SHARMA FELLOWSHIP HIGHLIGHT

2020-21 Fellow:
Fangyu Li, MS
Philip R. Nader, MD
Jennifer Orlet Fisher, PhD

Professor, Department of Social and Behavioral Sciences,
Associate Director, Center for Obesity Research and Education,
Temple University, College of Public Health
TAMING CHILDREN’S SWEET TOOTH:
A BIOPSYCHOSOCIAL APPROACH FOR
REDUCING ADDED SUGAR INTAKES
AMONG CHILDREN

Jennifer Orlet Fisher, PhD
Professor, Department of Social and Behavioral Sciences
Associate Director, Center for Obesity Research and Education

College of Public Health
Center for Obesity Research and Education
Obesity, %

- 2-5 y
- 6-11 y
- 12-19 y

1999-2002: 10.3
2003-2006: 15.8
2007-2010: 16
2011-2014: 20.9 *
2015-2018: 19.3 *

* Environmental Contributions to the Obesity Epidemic

Ogden et al., JAMA, 2020
Race/ethnicity:
- Hispanic: 25%
- Black: 22%
- White: 14%
- Asian: 11%

Household income:
- ≤130% FPL: 19%
- >130% to ≤350% FPL: 20%
- >350% FPL: 11%

HH education:
- High school or less: 22%
- Some college: 18%
- College: 10%

Hales et al. NCHS Data Brief, 2017
Ogden et al., MMWR, 2018
Why is added sugar a critical target for prevention?
“Strong evidence supports the association of added sugars with increased cardiovascular disease risk in children through increased energy intake, increased adiposity, and dyslipidemia.”

Vos et al., Circulation, 2016
Added sugar intake in US population
NHANES 2005-2016 (N = 44,075)
Added sugar intake among US adults
NHANES 2003-2004

**Men**
- ≤125% FPL: 21.4 Teaspoons per day
- >125% to ≤349% FPL: 20.1 Teaspoons per day
- >349% FPL: 18.4 Teaspoons per day

**Women**
- ≤125% FPL: 16.3 Teaspoons per day
- >125% to ≤349% FPL: 14.2 Teaspoons per day
- >349% FPL: 13.2 Teaspoons per day

*Adjusted for age, race/ethnicity, and education

Thompson et al., JAND, 2009
Nutrient content analysis of 384 foods

Ultra processed foods more energy-dense, less nutrient-dense and cheaper per calorie than unprocessed ($0.55 vs. $1.45 per 100 kcal)

Gupta, Front Nutr, 2019
US children 2-19 y
NHANES 2009-2014

- 65% of total energy
- 92% of energy from added sugars

Neri et al., Pediatric Obesity, 2019

Coefficient for linear term = 0.19 (95% CI 0.15 to 0.23). Wald test for linear term p < 0.0001. Wald test for all non-linear terms p = 0.21
Top 5 sources of added sugar vs. saturated fat

US adolescents NHANES 2011-2014

- Sugar-sweetened beverages (50%)
- Sweet baked goods (12%)
- Dairy desserts (5%)
- Pizza (10%)
- Sweet baked goods (8%)
- Candy (6%)
- Mixed dishes (8%)
- Milk (7%)
- Cereal (6%)
- Cheese (6%)

79% vs. 39%

Leme et al., Public Health Nutrition, 2018
Are children more vulnerable?
Taste preferences are innate

Preference

Rejection

Umami
Sweet
Sour
Bitter!

Steiner, Adv Child Dev Behav, 1979
Beauchamp, Pearson, Phys Behav, 1991
Rosenstein, Oster, Child Dev, 1998
Ventura, Mennella, Curr Opin Clin Nutr Metab Care, 2011
Mennela, Bobowski, Phys Behav, 2016
Children live in a different sensory world than adults

Children show heightened sensitivity for some bitters

Children with bitter-sensitive TAS2R38 genotypes were more sensitive to bitter taste of PROP than adults

Children have higher preferences for sweetness

Children preferred higher concentrations of sucrose, fructose, and NNS sucralose compared to adults

