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First 1,000 Days of Life: Relationship Between Early Life Nutrition and Future Health Outcomes

TODAY'S AGENDA:

- Introduction & Housekeeping
- Speaker Introduction
- Presentation
- Q&A
- Closing



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Mount Sinai School of Medicine

The First 1000 Days of Life:

Relationship Between
Early Life Nutrition and
Future Health Outcomes



Dr. Nicole M. Avena, PhD
Princeton University and Mount Sinai Medical School

Outline

- What is the “First 1000 Days” and why does it matter?
- Research on the impact of poor nutrition on cognitive health
- Research on the impact of poor nutrition on immune system health
- Research on the impact of poor nutrition on appetitive behaviors later in life
- Methods for improving nutrition in early life and pregnancy
- Questions

What are the “First 1000 Days”?



Why are the First 1000 Days so important for development?

- The parental environment and nutrition during the first few years of a child's life provides the building blocks for brain development, healthy physical growth and a strong immune system.
- Studies now suggest that this unique window is when healthful habits and behaviors can be entrained.
- This is perhaps the most important window where cognitive development is optimized and programming a normal immune response occurs.



Early indication of diet's impact on development: Dutch Winter Famine

Gestational Caloric Restriction and Predisposition of Offspring to Obesity




Ravelli GP *et al* (1976) **Obesity in young men after famine exposure in utero and early infancy.** N. Engl. J. Med. 295: 349–353


- The Dutch Winter Famine was the first examination of poor nutrition and gestation
- The results showed that babies born mid to late famine had low birth weights and higher risk of obesity later in life

Opening the Door: Environment is key


The environment in which a child is raised has an impact on their growth, wellbeing, and abilities later on



Environment involves parents' attitudes, interactions with children and reactions to child's behavior



Creating a positive environment, in which children feel able to explore, learn, make mistakes, and be creative, begins with parents



Part of the parents' role in creating a positive environment is to ensure that their child gets complete nutrition

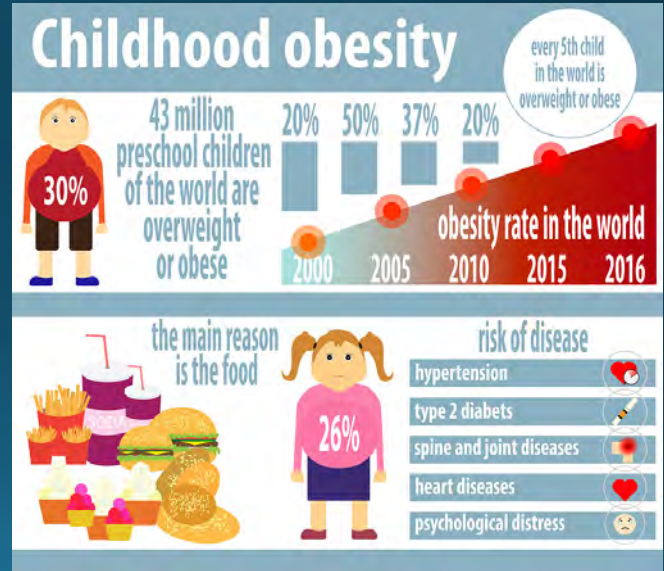
How does nutrition fit into the environment?



- Modeling, or eating alongside a child, has been proven to improve nutritional outcomes in young children.
- Sharing similar, healthy meals with a child can improve feeding and eating outcomes.

So, what's the problem?

- Malnutrition remains a significant problem for young children.
- Normal weight or overweight children can still be malnourished.
- Lack of proper nutrition in early life has a life-long impact, sometimes which is irreversible.
- There is a lack of information for new parents regarding the types of nutrients needed at different stages of development.
- Young children are often difficult to coax into eating well.
- introducing healthy food choices and limiting unhealthy choices early on may help with food preference.



