



Eatin' at Home- How Diet Influences Human Milk

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Conflicts of Interest



- I have no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this activity
- I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation

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Objectives



- Describe the role of the lactating parent's diet in allergic disease of the breastfeeding infant.
- Explain the role of DHA in the lactating parent's diet, and current recommendations on DHA intake.
- Identify how vitamin supplementation influences vitamin levels in human milk.
- Describe how calcium supplementation for breastfeeding women influences maternal bone density.
- Discuss the role of maternal Vit D supplementation and BM vitamin D level
- Explain the role of choline in infant development and dietary sources of choline
- Discuss the importance of iodized salt to prevent iodine deficiency during preg/lactation
- Understand the effect of maternal probiotic supplementation and BM probiotic levels

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[For Parents & Caregivers](#) - [Contact](#) - [My Favorites](#)

[Why 1,000 Days](#) - [Issues](#) - [Resources](#) - [News](#) - [About](#) - [Take Action](#) Q



The 1,000 days from pregnancy to age two **offer a crucial window** of opportunity to create brighter, healthier futures.

The first 1,000 days are a time of tremendous potential and enormous vulnerability. How well or how poorly mothers and children are nourished and cared for during this time has a profound impact on a child's ability to grow, learn and thrive. This is because the first 1,000 days are when a child's brain begins to grow and develop and when the foundations for their lifelong health are built.

Research in the fields of neuroscience, biology and early childhood development provide powerful insights into how nutrition, relationships, and environments in the 1,000 days between a woman's pregnancy and a child's 2nd birthday shape future outcomes.

Nutrition, in particular, plays a foundational role in a child's development and her country's ability to prosper. Poor nutrition in the first 1,000 days can cause irreversible damage to a child's growing brain, affecting her ability to do well in school and earn a good living—and making it harder for a child and her family to rise out of poverty. It can also set the stage for later obesity, diabetes, and other chronic diseases which can lead to a lifetime of health problems.

“Poor nutrition in the first 1000 days can cause irreversible damage to a child’s growing brain... It can also set the stage for later obesity, diabetes, and other chronic diseases...”

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Maternal Diet Recommendations by the CDC



- An additional 330-400 kcal/day
 - Calorie requirement calculator- <https://www.nal.usda.gov/human-nutrition-and-food-safety/dri-calculator>
- Eat a variety of fish, 4 oz 2-3 times a week, from the 'best choice' list from the FDA
- 290mcg of iodine daily in the first-year pp
 - Dairy, eggs, seafood, iodized table salt
- 550mg of choline daily in the first-year pp
 - Dairy, eggs, meat, seafood, beans, peas, lentils
- Avoid high amounts of caffeine (>300mg/day, or >2-3 servings/day)
- Take B-12 and DHA supplement if limited in the diet (vegans, vegetarians)
- Possible use of a multivitamin, depending on the nutritional needs of the mother

<https://www.cdc.gov/breastfeeding/breastfeeding-special-circumstances/diet-and-micronutrients/maternal-diet.html>

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Breastfeeding and Food Allergies



A woman reports that her first child is allergic to eggs and peanuts.

She is contemplating a second pregnancy asks you if she should avoid eggs and peanuts in her diet during pregnancy and lactation, with the hope that her next child won't have these food allergies.

You advise:

- A. Yes, it would be wise to avoid these foods during pregnancy and lactation
- B. You just need to avoid them during lactation
- C. Avoiding these foods during pregnancy and lactation will not prevent food allergies.

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Breastfeeding and Food Allergies



- No good evidence to support avoidance of allergenic foods during pregnancy and/or lactation to avoid childhood food allergies.
- 1 systematic review found that maternal diet rich in fruits, vegetables, fish, foods with vit D and Mediterranean dietary pattern may be associated with lower allergy risk in infants.

Pediatrics 2019; 143(4)

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A maternal mediterranean diet is healthier for infant brain development