Beauchamp 1985; Beauchamp 1990; Liem, 2003; Mennella, 2005; Coldwell, 2009; Mennella, 2010; Mennella, 2011; Mennella, 2014; Liem, 2017
Daily added sugar intake in US population

NHANES 2005-2016 (N = 44075)
Daily added sugar intake in US population
NHANES 2005-2016 (N = 44075)
The sensation of sweetness is context dependent and children can acquire meaning through associative learning and familiarization

- Children fed sugar water as infants preferred a more concentrated sugar solution at 2 y and throughout later childhood (6–10 y)

- Children (4-7 y) whose mothers reported adding sugar to their foods on a routine basis were significantly more likely to prefer apple juices with added sugar and cereals with higher sugar contents

- Children (6-11y) exposed to sweet orangeade for 9 days increased preference for sweet orangeade

- Children (4-5 y) who were repeatedly exposed to sweetened tofu (an unfamiliar food) preferred that version over salted and plain versions

Beauchamp 1982; Beauchamp, 1984; Sullivan, 1990; Liem, 20002; Liem, 2004; Park, 2014; Mennella, 2015; Mennella 2016
Family as a critical context for learning about sugar.
Snacking among US children 2-19 y 2018-2018

Frequency
~75% children
≥ 2 snacks/d

Energy
24% daily energy
36% total sugars

Quality
55% energy from high SoFAS foods

Adapted from: Piernas, Popkin, Health Aff, 2010
Dunford, Popkin, Pediatric Obesity, 2017
What We Eat in America, NHANES 2017-2018
Why does your child get snacks?

59 Hispanic, Black and white parents of preschoolers with low incomes

<table>
<thead>
<tr>
<th>Reason</th>
<th># of parents endorsing (n=59)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child asks-wants it-craves it</td>
<td>32</td>
</tr>
<tr>
<td>Reward for good behavior</td>
<td>25</td>
</tr>
<tr>
<td>Specific for current hunger or thirst</td>
<td>23</td>
</tr>
<tr>
<td>“Hold over” to prevent hunger or thirst</td>
<td>23</td>
</tr>
<tr>
<td>Bribe or to stop or prevent bad behavior</td>
<td>15</td>
</tr>
<tr>
<td>Part of the daily routine</td>
<td>14</td>
</tr>
<tr>
<td>To promote health</td>
<td>13</td>
</tr>
<tr>
<td>Part of playing-social activity</td>
<td>13</td>
</tr>
<tr>
<td>Special event/ occasion/ celebration</td>
<td>11</td>
</tr>
<tr>
<td>Treat for no specific reason</td>
<td>8</td>
</tr>
</tbody>
</table>

Blake, Younginer, Fisher, et al., unpublished
Non-nutritive > nutritive, *p < .001

Average SoFAS Kcal/100 grams

Health
Routine
Hunger/Thirst
Holdover
Distraction/Bribe
Playing
Child Asks
Out
Reward
Special Occasion
Treat

Blake, Younginer, Fisher, et al., unpublished
# Odds of meeting obesity dietary recommendations

271 children, 2-12 y with low-income backgrounds

<table>
<thead>
<tr>
<th>Nutritive reasons</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To help child grow</td>
<td>1.05 (0.92, 1.19)</td>
</tr>
<tr>
<td>Because child is hungry</td>
<td>0.88 (0.77, 1.01)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-nutritive reasons</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reward for good behavior</td>
<td>0.83 (0.70, 0.99)*</td>
</tr>
<tr>
<td>To keep child quiet</td>
<td>0.89 (0.73, 1.08)</td>
</tr>
<tr>
<td>Celebrate event or holiday</td>
<td>0.72 (0.52, 0.99)*</td>
</tr>
<tr>
<td>Celebrate child's achievements</td>
<td>0.82 (0.68, 0.98)*</td>
</tr>
</tbody>
</table>

* P < 0.05, adjusted for child race, child age, child sex, child BMI z-score, parent BMI

Blaine, Fisher, Taveras et al., Nutrients, 2015
How can parenting play a supportive role in taming children’s sweet tooth?
Styles

