Obesity Prevention During Infancy

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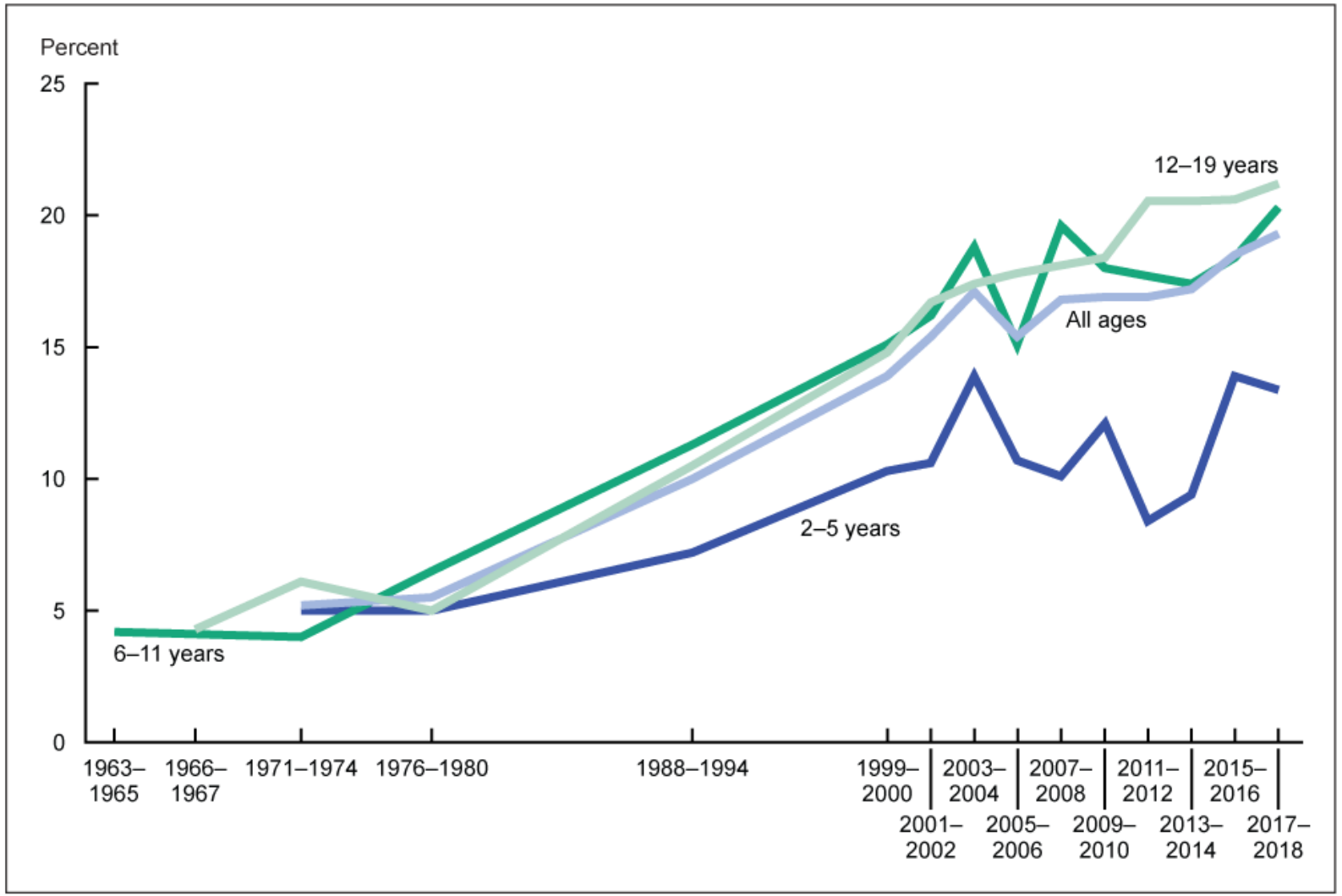
Department of Pediatrics

Children's Mercy Kansas City

- Approximately 42.4% of adults and 19.3% of children (ages 2-19) are obese.
- During the pandemic, the national rate of obesity among kids ages 2-19 increased to 22.4% in 2020.

Sources: Centers for Disease Control and Prevention, 2020; Harvard School of Public Health, 2020; State of Childhood Obesity, 2020

Trends in obesity among children and adolescents aged 2-19 years, by age: United States, 1963-1965 through 2017-2018



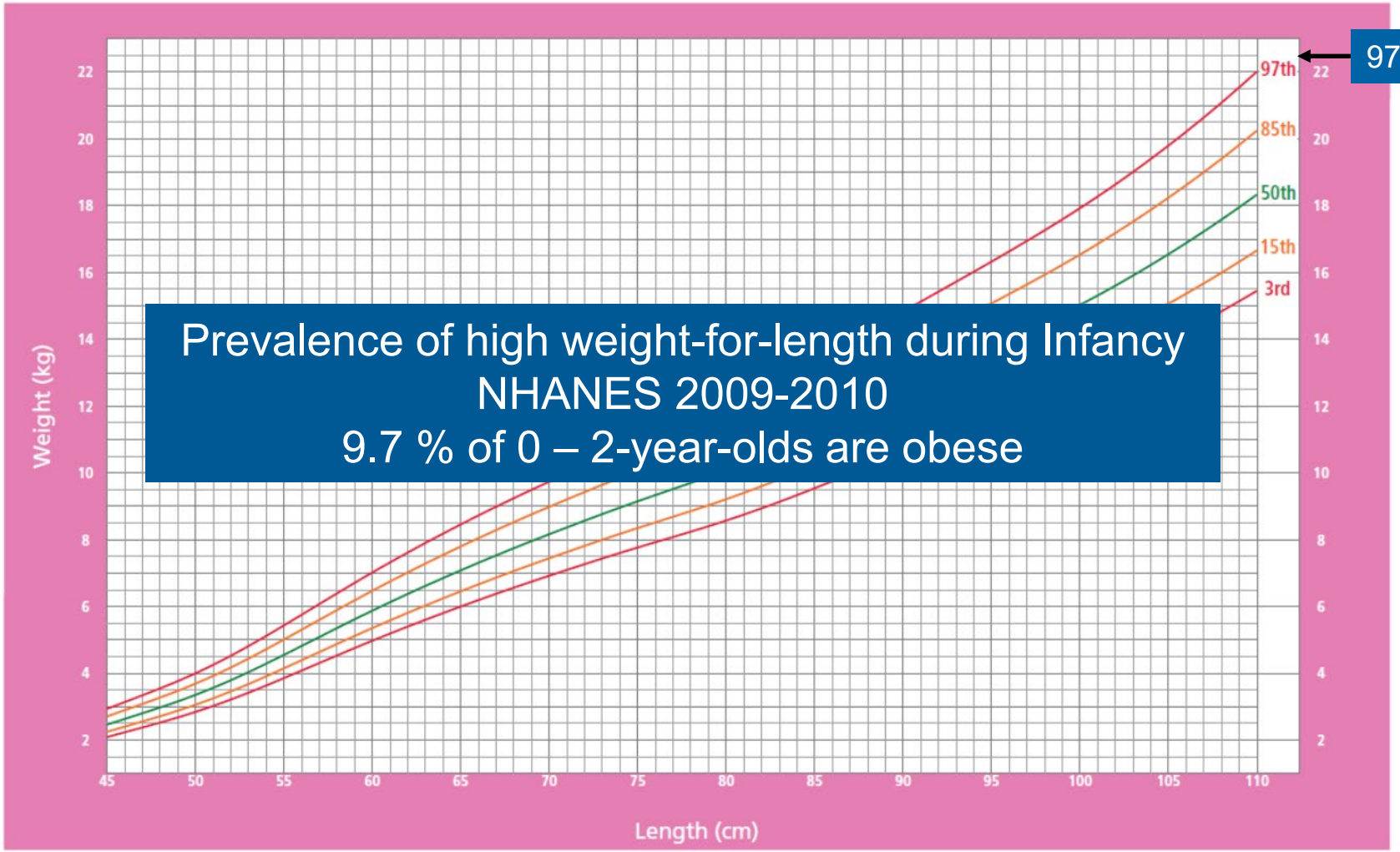
NOTE: Obesity is body mass index (BMI) at or above the 95th percentile from the sex-specific BMI-for-age 2000 CDC Growth Charts.
SOURCES: National Center for Health Statistics, National Health Examination Surveys II (ages 6–11), III (ages 12–17); and National Health and Nutrition Examination Surveys (NHANES) I–III, and NHANES 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, 2011–2012, 2013–2014, 2015–2016, and 2017–2018.