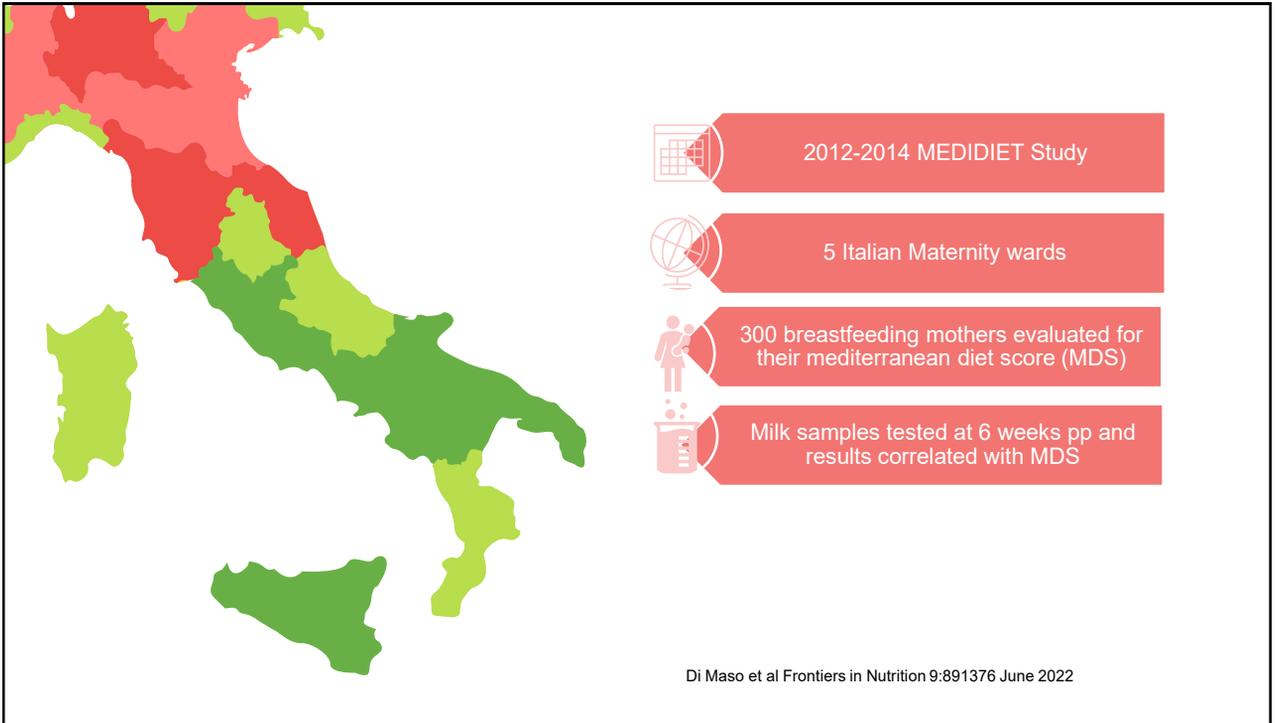
A. True

B. False

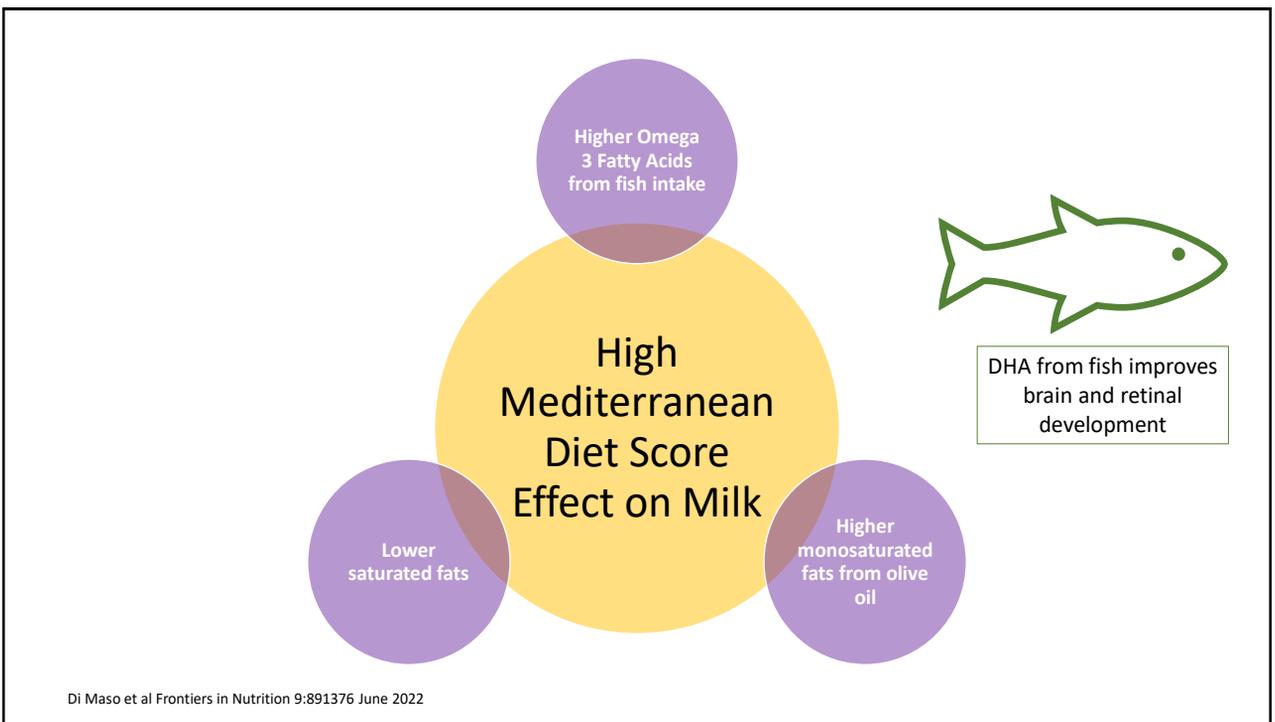
Di Maso et al Frontiers in Nutrition 9:891376 June 2022



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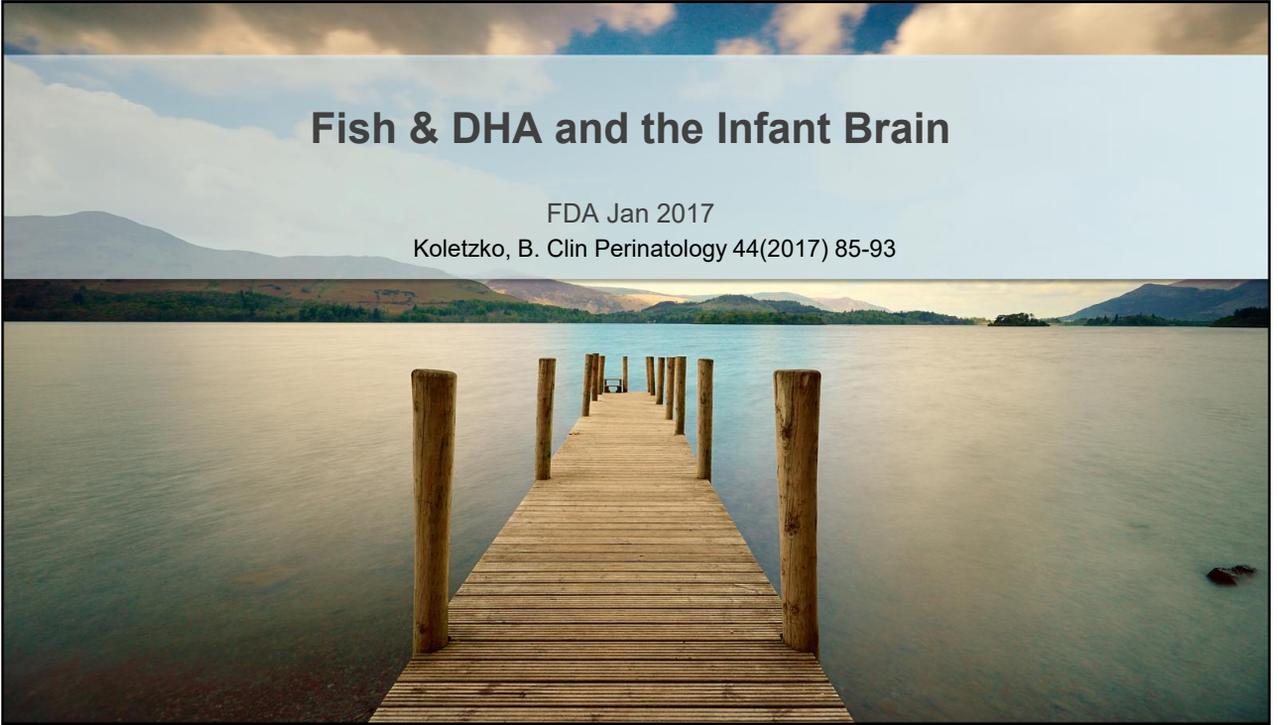


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Fish & DHA and the Infant Brain

FDA Jan 2017

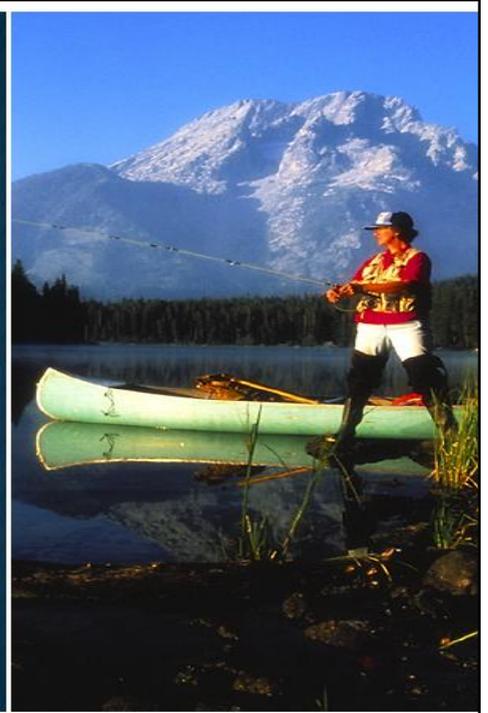
Koletzko, B. Clin Perinatology 44(2017) 85-93



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True or False?

Premature infants exposed to high amounts of DHA have improved visual function by the corrected age of 4 months **T** or F



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Fish & DHA and the Developing Infant Brain



- Breastfeeding meets the DHA needs of term infants, but not for preterm infants.
- For VLBW infants high DHA supplementation is associated with:
 - Enhanced visual and cognitive development
 - Reduced severe developmental delay
 - Reduced bronchopulmonary dysplasia
 - Reduced NEC
 - Reduced environmental allergies such as hayfever
- Mothers with VLBW infants need to take DHA supplements. Studies show that 3 grams of tuna oil/day would suffice.