Many chronic illnesses that plague modern society derive in large part by poor food choices, dictated by our taste preferences

Impact of Poor Nutrition on Cognitive Health

- Research shows that over 80% of overall cognition occurs in the first 1000 days of life
- Factors including environmental stress, poor nutrition, and poor relationships are leading causes of poor cognitive outcomes later in life including IQ and learning ability

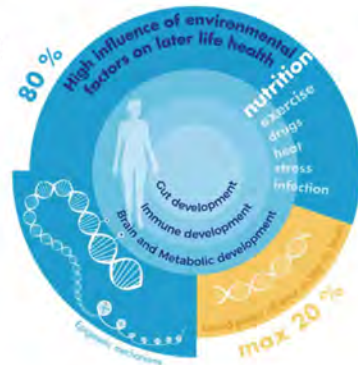
<https://www.nutriciaresearch.com/nutrition-for-life/early-life-nutrition/the-first-1000-days-a>

-unique-window-of-opportunity-to-shape-lifelong-health/

Environmental factors have much more impact on health in later life than genetics

It has been estimated that at most 20% of lifelong health can be explained by inherited genes.

This means that at least 80% of disease risk in later life is due to the environment, including nutrition and life style.



Impacts of poor nutrition on cognitive health

- Several nutrients that are not in a processed food diet are crucial for brain and nervous system development.
- Children who were fed more breastmilk within the first 28 days of life had larger volumes of certain regions of the brain and by age 7, had higher IQs and better scores in reading, mathematics, working memory and motor function tests (Belfort, Mandy B., 2016)
- After breastmilk, children who continued to eat a whole food diet had an easier time with language and learning new tasks.

Impact of poor nutrition on immune system health

- In the first 1000 days, baby is forming their gut microbiome, through gestation, breastmilk antimicrobials, and first solid foods.
- Diversity in the gut microbiome is important for immune function.
- During gestation and postpartum, vitamin D is a necessary vitamin to help develop your child's immune system. Vitamin D modulates overall inflammation and prevents illness (Katrina Beluska-Turka et al., 2019)
- Adding a variety of fiber and colorful fruits and vegetables to early childhood diet can also allow the gut microbiota to have variety

Impact of Poor Nutrition on Appetitive Behaviors Later in Life

Diet during pregnancy can have lasting effects



- *In utero* exposure to drugs of abuse can affect development and can promote addiction in offspring.
- Maternal obesity during pregnancy increases the risk of obesity in offspring.
- Diet *in utero* can have long-lasting effects on food intake and preference.



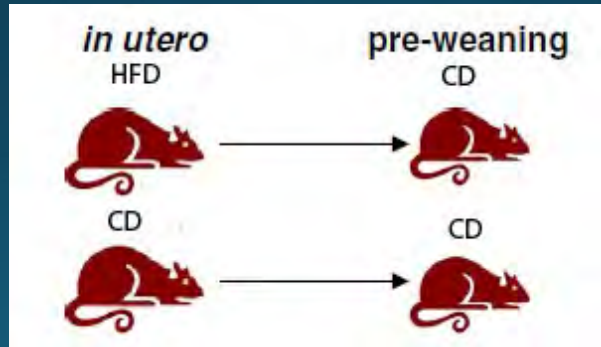
Effects of perinatal exposure to palatable diets on body weight and sensitivity to drugs of abuse in rats

Miriam E. Bocarsly^a, Jessica R. Barson^b, Jenna M. Hauca^a, Bartley G. Hoebel^a,
Sarah F. Leibowitz^b, Nicole M. Avena^{c,*}