Newsweek
When I Grow Up, I'm Going to Weigh 300 Lbs.
Help!
MELIN
GATES'S BIRTH
CONTROL
BOMBSHELL
BILL MAHER
REMEMBERS
JOHNNY
CARSON
THE RAW
COURAGE OF
CHINA'S
BLIND
FUGITIVE

Weight-for-length GIRLS

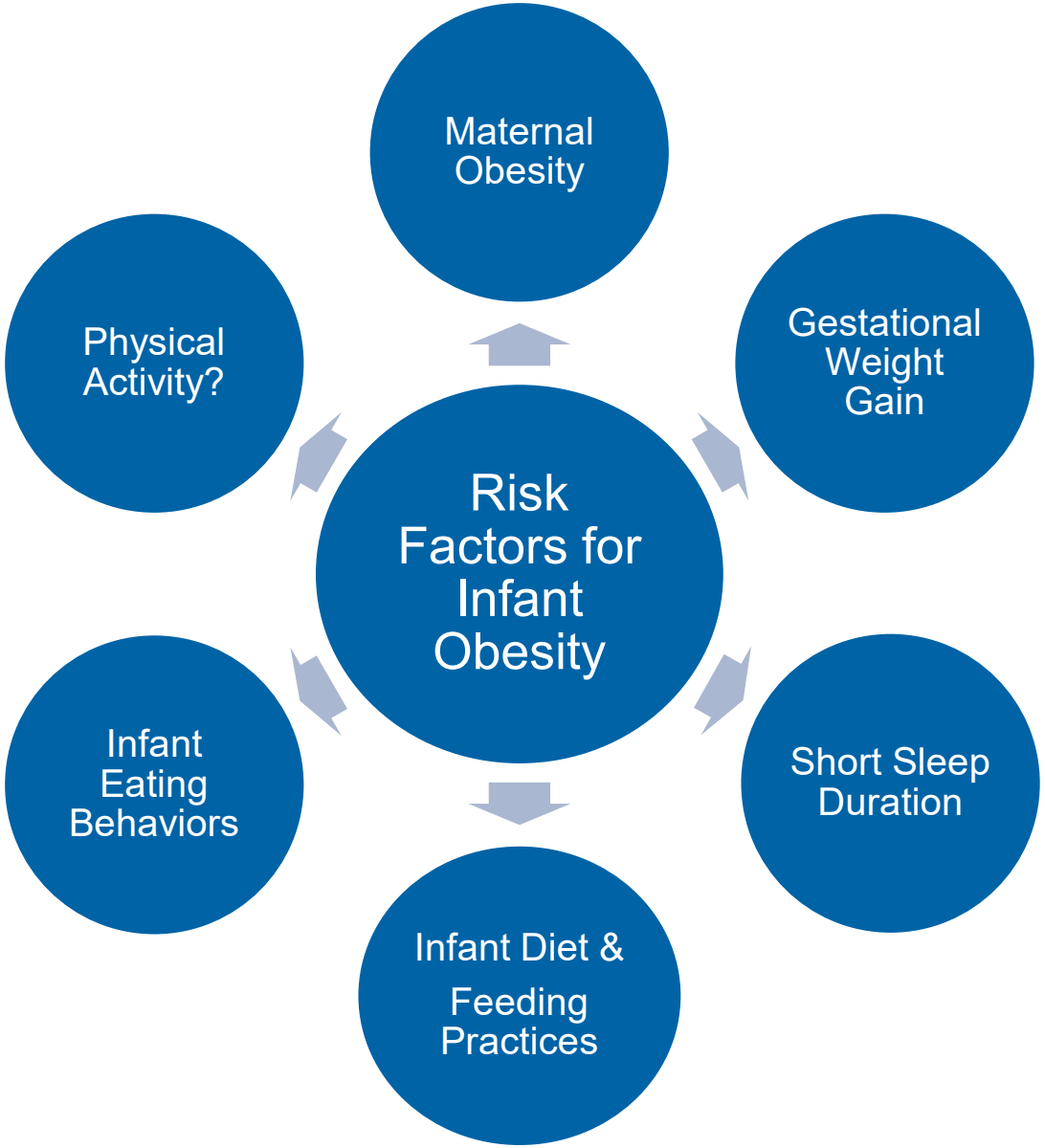
Birth to 2 years (percentiles)

World Health Organization



Prevalence of high weight-for-length during Infancy
NHANES 2009-2010
9.7 % of 0 – 2-year-olds are obese

WHO Child Growth Standards


Maternal Obesity
Gestational Weight Gain
Short Sleep Duration
Infant Diet & Feeding Practices
Infant Eating Behaviors
Physical Activity?
Risk Factors for Infant Obesity

Infant Eating Behaviors

Infant Diet & Feeding Practices

Motivation to eat/ food reinforcement

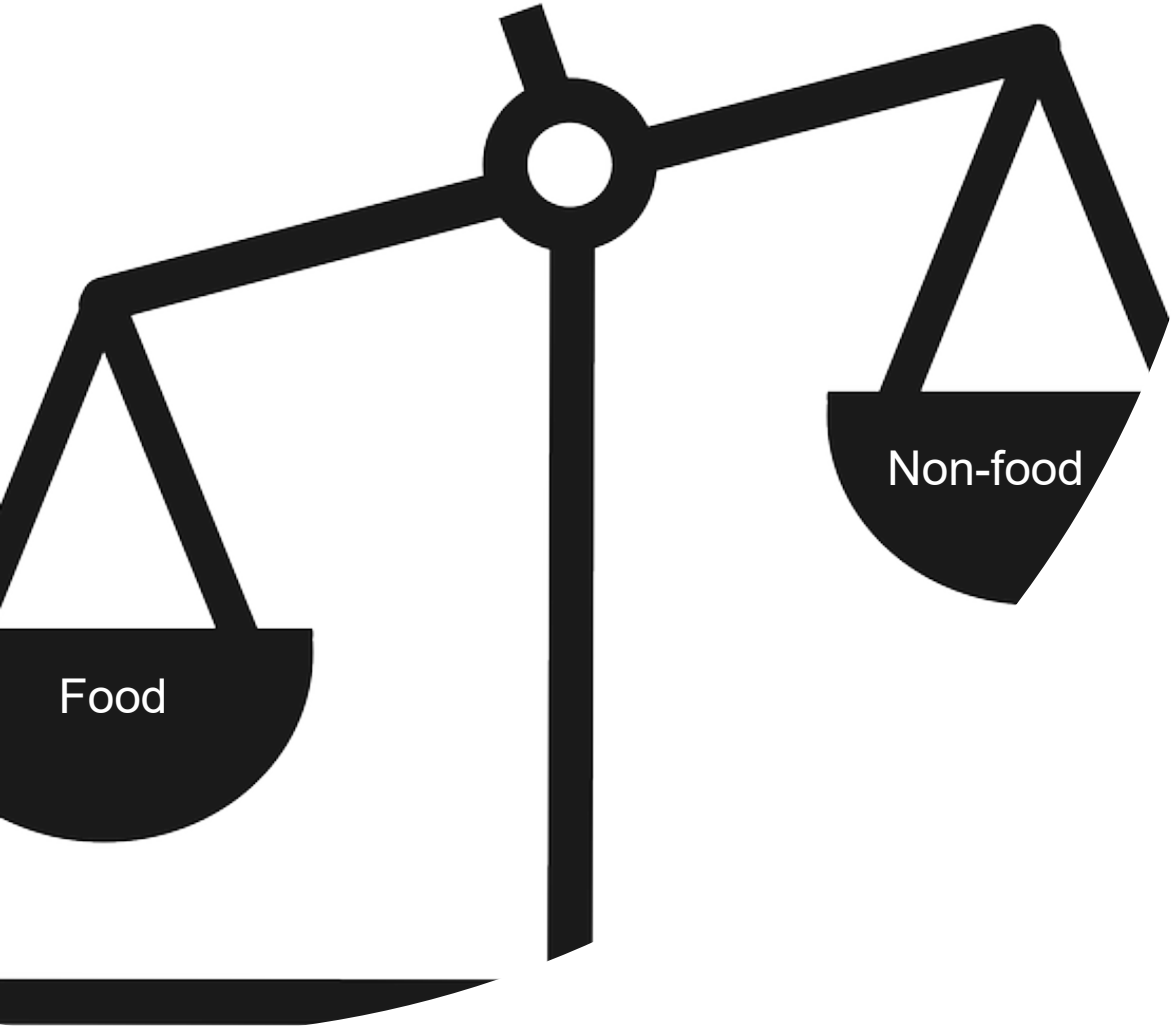
Added sugars and hyperpalatable baby food consumption

What is food reinforcement?