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Fish & DHA and the Developing Infant Brain For Term Infants



- Fish is an important source of protein and DHA for pregnant and nursing individuals, and for children.
- DHA develops neural tissue
 - neurogenesis, neurotransmission, myelination, among other neurologic effects
- Moderate fish consumption during pregnancy is associated with a child's early verbal development and IQ.
 - If a pregnant person eats 8-12 oz of fish a week, her child may gain 3.3 extra IQ points by age 9.
 - More than 12 oz of week not shown to be beneficial, and increases mercury exposure
 - Eating less than 3 oz a week is harmful to the fetus
- Canned light tuna is the least expensive and safest way to consume the recommended amount of fish each week.

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Choose a variety of fish that are lower in mercury.

While it is important to limit mercury in the diets of those who are pregnant or breastfeeding and children, many types of fish are both nutritious and lower in mercury.

This chart can help you choose which fish to eat, and how often to eat them, based on their mercury levels.

What is a serving? As a guide, use the palm of your hand.

Pregnancy and breastfeeding:
1 serving is 4 ounces

Childhood:
On average, a serving is about:
1 ounce at age 1 to 3
2 ounces at age 4 to 7
3 ounces at age 8 to 10
4 ounces at age 11

Eat 2 to 3 servings a week from the "Best Choices" list
(OR 1 serving from the "Good Choices" list).

Eat 2 servings a week from the "Best Choices" list.

Best Choices			Good Choices		
Anchovy	Herring	Scallop	Bluefish	Monkfish	Tilefish (Atlantic Ocean)
Atlantic croaker	Lobster, American and spiny	Shad	Buffalofish	Rockfish	Tuna, albacore/white tuna, canned and fresh/frozen
Atlantic mackerel	Mullet	Shrimp	Carp	Sablefish	Tuna, yellowfin
Black sea bass	Oyster	Skate	Chilean sea bass/Patagonian toothfish	Sheepshead	Weakfish/seatrout
Butterfish	Pacific chub mackerel	Sole	Grouper	Snapper	White croaker/Pacific croaker
Catfish	Perch, freshwater and ocean	Squid	Halibut	Spanish mackerel	
Clam	Tilapia	Trout, freshwater	Mahi mahi/dolphinfish	Striped bass (ocean)	
Cod	Pickrel	Tuna, canned light (includes skipjack)			
Crab	Plaice	Whitefish			
Crawfish	Pollock	Whiting			
Flounder	Salmon				
Haddock	Sardine				
Hake					

Choices to Avoid HIGHEST MERCURY LEVELS

King mackerel	Shark	Tilefish (Gulf of Mexico)
Marlin	Swordfish	Tuna, bigeye
Orange roughy		

What about fish caught by family or friends? Check for [fish and shellfish advisories](#) to tell you how often you can safely eat those fish. If there is no advisory, eat only one serving and no other fish that week. Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants.

<https://www.fda.gov/food/consumers/advice-about-eating-fish>

www.FDA.gov/foodadvice
www.EPA.gov/fishadvice

U.S. FOOD & DRUG ADMINISTRATION

EPA United States Environmental Protection Agency

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Other options for omega-3 free fatty acids

- Algae-based supplements
- Flax
- Hemp
- Walnuts
- Seaweed, except for concerns about excessive iodine intake

Marshall et al Expert review of nutrition during pregnancy and lactation Am J Ob & Gyn May 2022

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A mother has a history of migraines, and she was told by her neurologist to take 400mg of vitamin B-2 (riboflavin) each day to prevent migraines. (The RDA is 1.3 mg) Now that she is breastfeeding, she is wondering if this is safe. The neurologist told her to ask a lactation consultant.

You advise:

A. No, because the amount is too high for the infant

B. Yes, it is safe because the amount in breastmilk is not excessively high



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Maternal Vitamin/Mineral Intake and Breastmilk Levels



Increased Intake Increases BM Levels

- Vitamins:
 - A, C, D, E
 - B-1, B-2, B-6, B-12
- Selenium

Increased Intake Does Not Change BM Levels

- Zinc
- Copper
- Iron
- Chromium
- Cadmium
- Calcium

Breastfeeding Med 12(9) 2017; Matern Child Nutr 2018; 14(S3)

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TABLE 2. HIGH-DOSE ORAL VITAMIN USES

<i>Vitamin</i>	<i>Use^a</i>	<i>Daily high dose^b</i>
B ₂	Migraine	400 mg
B ₆	Neuritis	200–600 mg
B ₁₂	Anemia, CV health, vegetarianism	250–5,000 mcg
Biotin	Skin and hair health	2.5 mg
C	Common cold	250–1,000 mg
D	Bone health, cancer prevention	2,000–6,000 IU
K	Bone health, CV health	1–5 mg

^aPurported benefits in the mother, not necessarily endorsed by the author. See NIH.⁹ for more information.

^bTypical doses likely to be encountered, see text and NIH.⁹
CV, cardiovascular.

Breastfeeding Med 14(5) 2019

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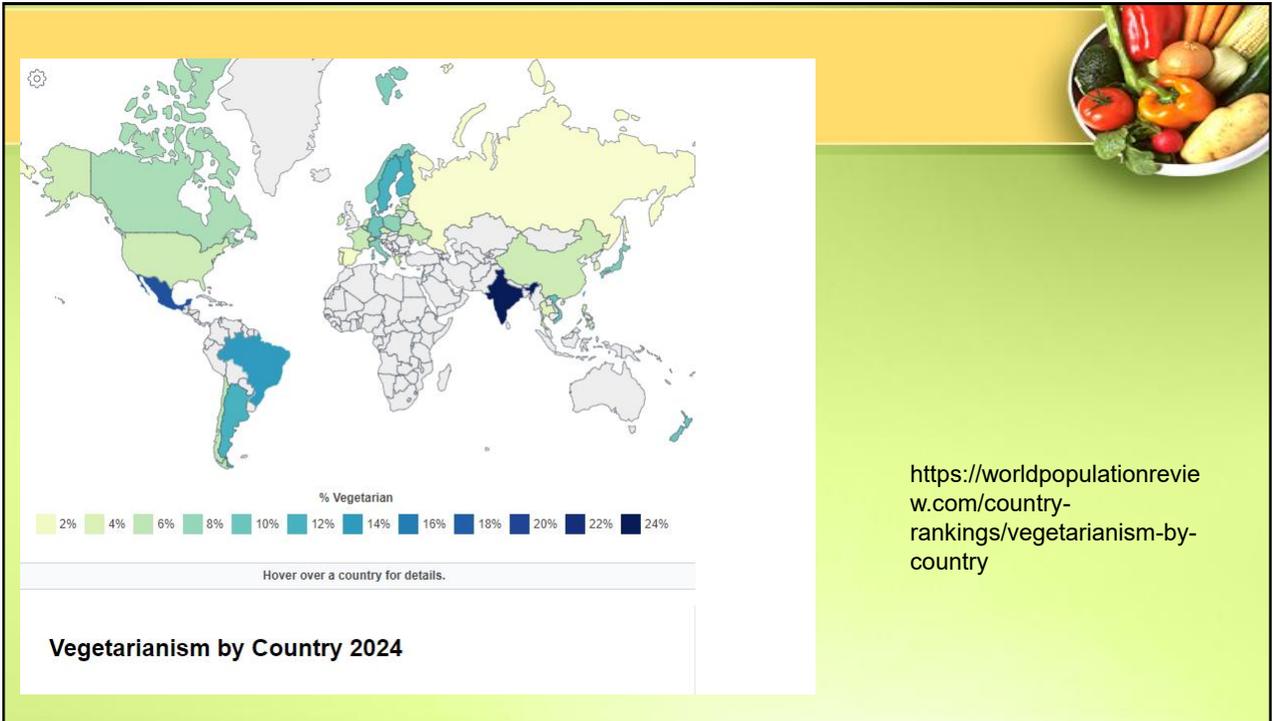
High Dose Vitamins During Lactation

