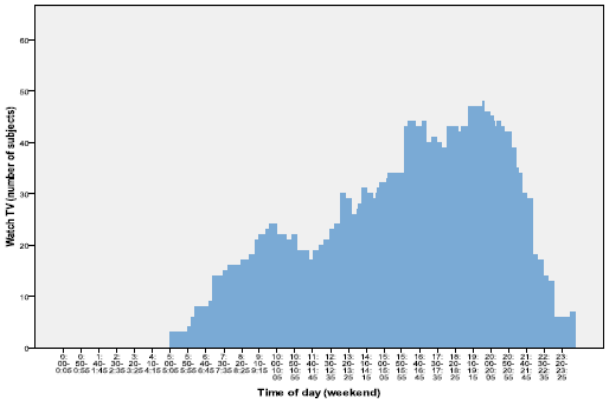


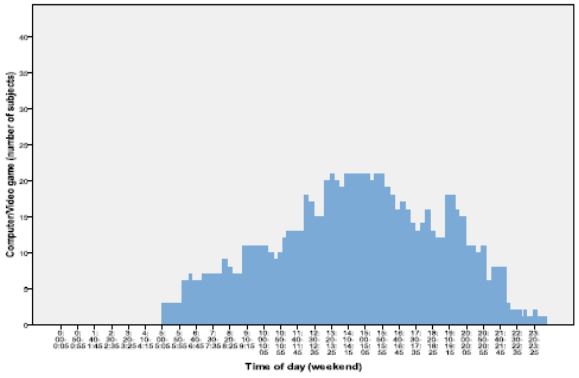


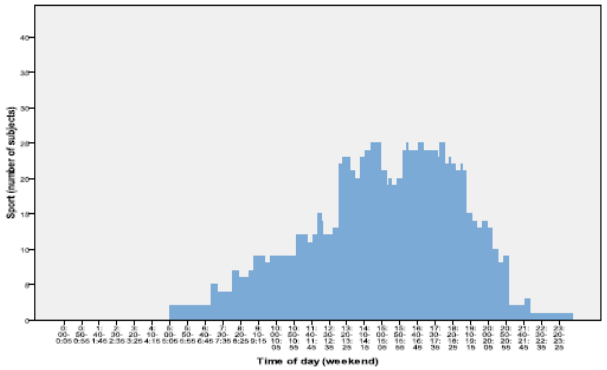
TV

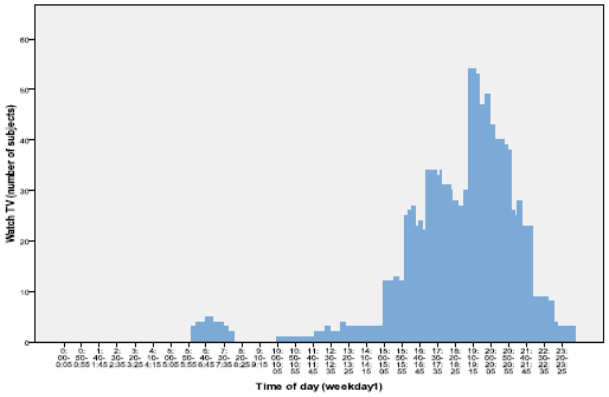
Comp/Video Game

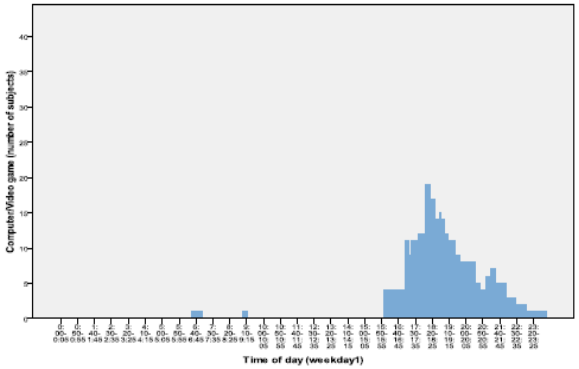
Sport