- The motivation to eat
- It measures how hard someone will work to gain access to a specific food
- The reinforcing value of food is mediated, in part, by dopaminergic activity
- How does it work? https://www.youtube.com/watch?v=JD2G0uqCp4o

Relative Food Reinforcement

Choice of food versus non-food alternative reward (e.g., reading, playing, etc.)



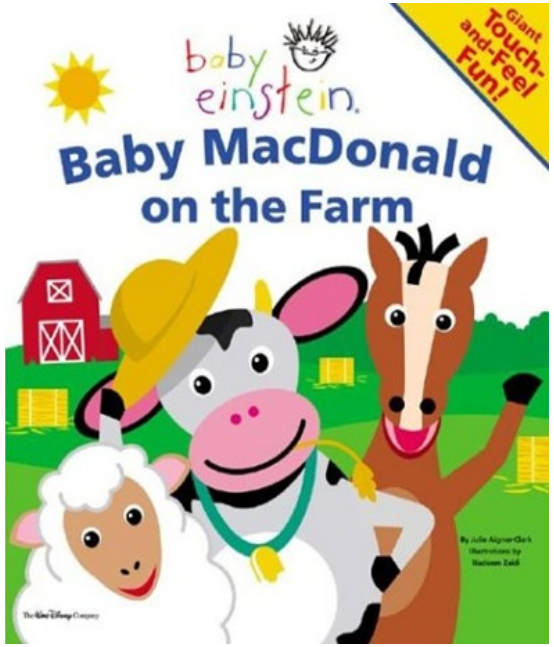
Relative Food Reinforcement

Relative reinforcing value of food (RRV_{food}) has been measured in:

- Pre-schoolers (Rollins et al., 2014)
- Children (Temple et al., 2008)
- Adolescents (Hill et al., 2009; Epstein et al., 2014)
- Adults (Saelens & Epstein, 1996; Epstein et al., 2007)

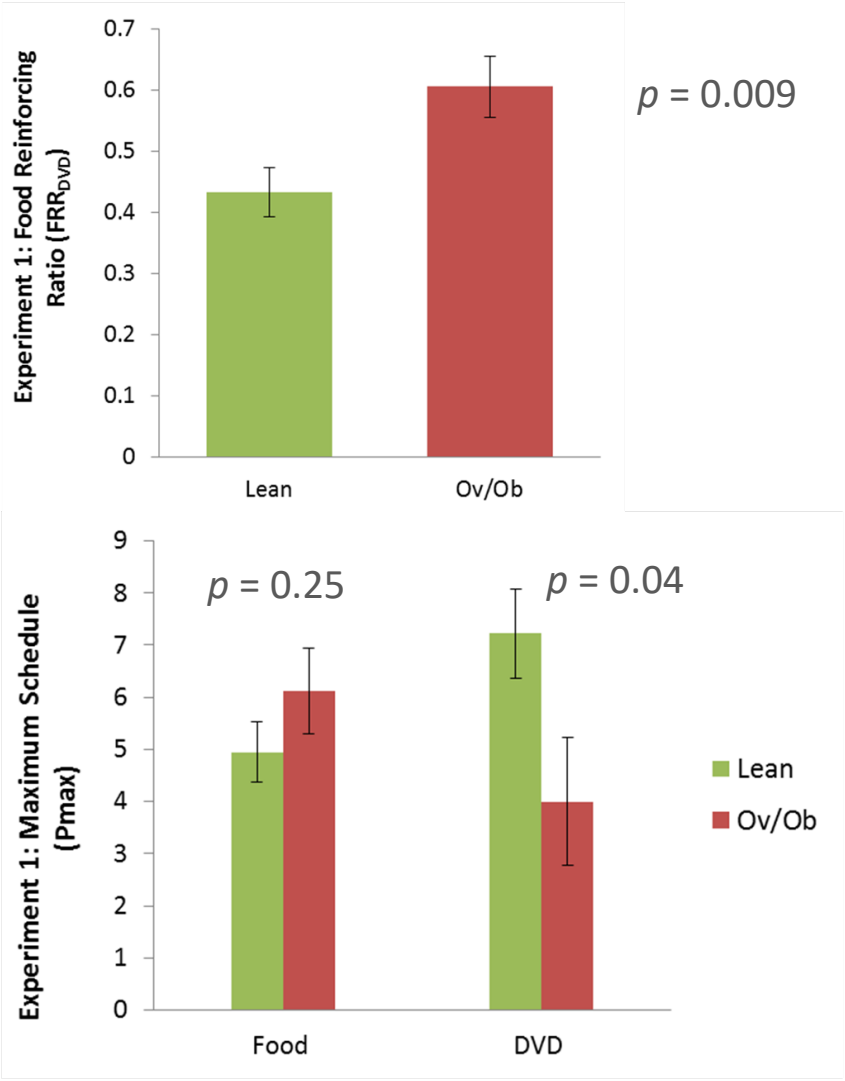
Children with overweight/obesity found food more reinforcing than non-food activities

Study 1



Kong, K., *Feda, D. M., Eiden, R. D., et al. (2015) AJCN.*

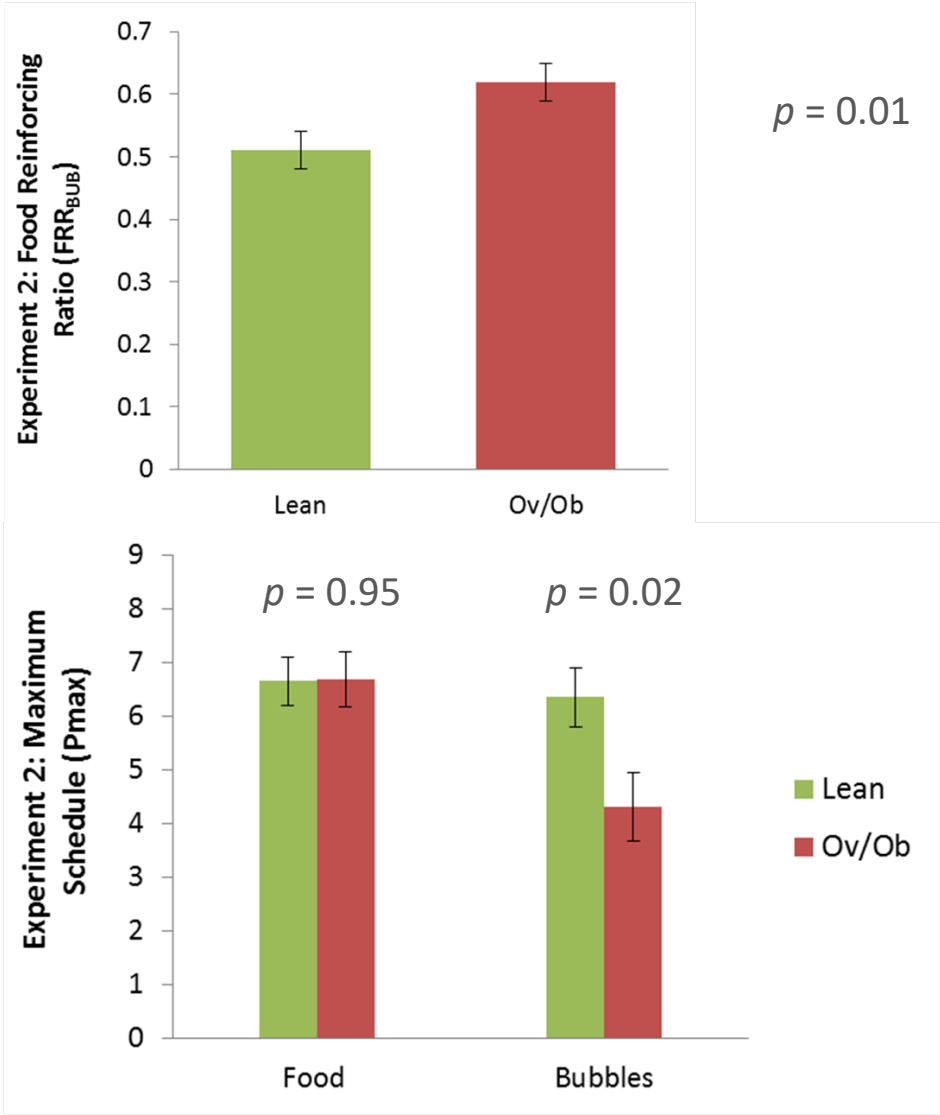
Figure 2: Infant obesity status in relation to food reinforcing ratio of favorite food (FRR_{DVD}) in Study 1 (Baby Einstein- Baby MacDonald™ DVD)