Breastfeeding Med 14(5) 2019



- Vit C- highest dose of 4,000mg- infant dose safe, limit of transmission into BM
- B-2 (riboflavin)- High doses (400mg) for HA prevention- wide margin of safety. High doses used for neonates with hyperbili
- B-6- high doses markedly increase BM level. Best to avoid megadoses (over 200mg/day). Effect on infant not known
- B-12- supplements of up to 5000mcg a day is considered safe, based on BM levels. Wide margin of safety
- Vit K- mat doses of 1-5mg are safe for infant, similar to levels in formula
- Biotin- high mat doses of 2500mcg assumed safe, wide margin of safety

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Vegetarian/Vegan Diets and Breastmilk

- Vegetarian diets differ between individuals and cultures/populations.
- Low B-12 intake during lactation => low breastmilk B-12 content
- Lower DHA in breastmilk unless eating fish or supplementing with DHA
- Fewer saturated fats and trans fats in breastmilk
- Lower vit D levels in breastmilk without supplementation
 - Vit D is found in fish, liver oils, egg yolks. Less in beans, broccoli, leafy greens

Nutrients 2019, 11, 557

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The amount of vitamin D that a lactating mother needs to provide sufficient vitamin D in her breastmilk depends on her BMI.

- A. T
- B. F

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Vitamin D During Breastfeeding

- All infants require 400-1000 units of vitamin D each day
 - Responsible for bone metabolism and calcium homeostasis
 - Increases calcium absorption from the gut
 - Sources are UVB radiation, oily fish, fortified milks, or vitamins
- Nutritional rickets in USA 1986-2003
 - 83% AA, 96% breastfed, only 5% were supplementing with Vit D
- Vitamin D levels in breastmilk are based on maternal serum Vit D level
- Maternal dosing of 6400u of vit D-3 daily may bring BM levels to sufficiency
 - Mat Vit D dosing converts to 25 (OH) D in maternal liver within 24 hrs
 - 25 (OH) D does not pass into breastmilk, just D3
 - D3 needs to be taken EVERYDAY for adequate D in BM

Best Practice & Research Clin Endocrin & Metab 32 (2018) 39-45
Pediatrics 136 (4) Oct 2015 p. 625- 634

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Effect of BMI on Vitamin D Level

Mean 25(OH)D concentrations and bone mineral densities in all participants and by BMI subgroup at V1, V4 and V7

	Total	Maternal BMI category			P*	
		<25 kg/m ²	25 - <30	≥30 kg/m ²		
V1	Mean (SD) maternal 25(OH)D concentration, ng/ml N=234	34.1 (13.3) N=74	37.2 (14.8) N=74	34.7 (13.6) N=88	30.1 (10.0) N=72	0.004 ^B
	Mean (SD) maternal bone mineral density, g/cm ² N=224	1.01 (0.13) N=70	0.97 (0.15) N=70	1.01 (0.11) N=87	1.06 (0.11) N=67	<0.001 ^{B,C}
	Mean (SD) infant 25(OH)D concentration, ng/ml N=206	14.2 (9.4) N=67	15.5 (9.4) N=67	13.1 (9.2) N=80	14.5 (9.8) N=59	0.31
	Mean (SD) infant bone mineral density, g/cm ² N=197	0.21 (0.02) N=61	0.21 (0.02) N=61	0.21 (0.02) N=79	0.20 (0.02) N=57	0.37
V4	Mean (SD) maternal 25(OH)D concentration, ng/ml N=181	45.1 (20.1) N=73	47.4 (22.1) N=73	49.0 (20.9) N=55	37.9 (14.1) N=53	0.007 ^{B,C}
	Mean (SD) maternal bone mineral density, g/cm ² N=177	0.99 (0.12) N=72	0.94 (0.10) N=72	0.99 (0.12) N=54	1.05 (0.12) N=51	<0.001 ^{B,C}
	Mean (SD) infant 25(OH)D concentration, ng/ml N=173	44.3 (17.7) N=71	49.2 (17.8) N=71	39.3 (13.9) N=52	40.1 (16.3) N=48	0.001 ^{A,B}
	Mean (SD) infant bone mineral density, g/cm ² N=170	0.23 (0.02) N=66	0.23 (0.02) N=66	0.23 (0.02) N=52	0.23 (0.02) N=52	0.40
V7	Mean (SD) maternal 25(OH)D concentration, ng/ml N=130	44.9 (22.0) N=59	50.7 (24.7) N=59	41.3 (19.7) N=33	39.2 (17.4) N=38	0.02 ^B
	Mean (SD) maternal bone mineral density, g/cm ² N=129	0.97 (0.12) N=59	0.94 (0.11) N=59	0.97 (0.12) N=33	1.02 (0.11) N=37	0.007 ^B
	Mean (SD) infant 25(OH)D concentration, ng/ml N=111	42.8 (13.7) N=52	46.6 (13.6) N=52	38.8 (13.1) N=26	40.1 (13.4) N=33	0.02 ^A
	Mean (SD) infant bone mineral density, g/cm ² N=116	0.25 (0.02) N=55	0.25 (0.02) N=55	0.25 (0.03) N=25	0.24 (0.02) N=36	0.42

* P value calculated with ANOVA with Bonferroni correction. A=overweight vs. lean, B=obese vs. lean, C=obese vs. overweight

- All mothers given 6400 units of vitamin D supplementation
 - Lower vit D level in infants of high BMI moms
 - Higher bone density with higher BMI



J Pediatr 2017 Aug; 187: 147-152

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Lactating mothers have a higher calcium requirement than non-breastfeeding mothers



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Do Lactating Women Need More Calcium?

- 99% of calcium in a mother's body is in her bones
- Maternal PTH removes Ca from the bones into blood stream
- Calcium in BM comes from maternal bones (decrease in bone density)
- Mammary glands secrete PTH-related protein (PTHrP)
 - Liberates calcium from mother's bones
- High PRL inhibits estrogen/progesterone, allowing bone resorption
- When Ca in BM falls, PTHrP increases

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Bone Density Changes During Lactation

- Lumbar spine density decreases 5-10% during lactation (1-3%/month)
 - Hip, forearm and other sites much less bone loss
 - Less bone density loss for higher BMI
 - Higher estrogen level from body fat
- Greater milk output, greater bone density loss

J Bone Min Res 2017 Apr; 32(4)

28

Do Breastfeeding Women Need More Calcium?