Reflect the emotional climate and broader context within which practices are expressed

vs. Practices

Goal oriented behaviors (e.g. eat vegetables) that are thought to be more amenable to change than styles
Indulgent

Low demandingness, high responsiveness

- Fruit, juice, vegetables, whole grains, and dairy
- Energy-dense snacks, added sugar
- Overall diet quality
- Larger self-served portion sizes

Authoritative

High demandingness, high responsiveness

- Fruit, juice, vegetables, whole grains, and dairy
- Energy-dense snacks, added sugar
- Overall diet quality
- Larger self-served portion sizes

Patrick et al., 2005; Hoerr, IJBNPA, 2009; Hennessy et al., 2012; Fisher et al., Int J Obes, 2013; Tovar et al., Appetite, 2015; Lopez et al., Appetite, 2018; Ip et al., JAND, 2018; Hughes & Power, APA Handbook of Family Psychology, 2018
Healthy Eating Index Scores of foods served and consumed by children at dinner meals

145 Hispanic and Black families of preschoolers with low incomes

<table>
<thead>
<tr>
<th></th>
<th>Served</th>
<th>Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authoritative</td>
<td>47.5 ± 9.9</td>
<td>47.6 ± 6.8</td>
</tr>
<tr>
<td>Authoritarian</td>
<td>43.6 ± 8.1</td>
<td>41.5 ± 6.2</td>
</tr>
<tr>
<td>Indulgent</td>
<td>44.7 ± 7.0</td>
<td>43.6 ± 6.4</td>
</tr>
<tr>
<td>Uninvolved</td>
<td>41.2 ± 8.1</td>
<td>41.7 ± 7.8</td>
</tr>
</tbody>
</table>

Arlinghaus et al., AJCN, 2018
Longitudinal study of 187 Hispanic preschoolers in Head Start

- Child BMIz Age 4-5 y (n=187) vs. Indulgent Feeding Style
  - 0.28* from Child BMIz to Indulgent Feeding Style
  - 0.35* from Indulgent Feeding Style to Child BMIz

- Child BMIz Age 7-8 y (n=130) vs. Indulgent Feeding Style
  - 0.09* from Child BMIz to Indulgent Feeding Style
  - 0.79** from Indulgent Feeding Style to Child BMIz

Hughes, Power, O’Conner, Fisher, Micheli, Papaioannou (under review)
General Parenting Style and Child Weight

Over 800 1st grade children studied at 10 sites across the US

*Adjusted for income/needs ratio and race

Rhee et al., Pediatrics, 2006
Authoritative food parenting practices
Systematic review of 88 studies of children < 18 y

**Structure**
- Availability
- Modeling
  - Rules and setting limits
  - Monitoring
  - Meal and snack routines

**Autonomy Support**
- Praise
- Active guidance
- Child involvement
- Encouragement

Sugar sweetened beverages and salty snacks

Yee, Lwin, Ho, IJBNPA, 2017
Interventions to reduce consumption of sugar-sweetened beverages or increase water intake: evidence from a systematic review and meta-analysis

23 studies of children (n=10,964)
• Interventions reduced SSBs by 76 mL d⁻¹ (~2.5 fl oz)
• Medium effect size: −0.48
• Home-based interventions more effective than school
  • 1 of 9 home-based studies addressed parenting

Vargas-Garcia et al., Obesity Reviews, 2017
12 week group-based behavioral RCT (FFF vs. no treatment control) with mothers of preschoolers with low incomes to reduce solid fats and added sugars (SOFAS)

**Structure**
- Routines
- Limit setting
- Availability
- Child portion sizes

**Autonomy Support**
- Effective praise
- Responsiveness to cues
- Modeling

**Behavioral Change Techniques**
- Goal setting
- Problem solving
- Self-monitoring

Focus on SSB, Snacks
- SSB, dessert, candy, chips vs Water, milk, FV, pretzels, yogurt

Fisher, Serrano, Foster et al., IJBNPA, 2019
FFF decreased children’s intake of solid fats and added sugars and increased in maternal authoritative feeding practices (n=119).