Study 2

Kong, K., *Feda, D. M., Eiden, R. D., et al. (2015) AJCN.*

Figure 3: Infant obesity status in relation to food reinforcing ratio of favorite food (FRR_{BUB}) in Study 2 (playing with bubbles)



Results/Implication

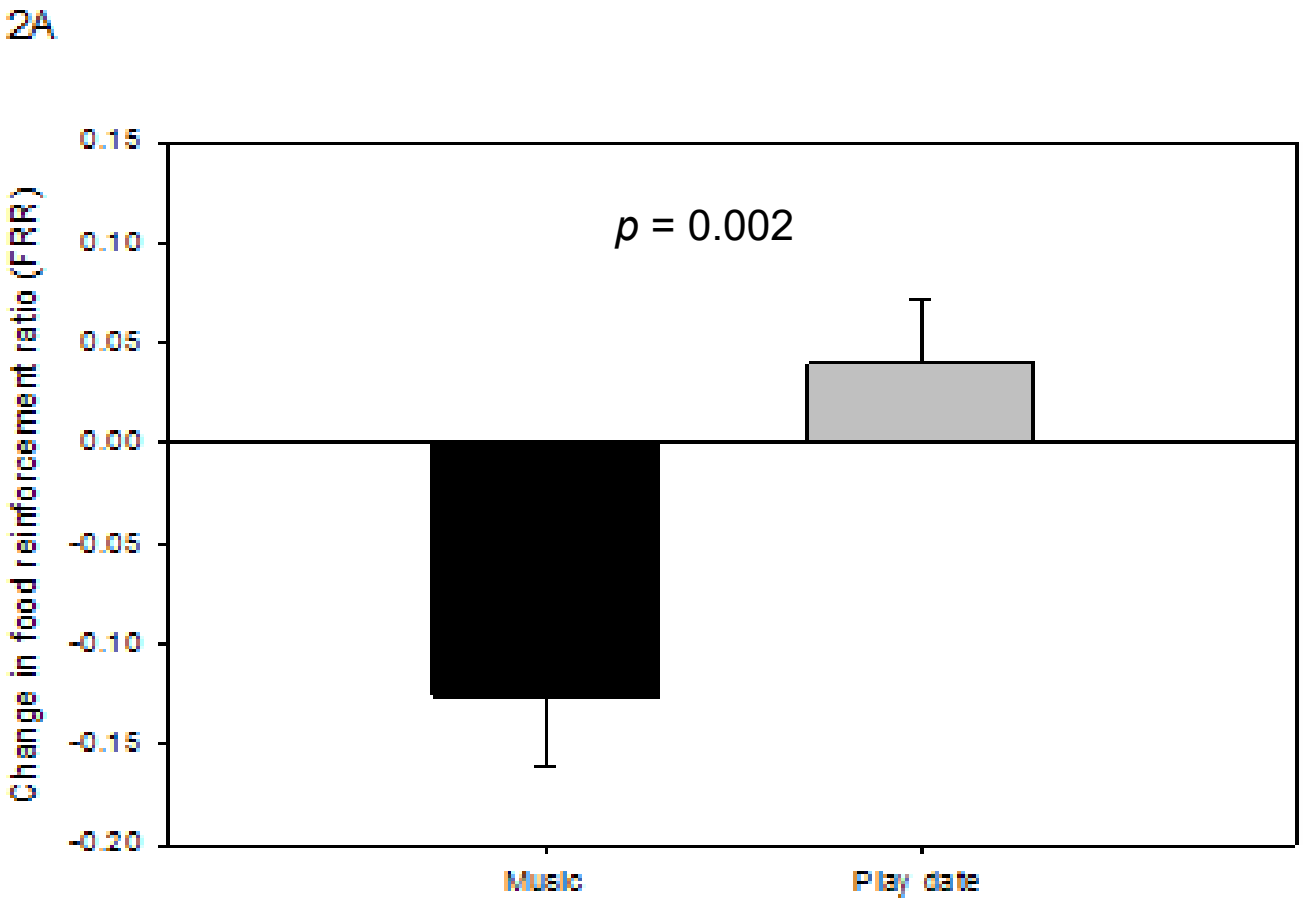
- Infant weight status is associated with FRR
- Strongly driven by the non-food alternatives
- Lack of access to pleasurable alternatives → Obesity
- Can we increase the reinforcing value of non-food alternatives among infants who are highly motivated to eat?

Music Together Pilot

- Randomized controlled trial (n = 27)
- Music or Playdate (active control)
- The purpose: to assess the effects of a 6-week music program on the relative reinforcing value of food in infants (9 – 15 months) with **high motivation to eat**

Music Together Pilot

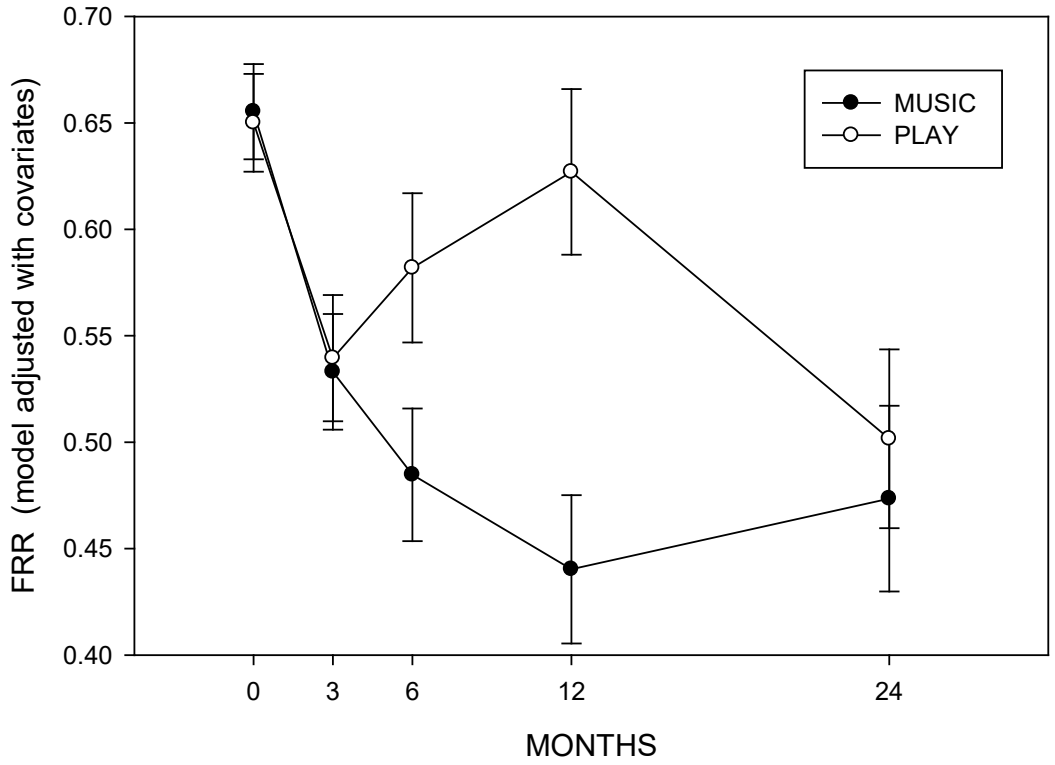
***Kong, K.**, Eiden, R. D., Feda, D. M., et al. (2015) Obesity.*



R01 HD087082: “Enhancing Alternatives to Eating in Infants”

- 94 families with 9-15-month-old healthy infants who had high FRR
- 24-month music enhancement program (Music) vs. play date control (Play)
- 12-month active phase with weekly classes
- 12-month of maintenance phase with monthly classes