- Recommendations for calcium intake are 1000mg for non-pregnant, pregnant, and lactating women
- Increasing mat calcium during lactation does not increase BM calcium level
 - Tight control by PTHrP
 - No increase in calcium from the gut during lactation
- Increasing mat dietary calcium does not decrease bone resorption
- Breastmilk calcium levels ~ 260mg/liter
- The higher the milk produced, the greater the maternal calcium loss from bones

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Sweeteners in Breastmilk



Artificial sweeteners are considered unsafe during breastfeeding

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Artificial Sweeteners

- Acesulfame- found in diet sodas and artificial sweetener packets
 - Level in BM related to maternal dose, lasts in BM at least 18 hours
 - Not likely to reach an intake higher than acceptable daily intake (Lactmed 2023)
- Aspartame- breaks down in maternal GI tract to aspartic acid and phenylalanine, so not found in breastmilk
 - Only results in a slight rise in BM phenylalanine level
- Saccharin
 - Level in BM related to maternal dose
 - 4 cans of diet soda with saccharin daily for 2 days=> level in BM safe according to FDA (under recommended daily limit as mg/kg/day)
- Sucralose
 - Poorly absorbed from GI tract, so not likely to reach infant bloodstream via lactation

Breastfeeding Med 14 (1) 2019 p. 15-16

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Artificial Sweeteners

- Stevia- no degree of toxicity or carcinogenicity so considered safe
- Xylitol- no information during lactation, but likely safe
- Mannitol, sorbitol considered safe, both have low intestinal absorption (e-lactancia.org)
- Erythritol- no information on pregnancy and lactation, but considered safe for children

Breastfeeding Med 14 (1) 2019 p. 15-16

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Low Calorie Sweetener (LCS) Study Infant Feeding Practices II

- Analyzed maternal and infant survey data collected at 3 mo pp from 2005-2007, ~667 dyads
 - Question about maternal soda and fruit drinks (diet or regular) intake within the Diet History Questionnaire
 - Intensity of LCS based on # of servings/day and bfeeding intensity
- Adjusted for confounders- mat age, race/ethnicity, income, education, marital status, gest DM, pre-preg BMI, gest weight gain, calories ingested/day, infant's birth wt, bfeeding intensity
- 43.4% of women reported consuming diet beverages (DB)
 - 15.3% reported at least 8-16 oz/ day
 - Higher intake among white women, vs Black, Hispanic, or other
 - Higher intake among those with a h/o gest DM and higher pre-preg BMI

Huang_ Nutrients 2021 13, 2154

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Low Calorie Sweetener (LCS) Study Infant Feeding Practices II- Findings

- No difference in infant weight for age or BMI for age between those ingesting DB or not
- Significantly higher reports of vomiting among the infants exposed to LCS
 - Only among those exposed to LCS \leq once per week
 - No higher risk of vomiting if exposed to LCS $>$ 1x/week
- Lactmed mentions this in their information on artificial sweeteners

Huang_ Nutrients 2021 13, 2154

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Natural Sugars

- Fructose- metabolized in the liver to triglycerides. Commonly used are agave and high-fructose corn syrup
 - Increased maternal dietary intake increases BM levels within 3 hours
 - Fructose concentration remains elevated for 5 hours
 - One study showed that for 1mg/L increase in BM fructose is associated with a 257 gram increase in infant body weight, 170g increase in lean mass, 131g increase in fat mass and 5g increase in bone mineral content (Nutrients 2017; 9; 146)
 - Sucrose- table sugar=> fructose and glucose
 - Hyperglycemia in mothers associated with higher BM glucose levels (J Ped gastr nutr 1987 Nov-Dec;6(6): 936-41)

Breastfeeding Med 14 (1) 2019 p. 15-16

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Fructose and Infant Brain Development

- A study of 88 Hispanic lactating dyads performed a 24 h dietary recall at 1 and 6 mo (well controlled for many other confounders)
 - Sugar sweetened beverages and juices (SSB + J) at 1 mo pp correlated with poorer Bayley-III neurodevelopment scores at 24 months of age
 - Maternal whole fruit intake didn't matter
 - Maternal SSB + J intake at 6 months pp didn't have an impact
 - Infant fructose and SSB + J at 24 mo didn't have an impact
- Exposure to fructose at critical times may impair infant brain development
 - Decreased antioxidant enzymes in frontal cortex
 - Decreased brain-derived neurotrophic factor (a protein that supports brain development)

Am J Clin Nutr 112 (6) Dec 2020

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Keto Diet During Lactation

- Lactation requires glucose
 - To make lactose
 - For general functioning of glandular tissue
- Keto diet is high in fat, adequate in protein, and low in carb (glucose)
 - Energy comes from fat broken down into fatty acids
 - People become ketotic
- Lactating women often try to lose preg weight gain
- Ketoacidosis is the risk of the Keto diet for anyone
 - Blood becomes acidic => life-threatening
 - Bodily stress increases risk of ketoacidosis

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TABLE 1: Literature review of existing case reports and their precipitating factor.

Case Report	Precipitating Factor
A case of lactation "bovine" ketoacidosis [14]	Breastfeeding twins in the setting of a "selected diet"
A severe case of iatrogenic lactation ketoacidosis [15]	Nil per oral for 3 days to treat a bowel obstruction
"Bovine ketosis" in a nondiabetic postpartum woman [16]	Urinary tract infection in the setting of a weight reduction diet
Severe spontaneous "bovine" ketoacidosis in a lactating woman [17]	Urinary tract infection in the setting of a high protein, carbohydrate-free reduction diet
A case of bovine ketoacidosis in a lactating woman [18]	2-day nausea & vomiting in the setting of several small high-protein carbohydrate-free meals
Ketoacidosis associated with low-carbohydrate diet in a non-diabetic lactating woman [19]	Low carbohydrate, high fat diet for 10 days
Starvation ketosis in a breastfeeding woman [20]	Bariatric surgery during lactation
Severe ketoacidosis in breastfeeding woman with low energy and carbohydrate intake [21]	Illness while on a low carbohydrate diet
Ketoacidosis in a non-diabetic woman who was fasting during lactation [22]	Starvation during lactation due to abdominal pain
Lactation ketoacidosis: an unusual entity and a review of the literature [23]	No precipitating factor except for lactation
Life-threatening lactation or Bovine ketoacidosis [24]	Frequent skipping of meals while on a high protein, low carbohydrate diet
A rare cause of metabolic acidosis: ketoacidosis in a non-diabetic lactating woman [25]	Gastroenteritis in the setting of a low carbohydrate diet

Case Reports in Nephrology 2019

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Maternal Egg Consumption During Lactation Matern Child Nutr 2018; 14(S3)



Eggs are one of the best sources of choline

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F

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Maternal Egg Consumption During Lactation

- Excellent source of DHA, choline, lutein, zeaxanthin, riboflavin, B-12
- Choline
 - Precursor for neurotransmitters acetylcholine and sphingomyelin (forms white matter)
 - Promotes long term memory and cognition
 - Eggs are the most concentrated source of choline
 - 2 eggs provide 53% of maternal daily choline requirement during lactation
 - Other sources are meat, poultry, fish (animal-food sources)



Nutrients 2018, 10; 1513

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Maternal Choline intake, Fetal Brain Development, and Child Neurocognition