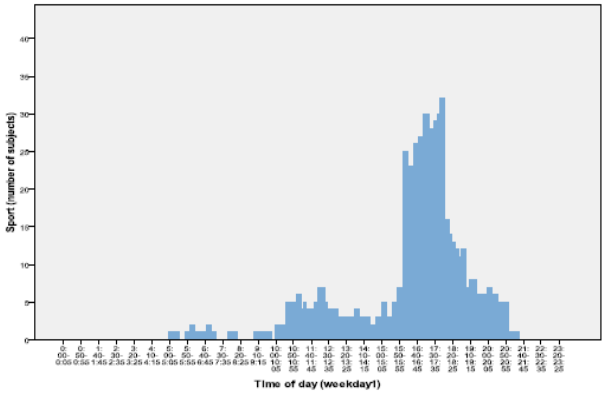


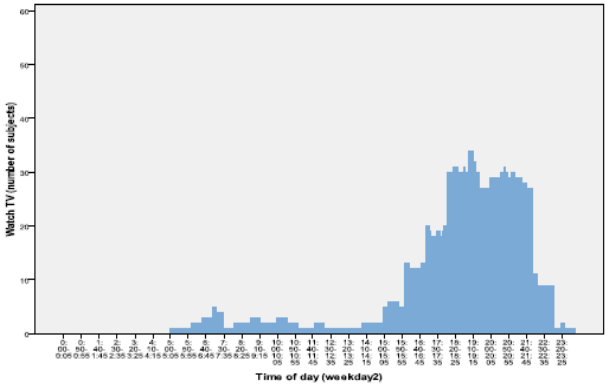


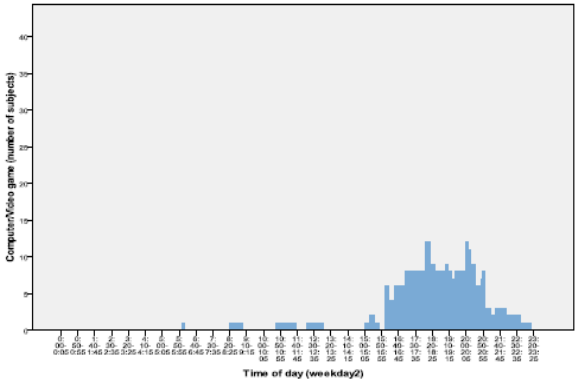


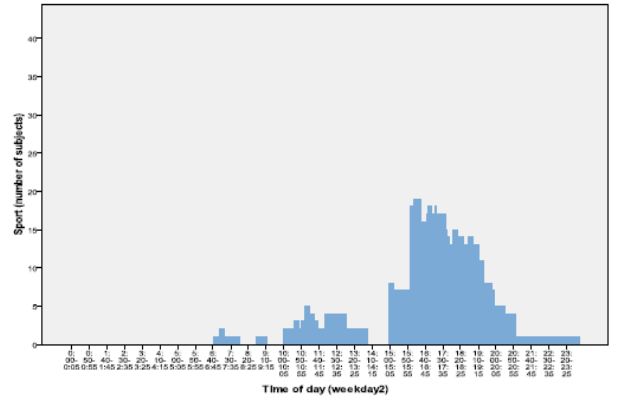




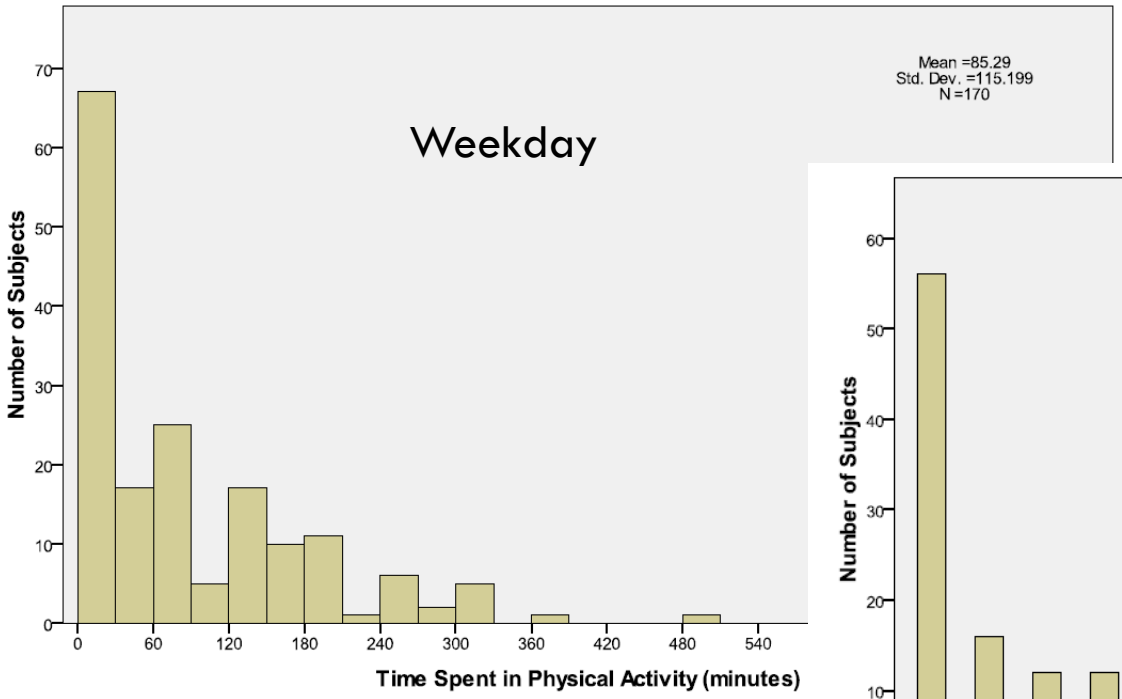


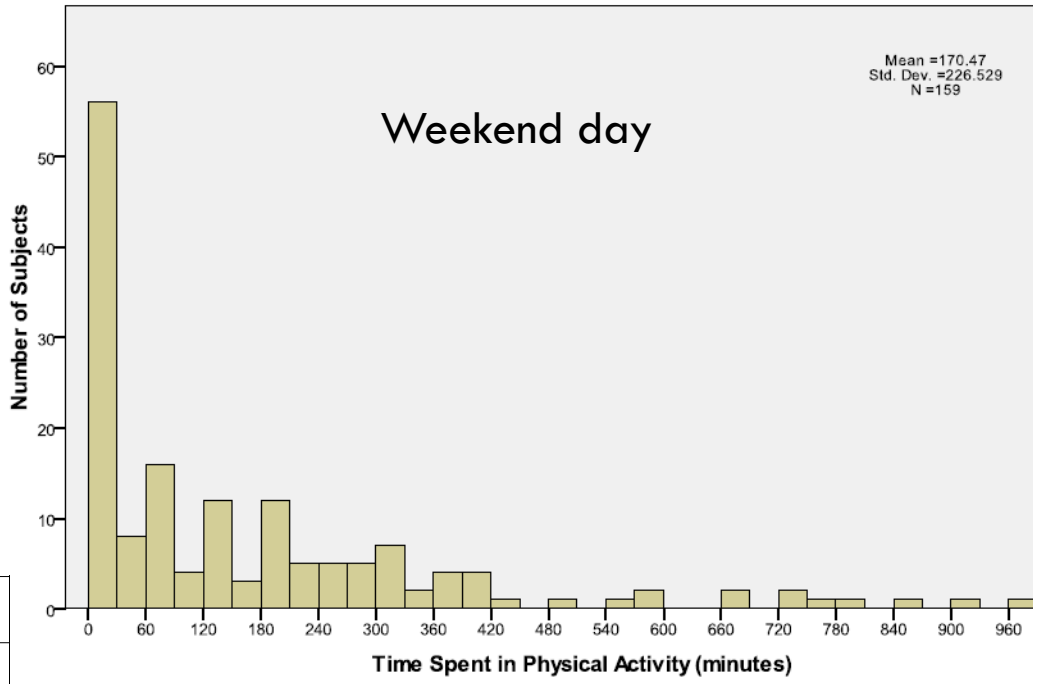






Total Time Spent in PA





Classification	Frequency	Valid Percent
Engaged in PA > 60 min for 3 days	19	14.1%
Engaged in PA > 60 min for 1 or 2 day(s)	83	61.5%
Not Engaged in PA > 60 min for 3 days	33	24.4%
Total Valid Subjects	135	100%