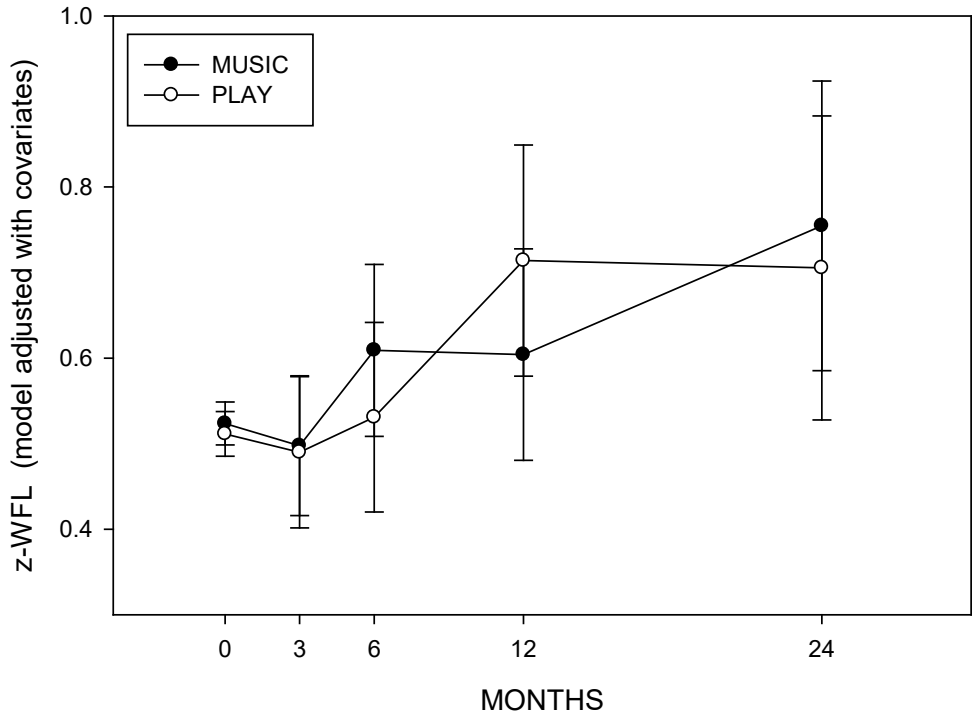
Change in food reinforcement ratio (FRR)



- There were differential group changes across time for FRR (group*month; $p = 0.025$).
- The Music group had greater decreases compared with the Play group from baseline to 12 months ($p = 0.003$), but not at any other time points.

Kong, Eiden, and Epstein (unpublished)

Change in weight-for-length z-score

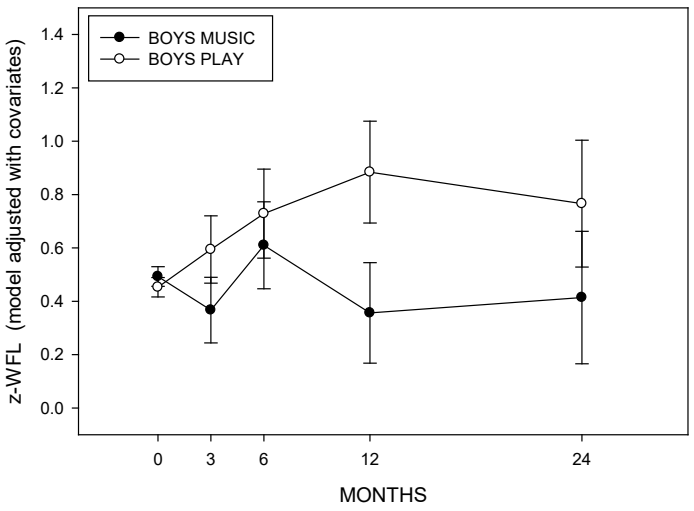


- There were no differential group changes across time for infant zWFL (group*month; $p = 0.483$).

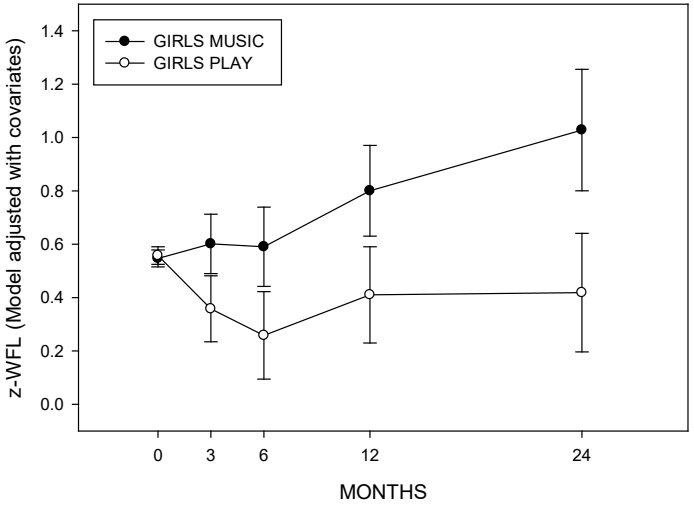
Kong, Eiden, and Epstein (unpublished)

Change in weight-for-length z-score

BOYS



GIRLS



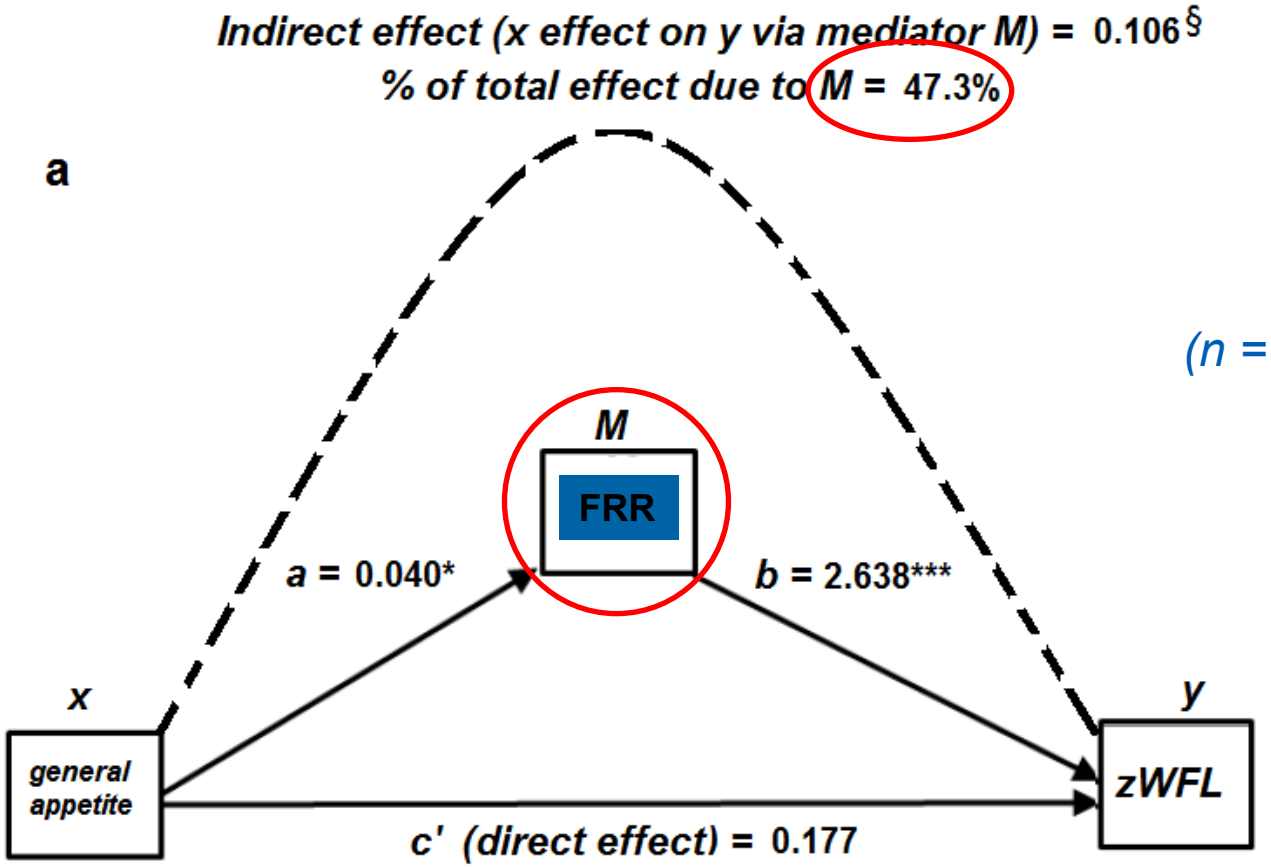
- We observed an overall moderation effect for zWFL (group*month*sex, *p* = 0.049) with sex moderating group differences.
- Boys showed significant zWFL attenuation in the Music group compared to the Play group from 0 to 12 months (β = -0.568, p = 0.036).
- Girls showed significant zWFL attenuation in the Play group compared to the Music group from 0 to 24 months (β = +0.624, p = 0.048).

Kong, Eiden, and Epstein (unpublished)

How does a high food reinforcement ratio (FRR) develop in some individuals and not in others as evidenced by 9 months of age?