- Lower maternal intake of choline during pregnancy is associated with higher risk of neural tube defects.
- Higher maternal choline intakes during the second ½ of pregnancy and early pp associated with favorable effects on child neurocognition such as memory, attention, and visuospatial learning



Obeid et al Adv in Nutrition 13(6) Nov 2022

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Foods Rich in Choline (mg/100g)

- Salmon –smoked– 220mg/100g
- Chicken –roasted– 79mg/100g
- Salmon –cooked– 91mg/100g
 - Tilapia – 83mg/100g
- Soy protein powder – 86mg/100g
 - Peanut Butter – 66mg/100g
 - Cocoa powder – 115mg/110g
 - Skim Milk – 38mg/cup



- Fried egg – 270/100g
- Hard-boiled egg – 230/100g
- Large Egg (one) – 120mg
- Beef Liver – 350mg/100g
- Chicken Liver – 330mg/100g
- Almonds – 52mg/100g
- Broccoli – 40mg/100g
- Brussels sprouts – 41mg/100g
- Cauliflower – 39mg/100g

Institute of Medicine
recommends 550mg/day
during breastfeeding,
450mg/day during pregnancy

USDA Database for Choline in Common Foods, Release Two, USDA-ARS, Jan 2008.

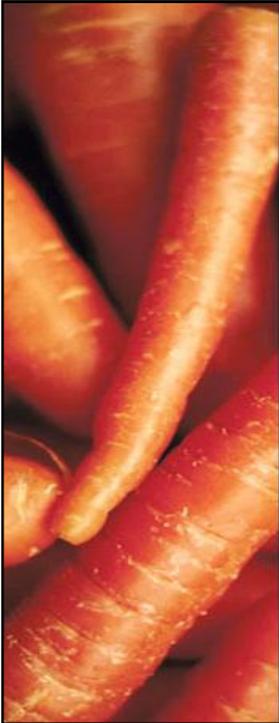
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Carotenoids During Lactation



Nutrients 2017 Aug 4;9 (8); Zielinska Nutrients 2019 Jan 18 (11)

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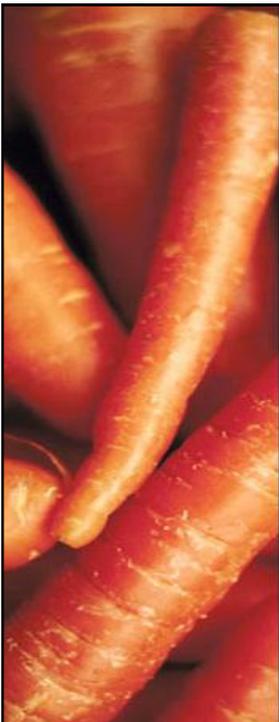


Carotenoids and Breastfeeding

- Antioxidants
 - 95% are beta-carotene, alpha-carotene, lycopene, beta-cryptoxanthin, lutein, zeaxanthin
 - Yellow, orange, red colors of produce
 - Also found in egg yolk, trout, salmon
- Highest level is in the brain
- Cannot be manufactured, must be taken in via diet

Nutrients 2017 Aug 4;9 (8); Zielinska Nutrients 2019 Jan 18 (11)

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Lactating individuals should avoid excessive orange vegetables during lactation to prevent carotenemia



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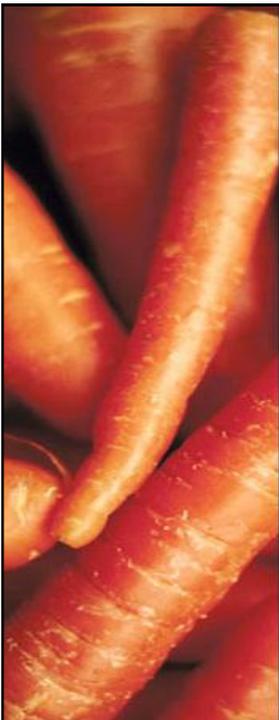


Carotenoids in Breastmilk

- Increased intake of carotenoids associated with increased levels in breastmilk
- Highest concentration in colostrum
- Highest in the fat content
- FDA does not require carotenoids in formula

Nutrients 2017 Aug 4;9 (8); Zielinska Nutrients 2019 Jan 18 (11)

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Role of Carotenoids in Breastmilk

- Anti-oxidants, prevent oxidative stress
 - Prevents decreased blood flow to fetus
 - Prevents inflammatory illnesses such as NEC, respiratory distress syndrome and bronchopulmonary dysplasia
 - Evidence of reducing risk of pre-eclampsia
- Promote optimal retinal development
 - Higher macular pigment optical density in infants with higher carotenoid levels
 - Low concentration of macular carotenoid pigment is a risk factor for macular degeneration
- Can be converted to vitamin A by the infant, essential for infant lung maturity and function

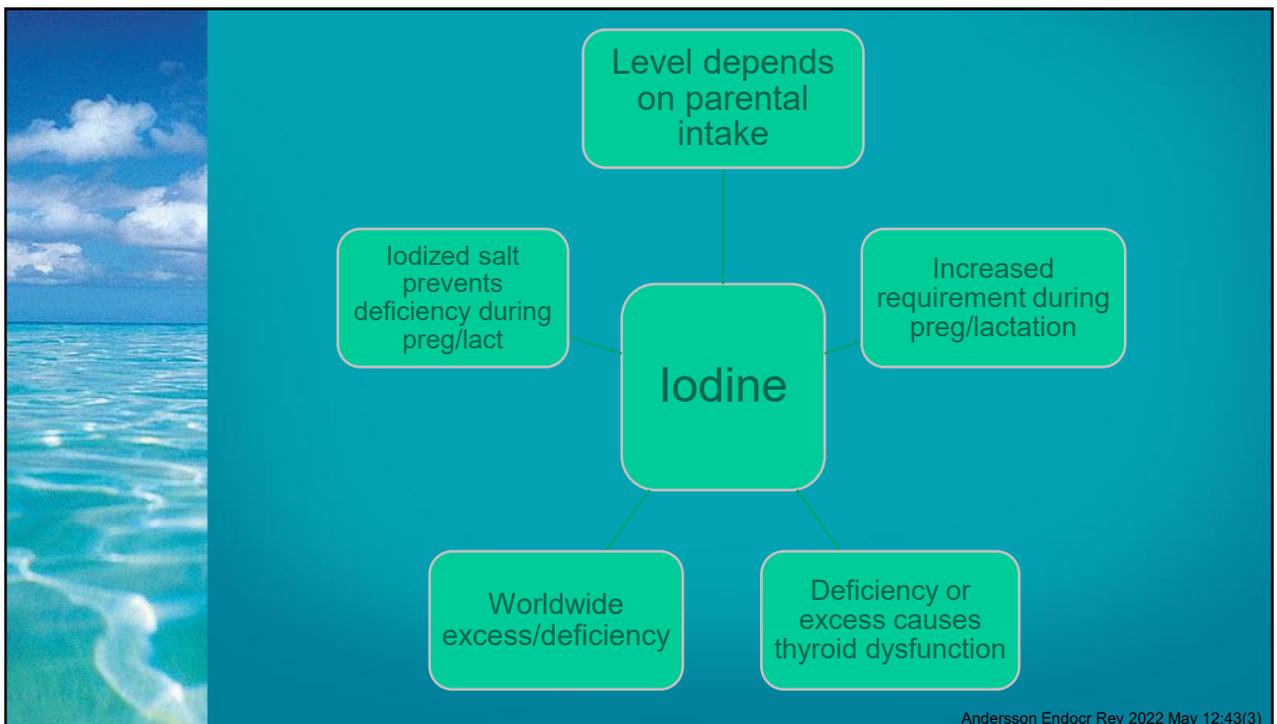
Nutrients 2017 Aug 4;9 (8); Zielinska Nutrients 2019 Jan 18 (11)