Physiology & Behavior 107 (2012) 568–575

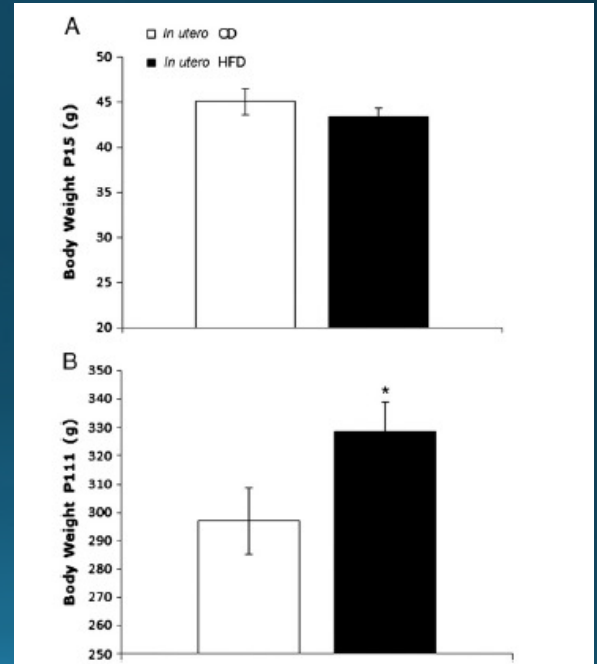
Experiment 1: Methods

Dams were maintained with *ad libitum* access to either a high-fat diet (5.15 kcal/g; 50% fat) or a control diet (4.29 kcal/g; 25% fat) from E6 onwards. On postnatal day 1, pups were cross-fostered to dams on a control diet and pups born to control-fed dams were cross-fostered to different control-fed dams.



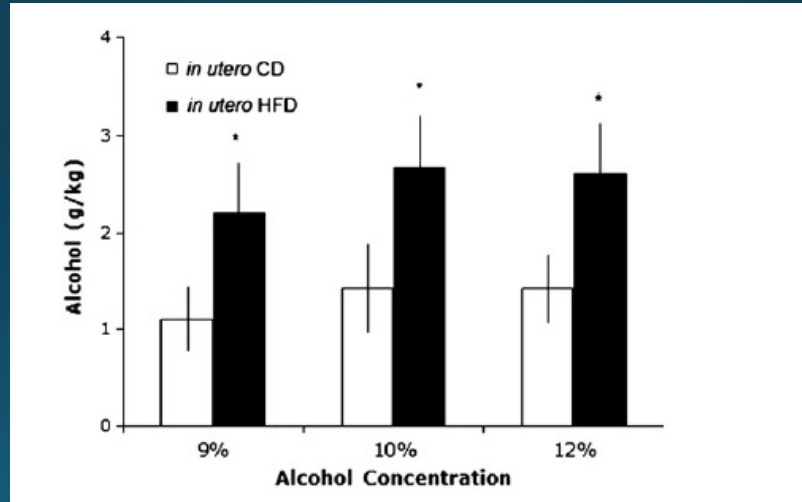
Effects of exposure to a high-fat diet *in utero* on offspring

- In adulthood, rats exposed to the high-fat diet *in utero* weighed more than rats exposed to the control diet.
- These rats also ate more of a high-fat diet in 1-h test meals (28 v. 25 kcal, $p < 0.05$, P71-73).
- At P69, these rats had significantly higher circulating triglyceride levels compared to offspring exposed to the control diet ($p < 0.05$).



Source: Bocarsly et al. (2012)

Exposure to a high-fat diet *in utero* results in increased alcohol intake later in life



Summary

- Baby rats that were exposed to a highly palatable diet *in utero* or when nursing, grew up to 1) prefer the taste later in life, 2) were at risk for developing high triglyceride levels and increased body weight.
- Baby rats exposed to a highly palatable diet *in utero* were sensitive later in life to drugs of abuse (alcohol).
- Other studies suggest a highly-palatable (junk food) diet given during pregnancy can alter gene expression in brain areas associated with reward and addiction (e.g., Vucetic et al., 2010; Ong & Muhlhausler, 2011).

Take Away: Exposure to certain foods (and a lack of exposure to others) *in utero* can program our brain and behavior when it comes to food preferences, health, and even risky behaviors.

Ways to Help Improve Nutrition in Early Life and Pregnancy

Some Challenges We Face...

Newborns' responses to basic tastes



Sweet



Sour



Bitter

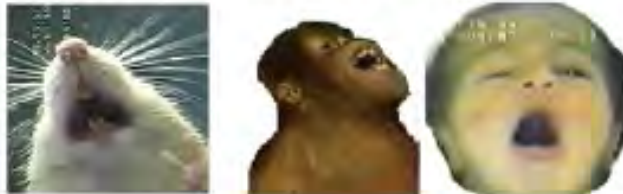


Salt

Hedonic Reactions (sweet)