Other Findings

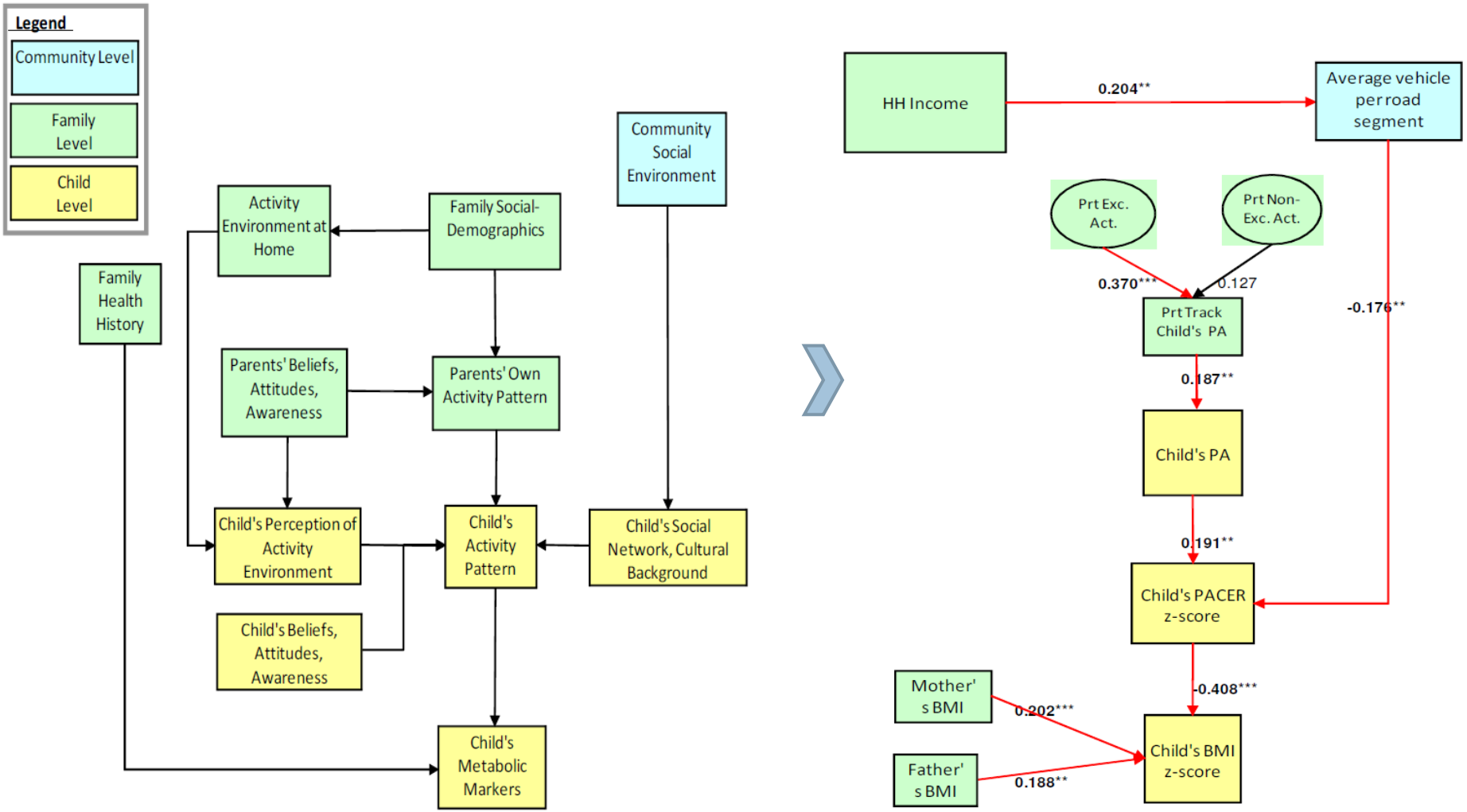
- Time use for Phone Use hard to recall
- Training is critical
- No pronounced gender difference in time use
- Multitasking behavior, e.g. snacking while watching TV or playing computer/video games