48

Iodine intake during lactation can affect infant thyroid function

~~True~~
False

49

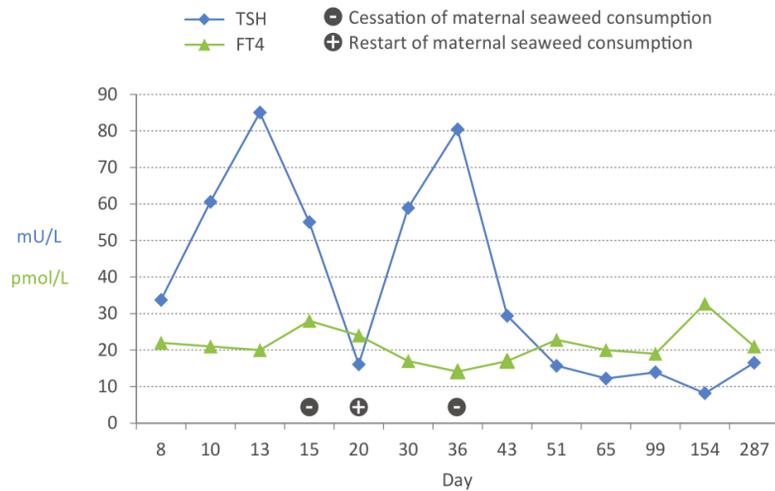


50

Case report of an infant with abnormal thyroid function on newborn screening

The mother consumed seaweed daily during pregnancy and lactation:

- Wakame miso soup daily
- Algae powder daily
- Hijiki or arame seaweed once a week
- Nori once a week



High TSH indicates low thyroid function

BMJ Case Rep 2021;14:e237930

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Other means of iodine overload during lactation

- RDA for iodine during lactation= 290mcg/day, according to CDC
- In many East Asian cultures, seaweed is considered a galactagogue, so consumed in large amts in the first few weeks
 - 1 cup of seaweed soup= 500-1700 mcg
- Infants exposed to high iodine in milk are protected by the Wolff-Chaikoff effect, which blocks iodine transport into the thyroid, => decreased thyroid function. The blockage lasts longer in infants than in adults
 - Some infants have permanent thyroid dysfunction

Andersson Endocr Rev 2022 May 12;43(3)

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Iodine Deficiency During Lactation

- Infants depend on parental intake of iodine during lactation
 - Infant RDA = 80mcg/day
- Primary source of iodine is iodized salt
 - Low amounts of iodine in produce
 - Seafood and seaweed are highest food sources of iodine
- Parental iodine deficiency can cause low thyroid function in the breastfed infant
- Breastmilk iodine levels typically normal in populations using iodized salt



Andersson Endocr Rev 2022 May 12;43(3)

53



Higher protein intake is associated with higher protein levels in human milk

~~True~~
False

54

Maternal BMI and Macronutrient Breastmilk Composition

- 40 mothers from Warsaw Poland
 - Healthy, term infants, exclusive breastfeeding, nonsmokers, all highly educated
- BM composition measured during 1st, 3rd, and 6th months
- Higher protein content with higher BMI (higher fat mass)
- No association between protein, fat, carb intake in mat diet and BM levels
- Low carb diet does not change lactose content of BM
 - Lactose is the most stable macronutrient, since it drives milk volume
- Milk composition is stable during Ramadan
- Fat concentration is independent of fat intake



Victor Amenze on Unsplash

55



The maternal diet during lactation plays a role in the infant gut microbiome:

- True
- False

56

Mantziari. Factors influencing the microbial composition of human milk
Sem Perinat 45(8) Dec 2021



Fig. 1 – Factors influencing the microbial composition of human milk.

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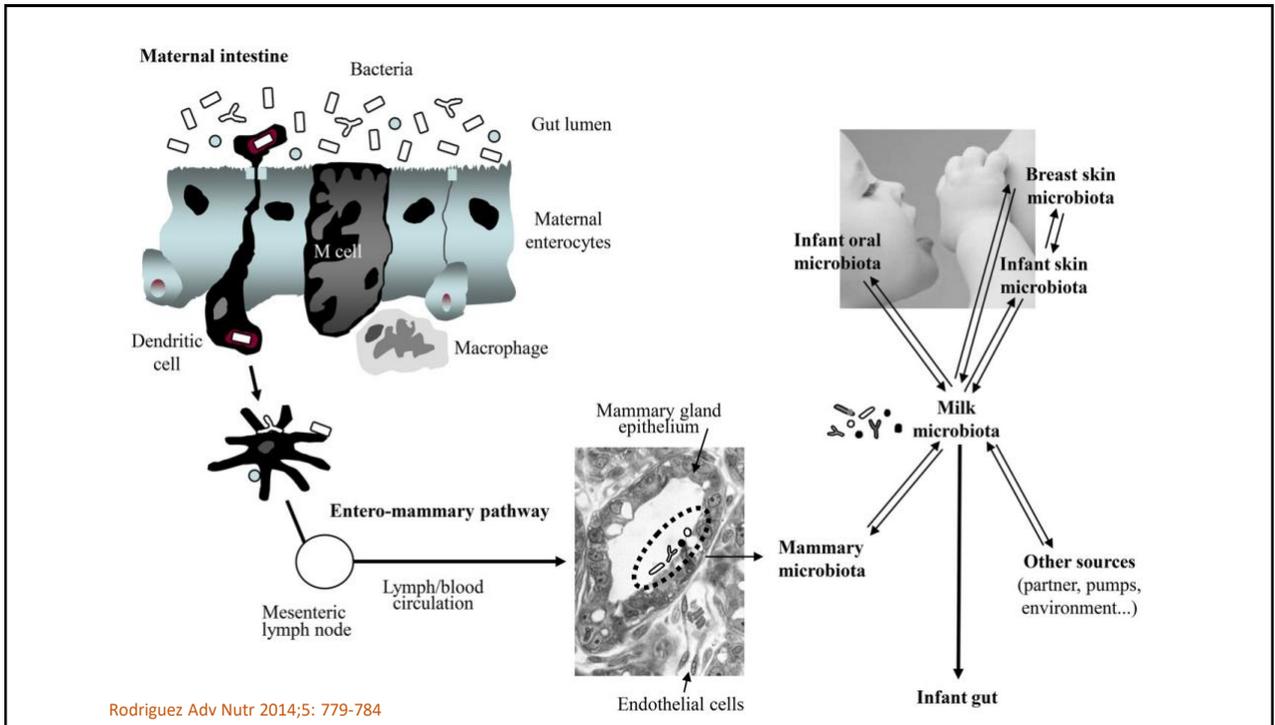
Maternal Intake of Fiber During Breastfeeding