Infants with big appetites: The role of a nonfood environment on infant appetitive traits linked to obesity

Kai Ling Kong,[1] Stephanie Anzman-Frasca,[1] Leonard H Epstein,[1] Rina D Eiden,[2] and Rocco A Paluch[1]

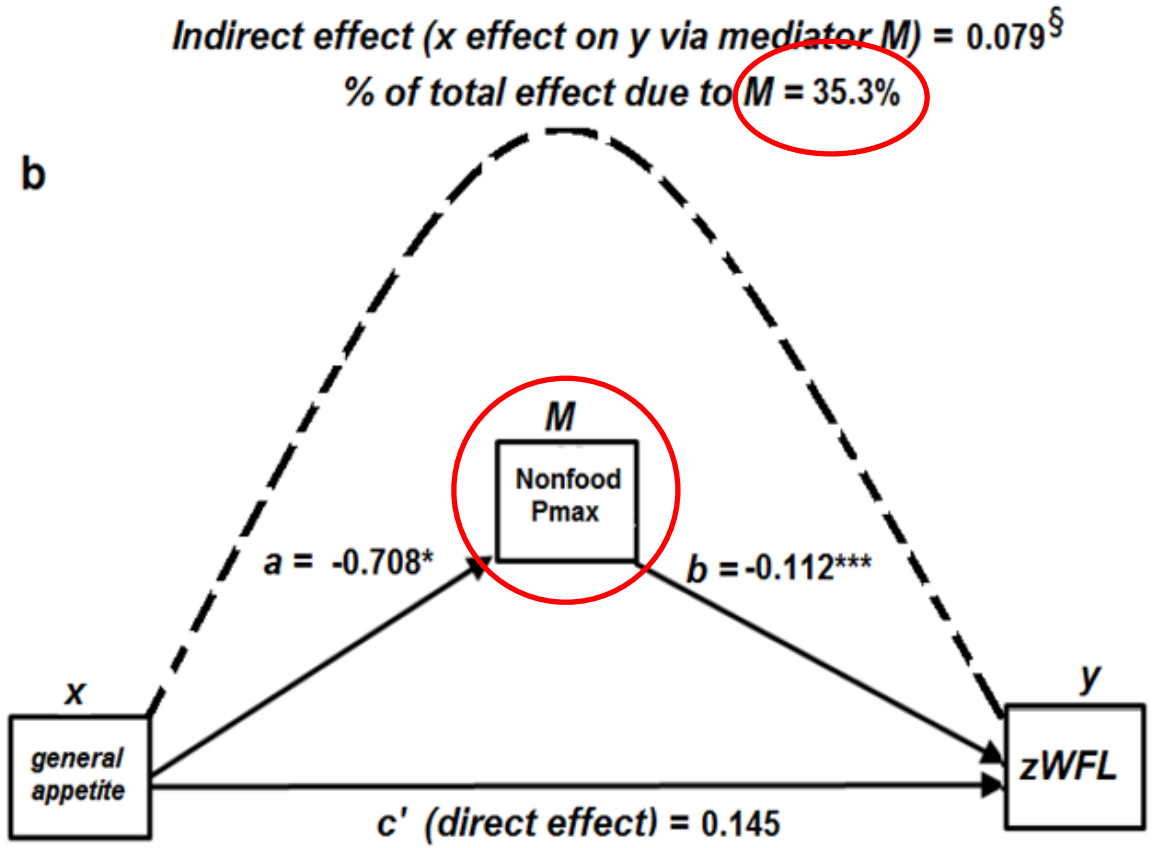


(n = 143; age = 13.9 mo; 77% Caucasian)

Am J Clin Nutr 2020;00:1–8. Printed in USA.

Infants with big appetites: The role of a nonfood environment on infant appetitive traits linked to obesity

Kai Ling Kong,[1] Stephanie Anzman-Frasca,[1] Leonard H Epstein,[1] Rina D Eiden,[2] and Rocco A Paluch[1]



Environmental Enrichment plays a significant role in attenuating substance abuse

Wheel-running attenuates intravenous cocaine self-administration in rats
Sex differences

Kelly P. Cosgrove, Robb G. Hunter, Marilyn E. Carroll*

Department of Psychiatry, University of Minnesota, Mayo Box 392, Minneapolis, MN 55455, USA

Received 15 January 2002; received in revised form 17 April 2002; accepted 29 April 2002

Environmental enrichment attenuates cue-induced reinstatement of sucrose seeking in rats

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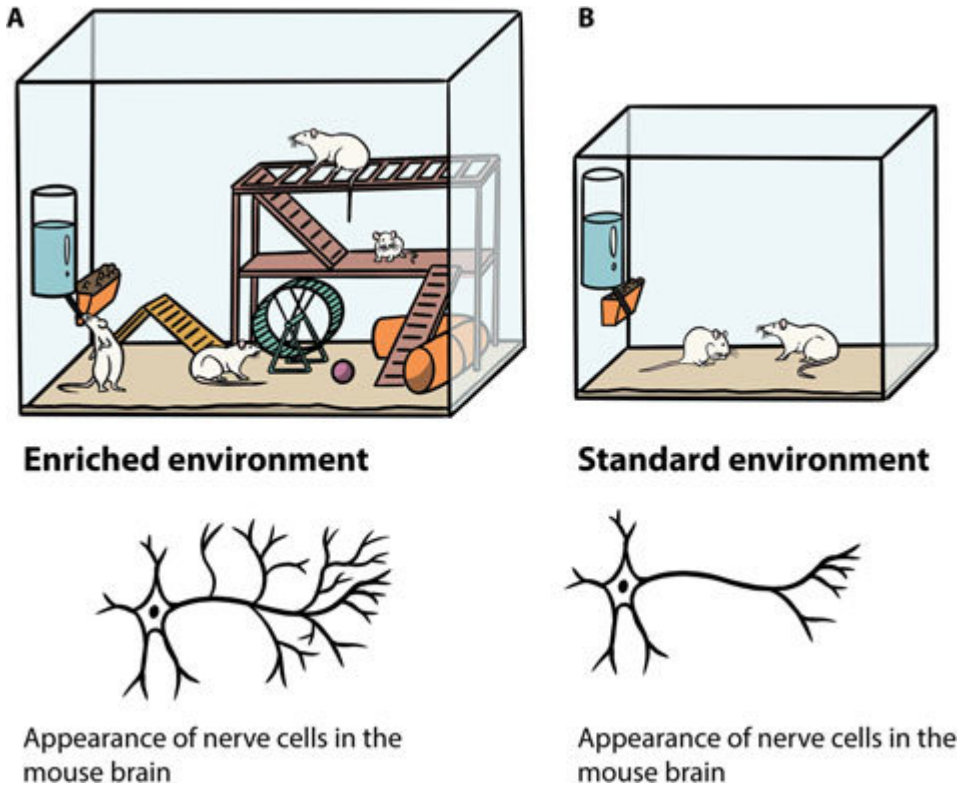
Department of Psychology and Program in Behavioral Neuroscience, Western Washington University, Bellingham, Washington, USA

Enriched environment: a study of how early non-food home environment protects against obesity development in infants



An early, enriched, non-food home environment, characterized by high quality parenting and accessibility to a variety of cognitively-stimulating activities, might play a role in:

- The development of a brain reward system that favors non-food rewards over food rewards
- Enhancing cognitive development for greater self-regulatory capacities early in life

Strategic Plan for NIH Nutrition Research
Nutrition in the birth-to-24 Month Period

DGA Dietary Guidelines for Americans
2020 - 2025
Make Every Bite Count With the *Dietary Guidelines*
Ninth Edition • DietaryGuidelines.gov

ANNALS OF GASTRONOMY NOVEMBER 25, 2019 ISSUE

CAN BABIES LEARN TO LOVE VEGETABLES?

Infants and Toddlers Eat Too Much Sugar, Researchers Say

Using C.D.C. data, researchers found that 98 percent of toddlers and 60 percent of infants consumed added sugar in sweetened drinks, baked goods and snacks.

HEALTHY DRINKS.
HEALTHY KIDS.

SEPTEMBER 18, 2019

Healthy drinks, healthy kids: First-ever consensus on recommendations for young children

by American Heart Association

Received: 17 May 2020 | Accepted: 28 July 2020
DOI: 10.1111/ijpo.12728

ORIGINAL RESEARCH

Pediatric OBESITY WILEY

High intake of added sugars is linked to rapid weight gain in infancy, breastfeeding ≥12 months may protect against this: A preliminary investigation

Kai Ling Kong Ph.D.[1] | Brenda Burgess Ph.D.[1] | Katherine S. Morris M.S., R.D[1] | Myles S. Faith Ph.D.[2] | Rocco A. Paluch M.S.[1]

The Journal of Nutrition
Nutrition and Disease

See corresponding commentary on page 1375.

Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

Kai Ling Kong,[1,2,3] Brenda Burgess,[4] Katherine S Morris,[4] Tyler Re,[1] Holly R Hull,[5] Debra K Sullivan,[5] and Rocco A Paluch[4]

International Journal of Obesity
www.nature.com/ijo

ARTICLE

PEDIATRICS

Added sugars mediate the relation between pre-pregnancy BMI and infant rapid weight gain: a preliminary study

Brenda Burgess[1], Katherine S. Morris[1], Myles S. Faith[2], Rocco A. Paluch[1] and Kai Ling Kong[3,4,5]✉

frontiers in Psychology

ORIGINAL RESEARCH
published: 13 April 2021
doi: 10.3389/fpsyg.2021.614607

The Prevalence of Hyperpalatable Baby Foods and Exposure During Infancy: A Preliminary Investigation

Kai Ling Kong [1,2,3], Tera L. Fazzino [4,5], Kaitlyn M. Rohde [4,5] and Katherine S. Morris [6]*

Snack food consumption is positively associated with overconsumed nutrients and weight-for-length z-scores during infancy and toddlerhood

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RESEARCH FROM ASN JOURNALS

Added sugars in formulas predict rapid weight gain in infants and toddlers

June 22, 2021
by Kathy Beerman, PhD

RESEARCH

A cross-country exploratory study to investigate the labelling, energy, carbohydrate and sugar content of formula milk products marketed for infants

Gemma Bridge,*[1] Marta Lomazzi[2,3] and Raman Bedi[4]

Key points

Only 38% of infants are exclusively breastfed. Most infants are fed with breastmilk substitutes for some or all of their nutritional needs.	Infant formula products from 11 countries were analysed. The majority of products were higher in sugar than breastmilk.	Mandatory regulation of sugar content in breastmilk substitutes is needed, with clear front of pack nutrition labels to aid consumer choice.

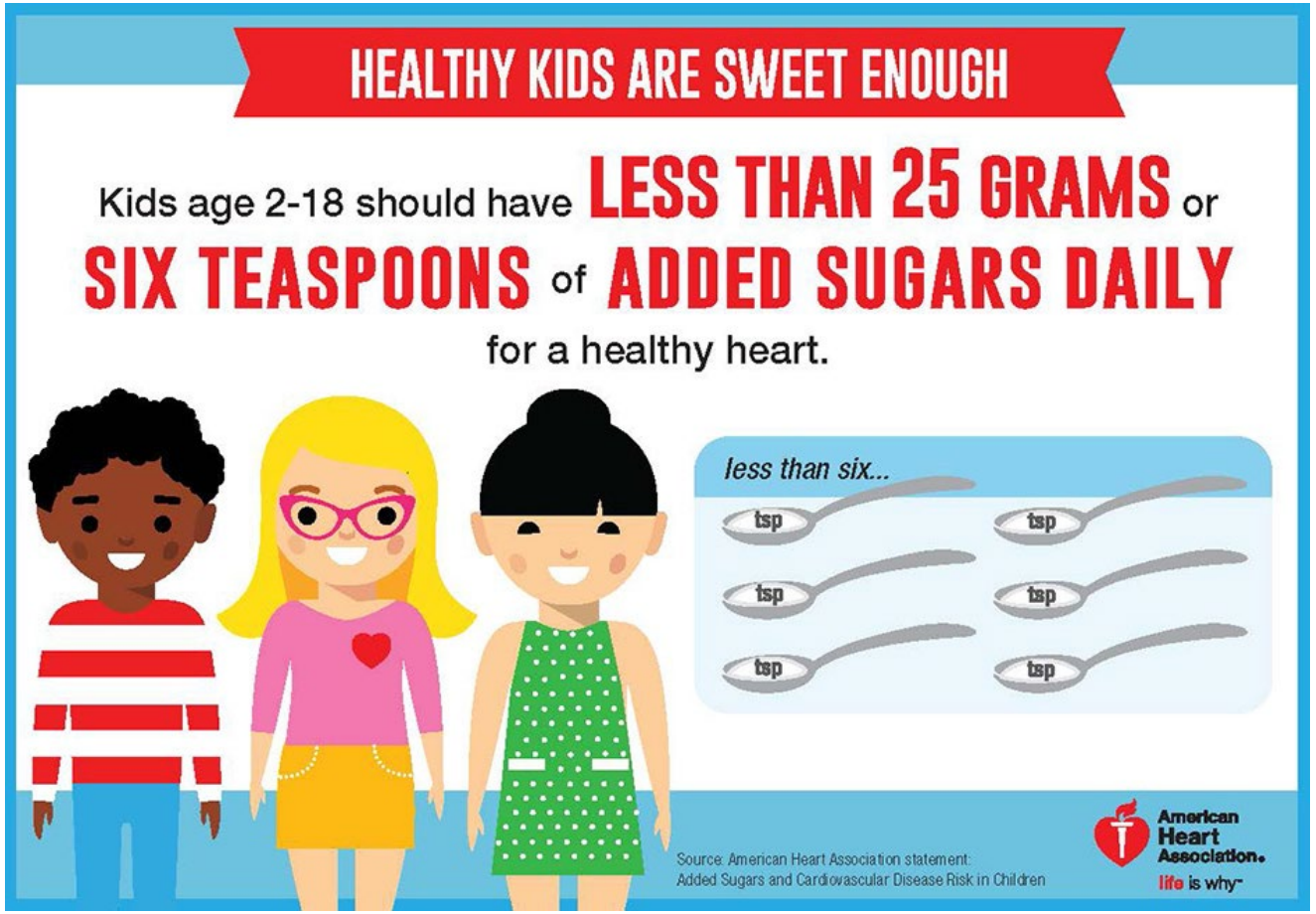
A recent nutritional assessment of 257 formula products from 11 countries demonstrated that formulas contain a mean of 5.9 g of added sugars per 100 mL (range, 1.1 - 9.8 g).

Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

Definition of added sugars:

- Those sugars or sweeteners added to foods during processing, such as sucrose, dextrose, corn syrup, honey, concentrates from fruits and vegetables and so on.
- Lactose is a form of added sugar in formula products.

Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers



Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

Avoid Added Sugars

Infants and young children have virtually no room in their diet for added sugars. This is because the nutrient requirements for infants and young children are quite high relative to their size, but the amount of complementary foods they consume is small. Complementary foods need to be nutrient-dense and not contain additional calories from added sugars. In addition, low- and no-calorie sweeteners, which can also be called high-intensity sweeteners, are not recommended for children younger than age 2. Taste preferences are being formed during this time period, and infants and young children may develop preferences for overly sweet foods if introduced to very sweet foods during this timeframe. For more information on added sugars, see ***Chapter 1.***

Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

Infants, 9 – 12 mo (n = 97)	Toddlers 13 – 15 mo (n = 44)
863 ± 200 kcal daily, 42.6% milk-based diet	1030 ± 232 kcal daily, 8.7% milk-based diet
97.3% consumed added sugars, 7% of total kcal	100% consumed added sugars, 4.2% of total kcal
Sources of added sugars: • Formulas (65.5%) • Baby snacks and sweets (5.7%) • Sweet bakery products (5.4%)	Sources of added sugars: • Sweet bakery products (20.6%) • Yogurt (16.8%) • Mixed dishes (11%)

***Kong**, Burgess, Morris, et al (2021) J Nutr*

Table 3: Nutrition facts for the infant formulas consumed by infants/toddlers in our cohort[1]

Brand	Type	kcal	Fat (g)	Carb (g)	Protein (g)	Added Sugar (g)	n
Enfamil Gentlease - prepared from powder	cow's milk	100.00	5.32	10.84	2.31	2.94	10
Store Brand Gentle - pre	cow's milk	1(				2.94	4
Enfagrow Premium Next powder	cow's milk	100.00	5		2.59	3.58	5
Similac Organic - prepared from	cow's milk	100.00	5		2.06	3.63	1
Enfamil A.R.- prepared from po	cow's milk	100.00	5		2.49	3.98	1
Gerber Good Start Gentle for Si prepared from powder	cow's milk	100.00	5		2.20	5.16	1
Similac Sensitive - prepared fro	cow's milk	100.00	5		2.15	5.59	1
Enfamil Nutramigen - ready to u	hydrolysate	100.00	5		2.78	6.33	2
Enfamil Infant - ready to use	cow's milk	100.00	5		1.97	7.01	3
Store Brand Advantage - prepar	cow's milk	100.00	5		1.98	7.04	2
Enfamil Infant - prepared from p	cow's milk	100.00	5		1.99	7.10	20
Milk Based formula (NDSR default option)	cow's milk	100.00	5		2.06	7.66	1
Similac Advance 20 - prepared from powder	cow's milk	100.00	5.57	10.65	2.06	7.66	5
Store Brand Infant- prepared from powder[2]	cow's milk	100.00	5.32	10.63	2.28	7.73	4

12 oz can of Coca-Cola has 39 g of added sugars

9 oz of the Store Brand infant formula has ~13 g of added sugars

[1] All nutrition facts are derived from the Nutrition Data System for Research (NDSR) and the formula brands are listed according to their amount of added sugars (1). For every 100 kcal of breastmilk, there are 6.24 g fat, 9.81 g carbohydrates, and 0.78 g protein per output by NDSR (no added sugars have been reported in breastmilk).