Adjusting for baseline daily SOFAS intake; *** p<0.001

Post-intervention

Fisher, Serrano, Foster et al., IJBNPA, 2019
Taming children’s sweet tooth: priorities for family-based prevention
1. Aligning prevention with parental aspirations and challenges
Building relationships at the table

“There’s nothing to me more important than sitting down and having time with your family. So many things you got to fight with out in the world that you shouldn’t have to [fight] inside your home. I think it helps when you create a relationship, and when you create a relationship within your own house, it helps you build outside of it.”

Teaching life lessons

“It’s not hard for me to say no because sometimes, you know, what’s good to you is not good for you. So I’m looking out for their well-being by saying no. So you might not like me right now…but you’ll love me later”.

Preventing hyperactivity and tooth decay

“…he had to get his teeth pulled out at the age of three… And my other two little ones, I was like no, cannot have that done, so that’s why I don’t give them candy.”

Herman et al., IJBNPA, 2012
Malhotra et al, JAND, 2013
FFF formative research: focus groups of mothers of preschoolers with low-income backgrounds

<table>
<thead>
<tr>
<th>Snacks involve less prep, balance, sustenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “You heat up a meal and a snack you just take out of the wrapper”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Snacks and meals are distinct</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “Well, I’m a snack person, I’m not too big on food.”</td>
</tr>
<tr>
<td>• “He’s real skinny…and he don’t like to eat - all he like is snacks and cereal.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moms like snacks too</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “But my thing is snacks, so I can’t keep snacks cause I know I’ll wanna eat a honey bun and I’ll wanna eat some cookies, then I’ll want some ice cream, then I’ll think about the chips. And I’m like oh, no, this is out of control.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Snacks help manage children’s behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “Sometimes a snack do help you out…Like if you doin’ something and they just like naggin’ or won’t be still, sometimes you can just like, sit ‘em down with a snack.”</td>
</tr>
</tbody>
</table>

Fisher, Wright, Herman et al., Appetite, 2015
Semi-structured interviews with parents (n = 40) of preschoolers

**Structure and Autonomy Support**
- Limit setting
- Schedules/routines
- Monitoring
- Reasoning
- Encouragement
- Child involvement

**Momentary influences**
- Fatigue/stress (70%)
- Limited time (65%)
- Child mood (47%)
- Activities/special events (25%)
- Schedule changes (22%)

**Indulgence and Coercive Control**
- Restriction
- Pressure to eat
- Bribes/threats
- Food to manage behavior

Loth et al., Appetite, 2018
Fragile Families & Child Wellbeing Study
~5,000 children born in 20 U.S. cities between 1998-2000

Age 3

Economic hardship

- Average (0.20***)
- Linear (0.17*)
- Quadratic (0.20*)

Age 9

Parent stress

- 0.13***

Age 9

Child consumption of high SFAS foods

Controlling for race and education

Schuler et al., Public Health Nutrition, 2020
**FFF authoritative food parenting intervention**

12 week group-based behavioral RCT (FFF vs. no treatment control) with 119 mothers of preschoolers with low incomes to reduce solid fats and added sugars (SOFAS)

### Structure
- Routines
- Limit setting
- Availability
- Child portion sizes

### Autonomy Support
- Effective praise
- Responsiveness to cues
- Modeling

### Focus on Snacks
- SSB, dessert, candy, chips vs Water, milk, FV, pretzels, yogurt

<table>
<thead>
<tr>
<th>Weekly Topic</th>
<th>FFF prevention goals</th>
<th>Parenting goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat with your child</td>
<td>Better nutritional outcomes</td>
<td>Building relationships, being responsive</td>
</tr>
<tr>
<td>Limiting is loving</td>
<td>Reduce solid fats and added sugars</td>
<td>Life lessons, saying no is loving</td>
</tr>
<tr>
<td>Start small</td>
<td>Age appropriate portion sizes</td>
<td>Reduce waste</td>
</tr>
<tr>
<td>Scheduled snacks</td>
<td>Reduce grazing</td>
<td>Reduce nagging, building relationships (mini meals)</td>
</tr>
<tr>
<td>Water breaks</td>
<td>Hydration, reduce solid fats and added sugars</td>
<td>Reduce cavities</td>
</tr>
<tr>
<td>Fewer sweets</td>
<td>Reduce solid fats and added sugars</td>
<td>Life lessons, preventing tooth decay</td>
</tr>
</tbody>
</table>