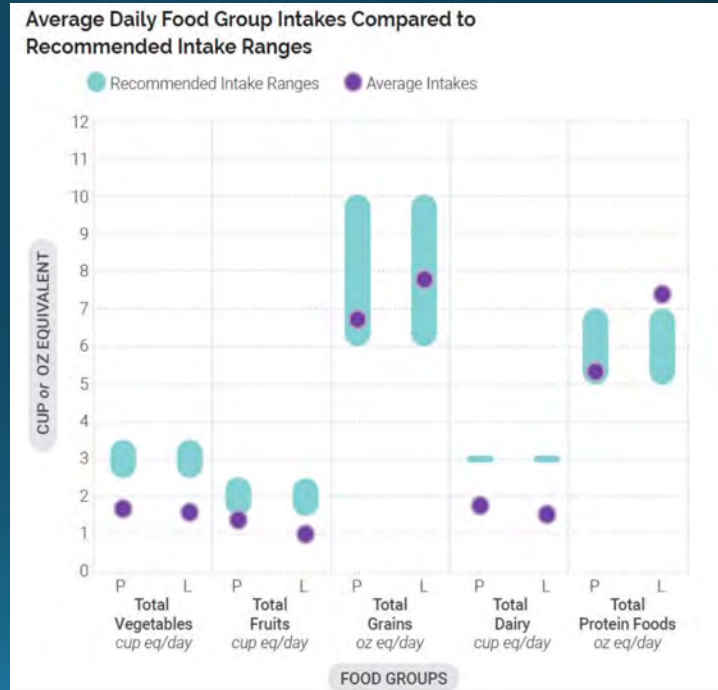


Aversive Reactions (bitter)



It isn't so easy to get all the nutrition needed from food

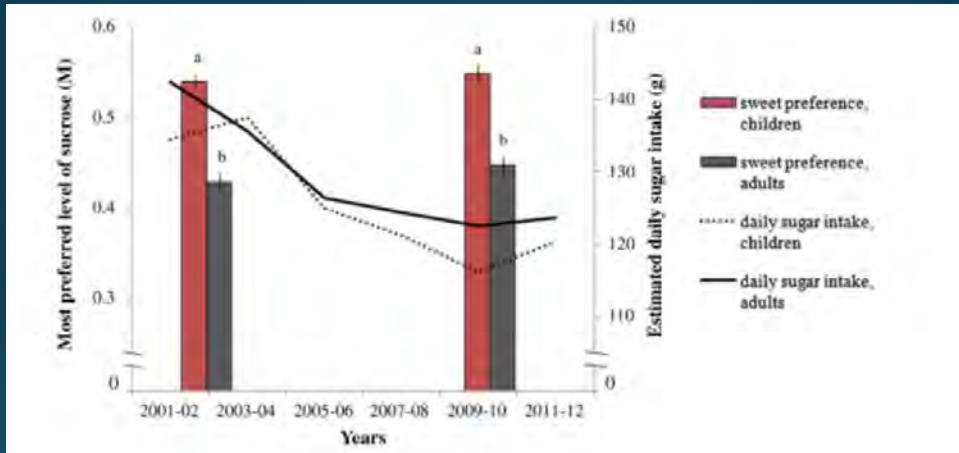
- The average American does not meet the necessary dietary requirements recommended by the USDA.
- Most are low in total fruits, vegetables, whole grains, and dairy.
- Although not easy, it is important to aim to achieve the necessary dietary intake for baby's health.



Source: USDA 2020-2025 Dietary Guideline For Americans

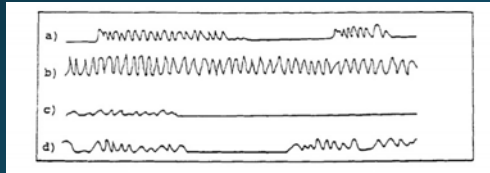
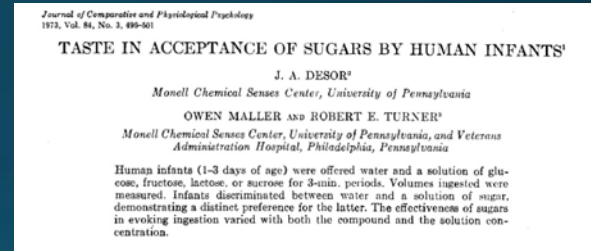
https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