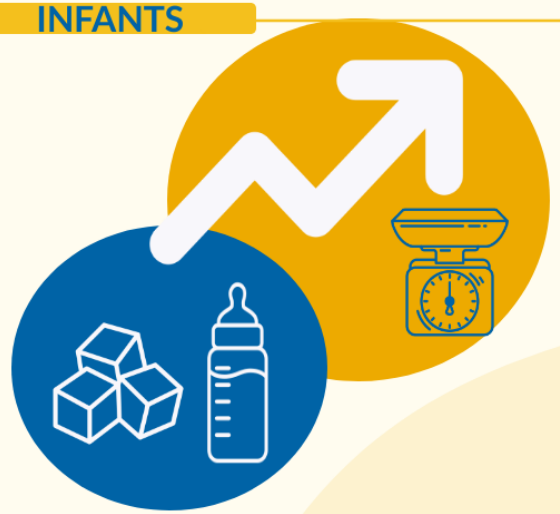
[2] Examples of a store brand: Parent's Choice, Up and Up

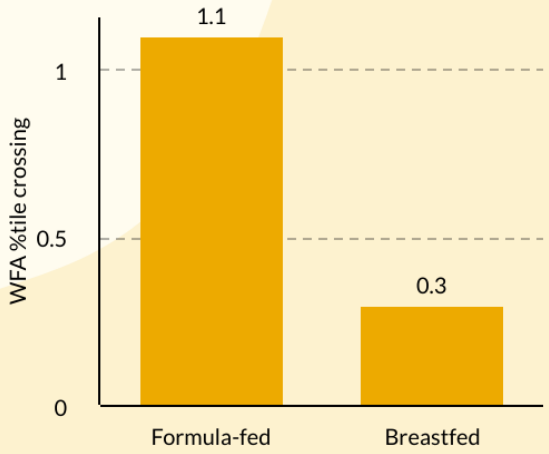
Association Between Added Sugars from Infant Formulas and Rapid Weight Gain in US Infants and Toddlers

INFANTS

Added Sugars from formula (65.5%)
Added sugars from other sources (34.5%)

INFANTS



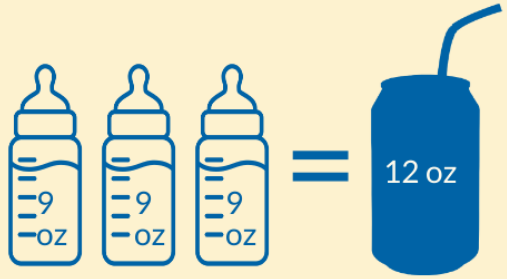


TODDLERS

Added sugar from formula (7.37%)
Added sugar from other sources (92.63%)

TODDLERS

Added sugars in formula ranged from 2.94 - 7.73 g/100 kcal



Baby Health Behavior Lab at Children's Mercy Hospital Kansas City;
Kai Ling Kong, Brenda Burgess, Katherine S Morris, Tyler Re, Holly R Hull, Debra K Sullivan, and Rocco A Paluch.

KU School of Medicine The University of Kansas
UMKC School of Medicine
Children's Mercy KANSAS CITY

frontiers in Psychology

ORIGINAL RESEARCH
published: 13 April 2021
doi: 10.3389/fpsyg.2021.614607

Check for updates

The Prevalence of Hyperpalatable Baby Foods and Exposure During Infancy: A Preliminary Investigation

Kai Ling Kong[1,2,3*], *Tera L. Fazzino*[4,5], *Kaitlyn M. Rohde*[4,5] *and Katherine S. Morris*[6]

[1] *Baby Health Behavior Laboratory, Division of Health Services and Outcomes Research, Children's Mercy Research Institute, Children's Mercy Hospital, Kansas City, MO, United States,* [2] *Department of Pediatrics, University of Missouri-Kansas City, Kansas City, MO, United States,* [3] *Department of Pediatrics, University of Kansas Medical Center, Kansas City, KS, United States,* [4] *Health Behavior and Technology Laboratory, Department of Psychology, University of Kansas, Lawrence, KS, United States,* [5] *Cofrin Logan Center for Addiction Research and Treatment, University of Kansas, Lawrence, KS, United States,* [6] *Division of Behavioral Medicine, Department of Pediatrics, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, Buffalo, NY, United States*

Obesity Symposium
EPIDEMIOLOGY/GENETICS

Obesity

Hyper-Palatable Foods: Development of a Quantitative Definition and Application to the US Food System Database

Tera L. Fazzino [1,2], *Kaitlyn Rohde*[1,2], *and Debra K. Sullivan*[3]

https://www.youtube.com/watch?v=LLrIUrUeBvk

Prevalence of Hyperpalatable Baby Foods and Exposure During Infancy: A Preliminary Investigation

- Only 12% of baby foods were hyperpalatable (HPF)
- Nearly all infants and toddlers has been exposure to HPF either through baby foods or adult (table) foods
- Infants consumed 38% of their daily food kcal from HPF
- Toddlers consumed 52% of their daily food kcal from HPF

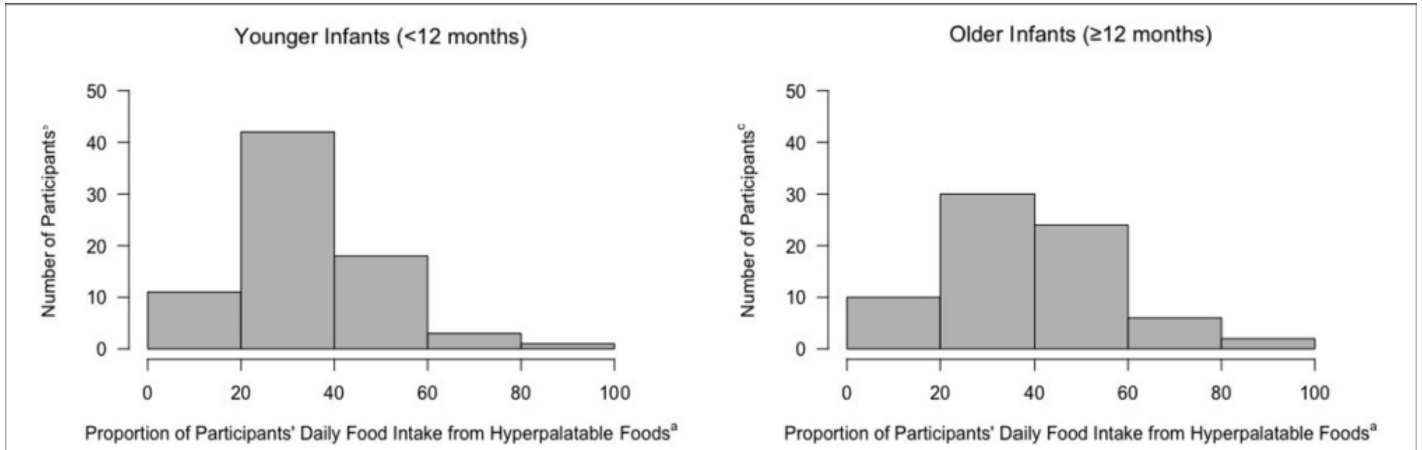


FIGURE 1 | Proportion of daily food intake (kcal) from hyperpalatable foods among infants. [a]Calculated as number of hyperpalatable foods consumed/total solid foods consumed per day. [b]$n = 75$, Younger Infants. [c]$n = 72$, Older Infants.

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Conclusion

- Importance of cultivating pleasure in infants via non-food alternatives to prevent maladaptive eating behaviors

- Obesity Prevention: It's Never Too Early to Start!

Collaborators: Leonard Epstein, Ph.D., Rina Eiden, Ph.D., Steph Anzman-Frasca, Ph.D., Katelyn Carr, Ph.D., Tera Fazzino, Ph.D., Holly Hull, Ph.D., Debra Sullivan, Ph.D., R.D.

Staff members: Katie Morris, M.S., R.D., Paige Guy, Rafeya Raquib, Jackie Szabat, M.S., Amy Smith, Ph.D., Catherine Serwatka, Stefanie Uwah

Contact email: kkong@cmh.edu