Correlation between Activity Types

	Sleep	Nap	Study	Motorized Travel	Active Travel	TV Watching	Video Game	Non-homework Computer Use	Phone	Sport	Play	Snacks	Meals
Sleep													
Napping													
Study													
Motorized Travel													
Active Travel		.196*		.248**									
TV Watching		.300**											
Video Game						.258**							
Non-homework Computer Use	-.170*					.180*	.229**						
Phone	-.233**							.220**					
Sport				.279**	.290**			.165*					
Play	.152*			.347**	.230**					.593**			
Snacks						.228**	.351**	.170*		.187*	.297**		
Meals			.194*	.363**				.198*			.248**	.261**	

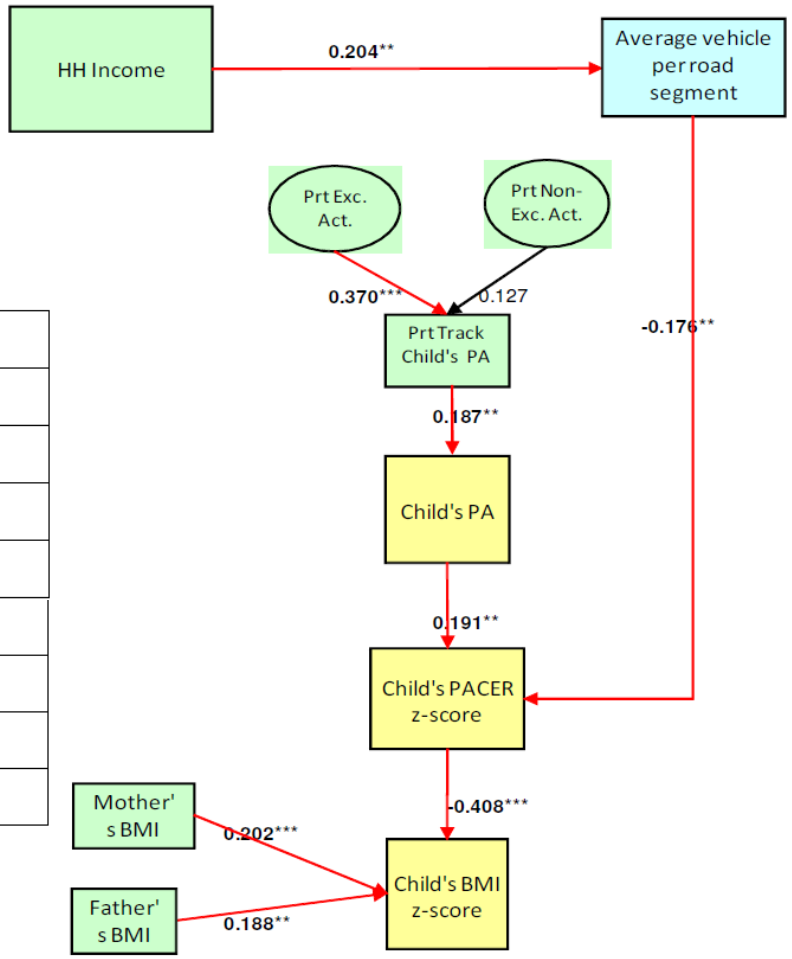
** $p < 0.01$, * $p < 0.05$

Structural Equation Modeling



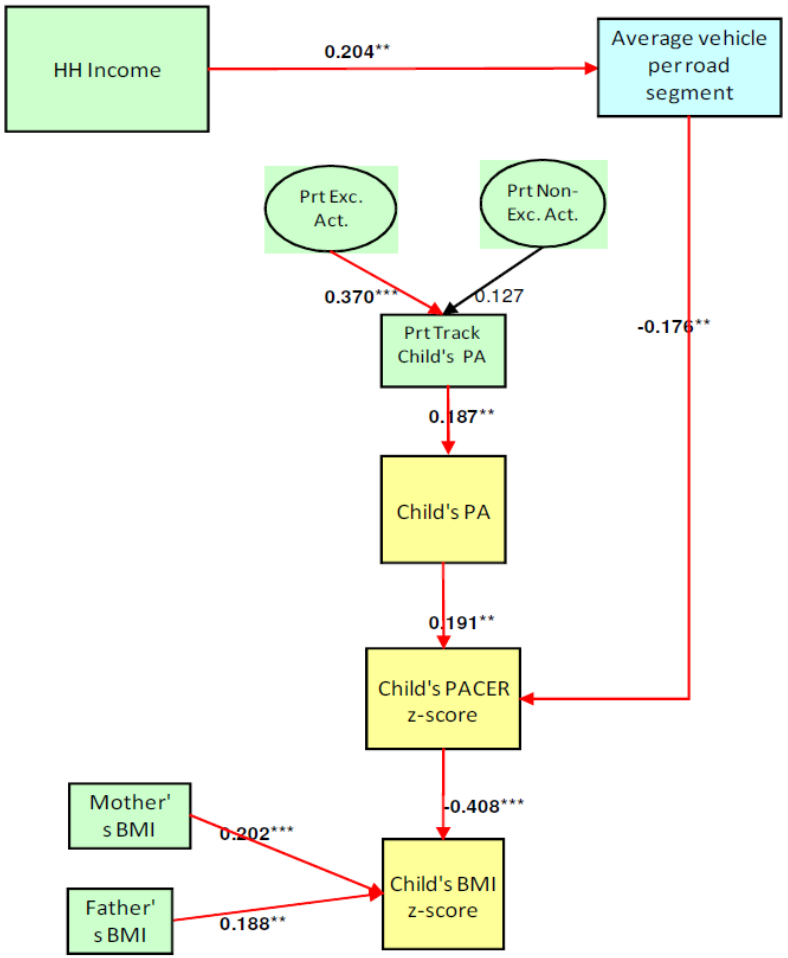
Structural Equation Modeling

Fit Measure	Value	p-Value
Chi-Square (d.f. = 66)	103.689	0.0021
Chi-Square ratio	1.571	
Tucker-Lewis index (TLI)	0.823	
Comparative fit index (CFI)	0.868	
RMSEA	0.055	0.000
RMSEA lower bound	0.033	
RMSEA upper bound	0.075	
BIC	8568.818	



Structural Equation Modeling

- Higher income family tend to reside in neighborhoods with busier traffic
- Children's fitness level negatively impacted by traffic density in neighborhood
- Active parents more likely to monitor their children's level of PA
- Parental monitoring has direct and positive impact on children's PA
- Children's BMI is impacted in part by their parents' BMI
- Relationship between child's PA participation and obesity indicator is mediated by child's fitness level



Summary

- GReAT is particularly useful for measuring and differentiating time use for various sedentary activities, which are typically not well captured by devices such as GPS loggers and accelerometers
- But not so great for capturing play, meals, and phone use
- Insight into the temporal context of how children organize their day is critical for effective formulation of interventions

Policy Recommendations

- Providing school based physical activity programs that appear fun and unintimidating to students after school hours and on the weekend

- Provide one-on-one counseling with high-risk students; use timeline graphs as a visual aide for students to reflect on their activity pattern and consider alternatives
- Encourage and support parental monitoring of children's activities at home