Children live in their own sensory worlds

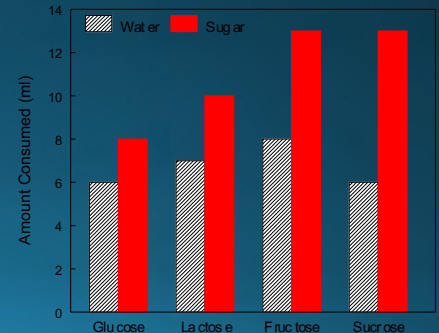


Infancy

- Within hours of birth, infants exhibit a strong preference for sweet tastes.
- Convergence of findings
 - Intake
 - Suckling patterns



Suckling curves generated by term (a: latex nipple; b: sucrose nipple) and preterm (25-36 wks gestational age) c: latex nipple; d: sucrose nipple) infant. Maone et al., 1990



Sweet Calm Cure

- Within hours of birth, infants exhibit a strong preference for sweet tastes.
 - Calming/decreases crying: a “sweetness effect”
 - **Sucrose** is safe and effective for reducing procedural pain from single events (e.g., heel prick, circumcision)



Blass and Shah, 1995; Barr et al., 1999;
Cochrane Database of Systematic Reviews:
Stevens et al., 2010

It Isn't *All* Bad News:

We Can Capitalize on What We Know About Early Exposure to Set Baby Down the Right Health Path

Inborn, evolutionarily driven taste preferences

Detection of salt and sweet is associated with powerful hedonic appeal and bitter is aversive, especially among children.

Detrimental consequences of not being exposed to flavors of healthy foods early in life.

Breast milk is evolutionarily "sweet", but for biological reasons of growing

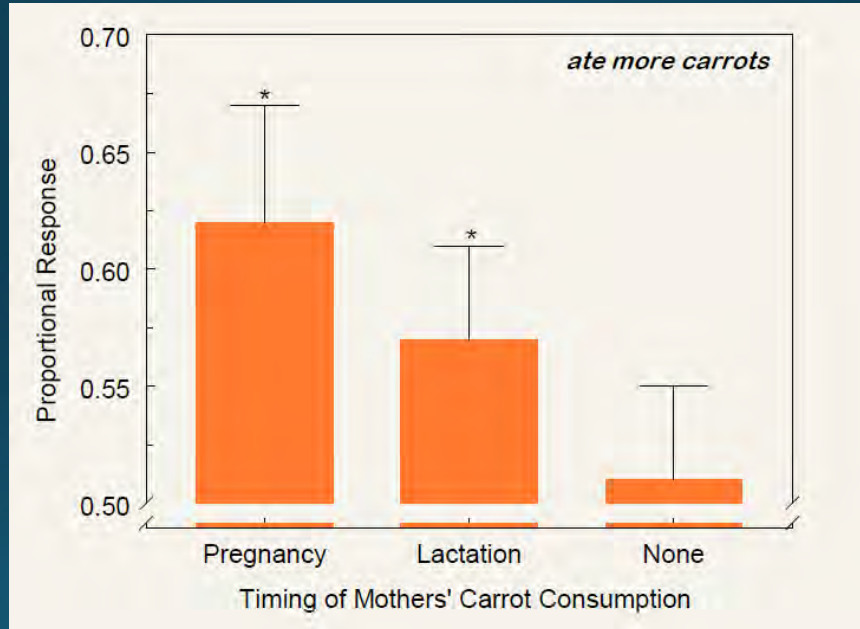
It isn't just *what*, but also *when* that matters

- Scientific studies suggest there are specific and unique nutritional needs for each trimester of pregnancy or stage of development.