Fisher, Serrano, Foster et al., IJBNPA, 2019
2. Approach added sugar within a broader context of development

Black, Gove, Merseth. Platforms to Reach Children in Early Childhood, 2017
INSIGHT Obesity Prevention Trial
Responsiveness in multiple behavioral domains

**Sleep**
- Sleep recommendation: total hours
- Consistent bedtime routines
- Drowsy but awake
- Bedtime between 7-8pm
- Sleep disruptions (e.g., milestones, fears, separation anxiety)
- Opportunity to self soothe

**Feeding**
- Bottle feeding tips
- Identifying hunger & fullness cues
- Repeated exposure
- Shared responsibility of feeding
- Age appropriate foods
- Portion size
- Mealtime routines

**Emotional/Social Regulation**
- Baby’s temperament
- Alternatives to food to soothe
- Positive reinforcement
- Emotion coaching
- Routines/expectations to reduce temper tantrums

**Interactive Play**
- Tummy time tips
- Activity, game and toy suggestions
- Spend time outdoors
- Limit restrictive devices
- AAP screen time recommendations
- Motor, social, cognitive & language developmental milestones

Paul IM et al. *JAMA*, 2018
INSIGHT

**INTERVENTION**

279 Mother-child pairs received intervention

140  Responsive parenting education

139  Home safety education (control)

Full-term singleton infants born to primiparous mothers

**BMI z-score at 3 years**

![Distribution of BMI z score at age 3 years](chart.png)

Mean BMI z score at age 3 years

- Responsive parenting: **-0.13**
- Home safety: **0.15**

Absolute between-group difference: **-0.28** (95% CI, -0.53 to -0.01)

Paul IM et al. *JAMA*, 2018
3. Address individual differences in children’s eating behaviors

**Food avoidance**
- Food fussiness
- Food neophobia
- Picky eating
- Satiety responsiveness
- Slowness in eating
- Emotional undereating

**Food approach**
- Enjoyment of food
- Food responsiveness
- Relative reinforcing value of foods
- Emotional overeating
- Eating in the absence of hunger
- Loss of control eating
- Faster eating rate
- Larger bite size

French, Epstein, Jeffery, Blundell, Wardle, Appetite, 2012
Carnell, Benson, Pryor, Driggin, Phys Behav, 2013
Fogel, Goh, Fries et al., Phys Behav, 2017
Fogel, Fries, McCrickerd et al., Appetite, 2018
100 Black children seen at dinner in 4 portion size conditions
34 children with obesity, 66 children with normal weight

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Weight status</th>
<th>Satiety responsiveness</th>
<th>Food responsiveness</th>
<th>Enjoyment of food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight status</td>
<td>ns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satiety responsiveness</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food responsiveness</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment of food</td>
<td>ns</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mooreville, Davey, Orloski et al, Obesity, 2015
Individual differences influence the way children interact with and are influenced by their environments

- Children’s eating behaviors
- Social and dietary environment
- Dietary and weight outcomes

• Home, childcare, school
• Food parenting, caregivers, peers

“Informing parents …may reduce any feeling of “blame” and empower parents to implement intervention recommendations”

Miller, Curr Nutr Rep. 2018
Conclusions

• High levels of added sugar consumption among children pose a threat to health and reflect both innate and learned influences.

• Authoritative approaches that provide structure and a healthful model of eating are important dimensions of food parenting for added sugar intake, particularly around snacking.

• Priorities for family-based approaches:
  • Understand contextual influences and parental aspirations
  • Address added sugar broader context of development
  • Highlight individual differences among children
Thank you!

Questions?

COLLEGE OF PUBLIC HEALTH
Center for Obesity Research and Education