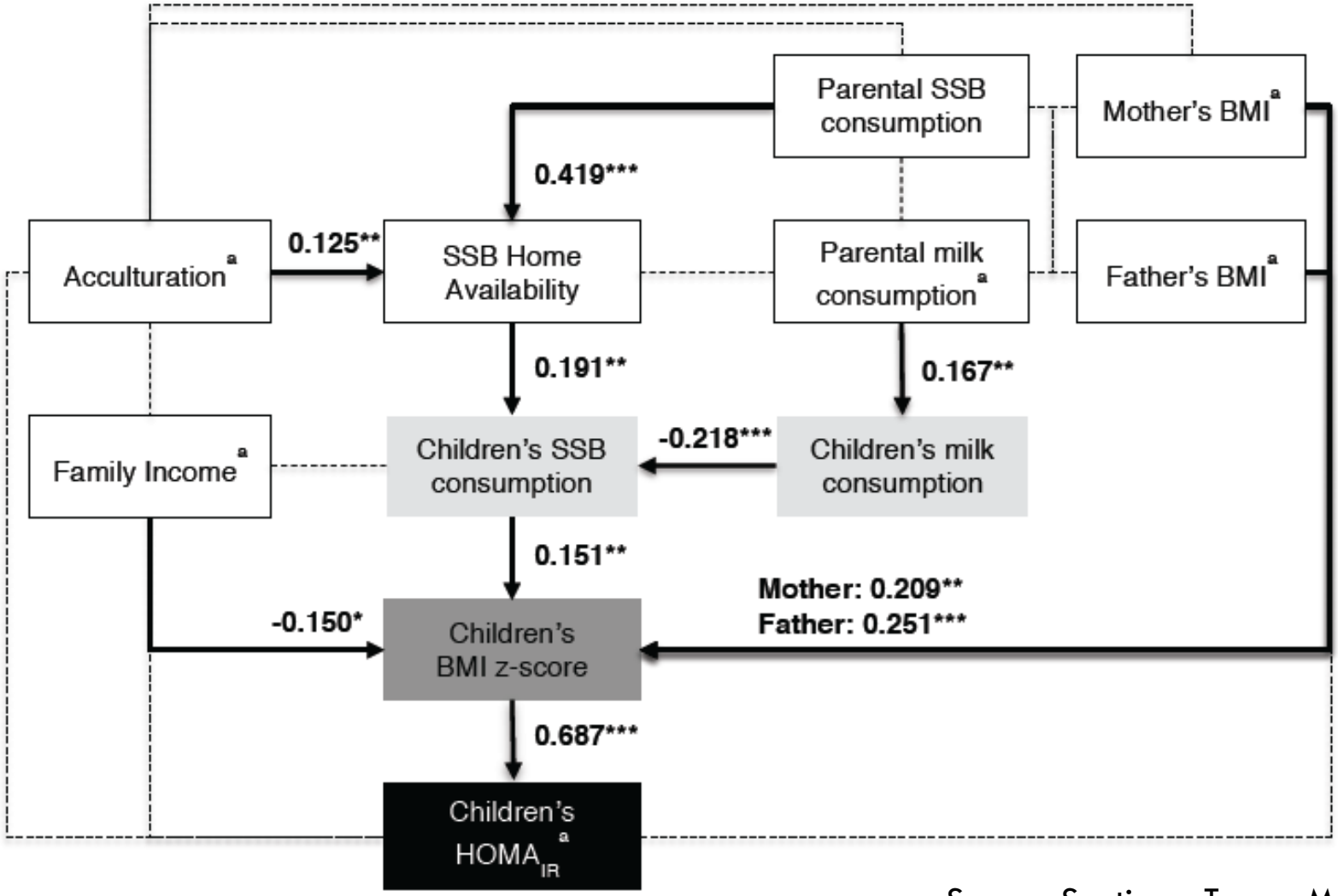
Directions for Further Research

- Verify validity of GReAT
- Larger sample size
- Better quantify individuals' energy balance
- Account for spatial correlation in SEM
- Time series data