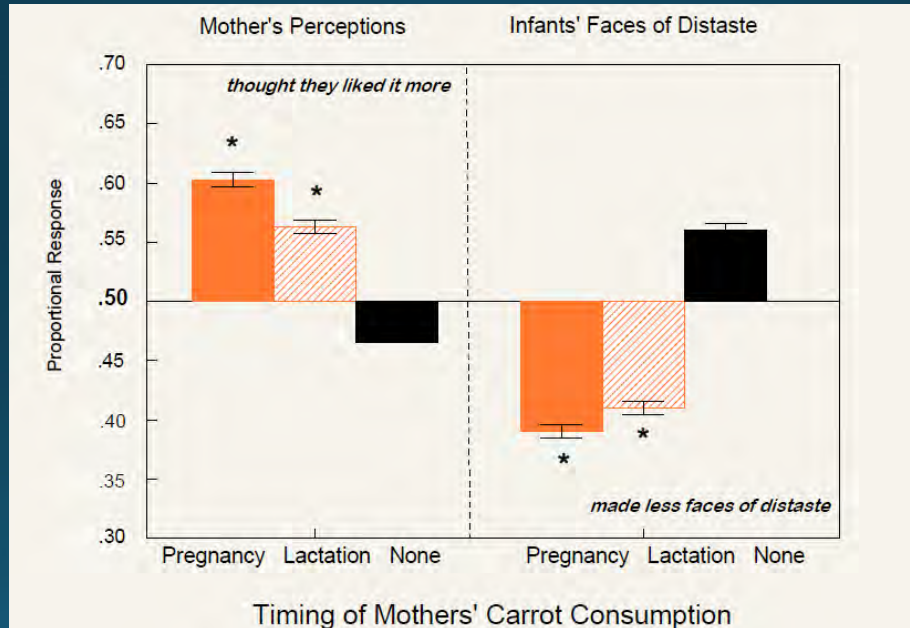


Can we “train” babies to eat healthy?

Intake of Carrot Relative to Plain Cereal



Babies made fewer faces of distaste and mothers thought they liked the carrot cereal more



Feeding Baby Solids: Wait until 6 months...

1

Even though baby's emotional and physical development might be advanced, their digestive systems can't handle solid foods until 6 months of age.

2

Sleep regression: if baby is waking at night, hunger is not the typical cause.

3

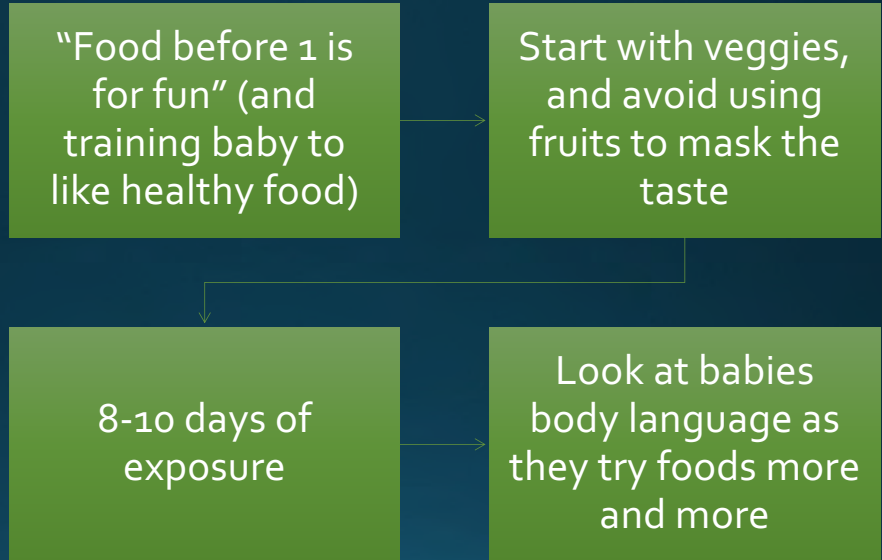
Rice or other cereal is a solid!

Learning About Food



- Presence of a food in the environment does not ensure that the animal will learn to eat this particular food.
- Rather, food preferences increase with repeated exposures and variety and are strongly influenced by the conditions in which the exposure occurs.

Repetition, Repetition, Repetition...



How Much, and How Often?

- Don't worry about getting 3 meals and snacks in at first
- Start off with 1-2 meals (which can be less than half of a small baby food jar), and work your way up
- By 7-8 months, most babies are eating 4 oz per meal, and 3 meals per day
- Break the meal up to be balanced (vegetables, protein, and use fruit as "dessert")
- Baby-lead weaning is best, when done right; if your child shows interest in certain foods (eye contact, reaching, salivation) allow them to try it.