Acknowledgement

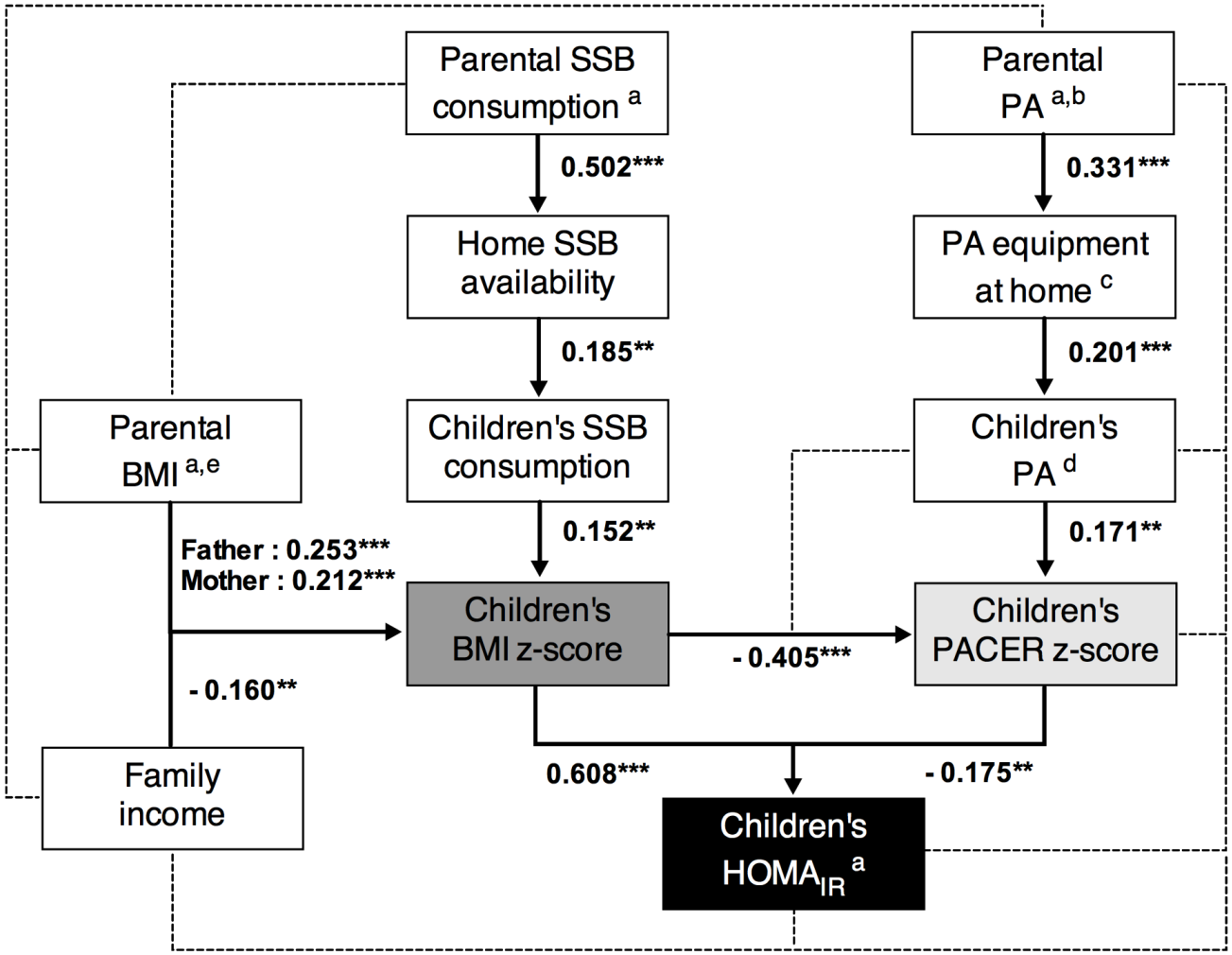
The community-engaged research project, Healthy Activities Partnership Program for Youth, is a partnership among staff from the Community Research Office and Bruce Guadalupe Community School at the United Community Center in Milwaukee, and researchers from the University of Wisconsin-Madison, who are members of the Wisconsin Prevention for Obesity and Diabetes (WIPOD) network. Also contributing to this study is the UW Collaborative Center for Health Equity, home to a NIH/NIMHD-funded Center of Excellence in Minority Health and Health Disparities (grant# 5 P60 MD 003428). Funding for this project was provided by the UW School of Medicine and Public Health from the Wisconsin Partnership Program, along with support from the UW Institute for Clinical and Translational Research, an NIH-funded Clinical and Translational Science Award (grant# 9U54TR000021).

SEM for Sugar-Sweetened Beverages (SSB) Consumption



Source: Santiago-Torres, M. (2014)

Familial correlates of Hispanic children's diet and PA in relation to metabolic health



Source: Santiago-Torres et al (2014)