Even before their 2nd birthday, many children have similar eating habits that plague adults:

- Too much sugars
 - 16% of total caloric intake comes from added sugars (Ervin et al., 2012)
- Too much salt
 - Estimated average intake of sodium for those ≥ 2 years is ~3,266 mg/day (should be half that)
- Too few vegetables
 - The recommended intake is 1-1.5 cups daily



Feeding Infant and Toddler Studies (FITS)

Fox et al., *JADA* 2004

Heird et al., *JADA* 2006

Mennella et al., *JADA* 2006

Siega Riz et al., *JADA* 2010

Ziegler et al., *JADA* 2006

What About Sweet Treats?

- The American Academy of Pediatrics recommends waiting to add sugar (honey, agave, maple syrup) to a child's food until after their 2nd birthday.
- Moderation is key—trying to avoid them at all costs will make you stressed and that isn't good for baby (or Mom).
- Remember to focus on health and try to teach baby about limitations. You want them to be able to eventually police themselves around sweets.
- Sweets don't have to be junk food. Fruit with honey or yogurt can be a "sweet treat"
- If baby sees a parent eating lollipops everyday, they will want a lollipop, even if they don't know what it tastes like!



Summary of Experimental Research: 6-12 months

Type of Exposure	Target Food	Result	Reference
8 days of repeated exposure	Pears	Increased acceptance of pears; no effect on acceptance of novel vegetable (green beans)	Mennella et al., 2008
8 days of repeated exposure	Peaches	Increased acceptance of peaches	Forestell and Mennella, 2007
9 days of repeated exposure	Carrots	Increased acceptance of carrots	Gerrish and Mennella, 2001
10 days of repeated exposure	Bananas or peas	Increased acceptance of target food; seen as early as 1 st day of exposure	Birch et al., 1998
8 days of repeated exposure	Green beans	Increased acceptance of green beans	Sullivan and Birch, 1994; Mennella et al., 2008; Forestell and Mennella, 2007
8 days of between-meal variety	Peaches, prunes, apples	Increased acceptance of novel fruit (pears); no effect of acceptance of novel vegetable (green beans)	Mennella et al., 2008
9 days of between-meal variety	Peas, potatoes, squash	Increased acceptance of novel vegetable (carrots) and meat (chicken)	Gerrish and Mennella, 2001
8 days of between-meal variety	Squash, spinach, carrots	Increased acceptance of carrots and spinach; increased acceptance of novel vegetable (green beans)	Mennella et al., 2008
8 days of between- and within-meal variety	Squash/peas, carrot/peas, squash/spinach	Increased acceptance of carrots and spinach; increased acceptance of novel vegetable (green beans)	Mennella et al., 2008
10-20 days of between- and within-meal variety	Pureed, lumpy and diced vs pureed and diced apple sauce	Increased acceptance of diced apples in those who experienced more complex textures.	Lundy et al., 1998

Baby Faces are Always Cute, But Not Always Accurate

- Although measures of liking are related to intake, they are governed by separate neural substrates, and consequently, do not always change in tandem;
- Because infants innately display facial expressions of distaste in response to certain flavors, caregivers may hesitate to continue offering these foods
- Mothers should be made aware that, with repeated dietary exposure, it may take longer to observe changes in facial expressions than intake.

(Pediatrics 120: 1247-54; 2007)



Brow Lowerer



Inner Brow Raise



Squint



Upper Lip Raise



Nose Wrinkle



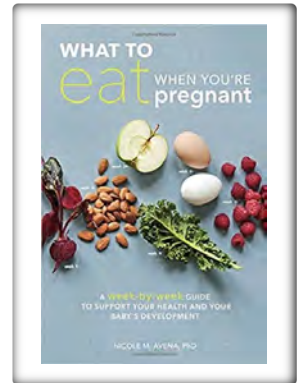
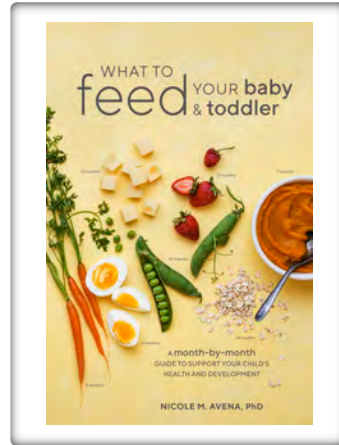
Gape

Thank you!

For more info:

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