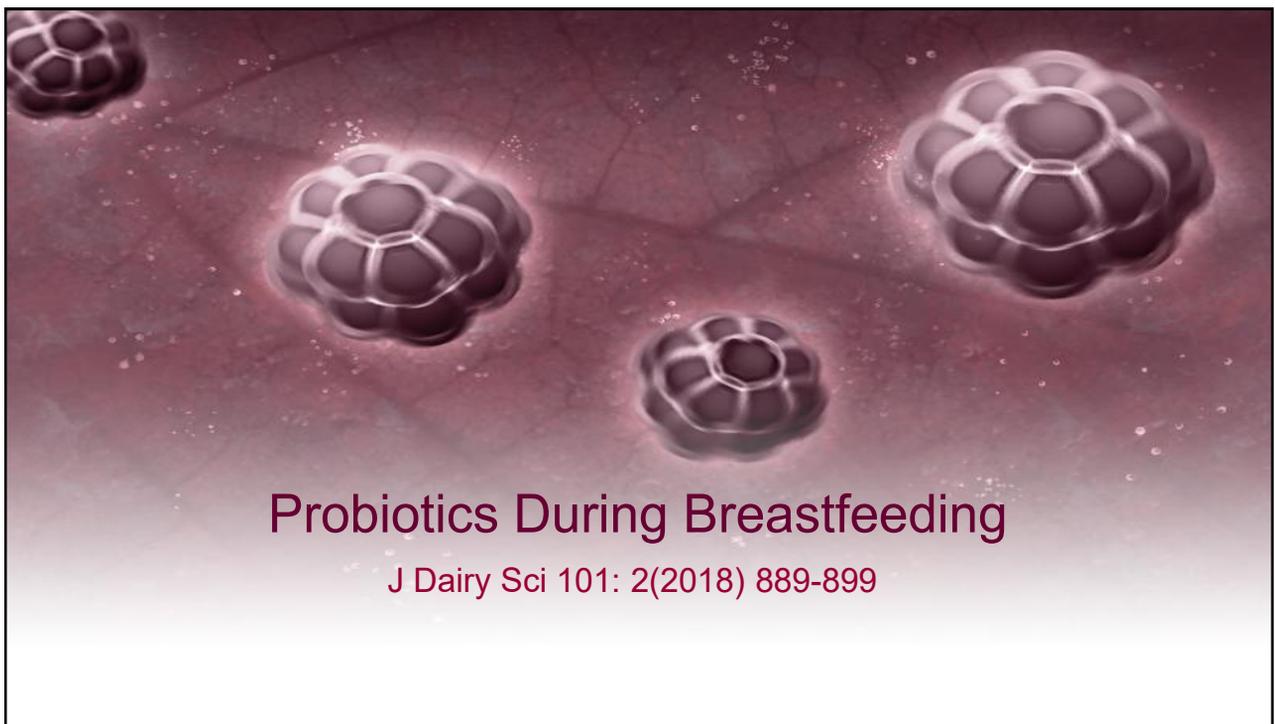
- Dietary fiber are ‘microbiota-accessible carbohydrates’ (MACs)
 - Whole grains, fruits, vegetables, legumes
- Fibers reduce risk of death and chronic disease
 - Reduced inflammatory markers
- Fiber-rich foods during pregnancy found to decrease allergic diseases in infants
- Gut bacteria are required to break down fibers
 - Humans don’t make the enzymes themselves, rely on gut bacteria
 - Wide range of bacteria are needed, since bacteria vary in what enzymes they have
- A wide variety of bacteria are supported with 30g of varied fibers in mat diet
- Healthier gut bacteria populate breastmilk and are transmitted to infant => Higher Bifidobacterium and lactobacillus

Nutrition and Metabolic Insights 12(1-10) 2019; Cortes-Macias J Nutr 2020:00:1-11

58



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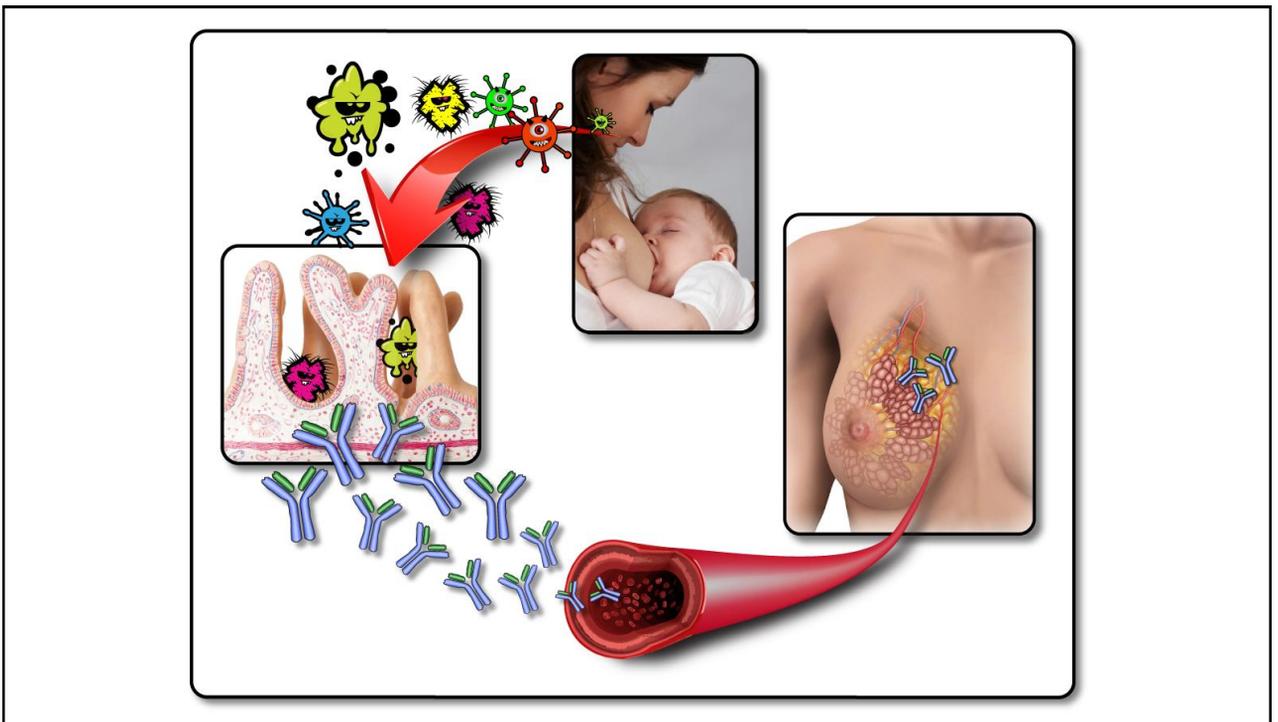


60

Probiotics taken during breastfeeding will show up in the breastmilk

~~T~~
F

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62

The ProPACT Trial Prevention of Allergy among Children in Trondheim (Norway)

- 415 breastfeeding mothers randomized to fermented milk with *Lactobacillus rhamnosus*, *acidophilus*, and *Bifidobacterium animalis lactis* vs milk w/o bacteria
- Milk was ingested daily from 36 wk gest thru 3 mo pp
- Milk samples on day 10 pp and at 3 mo pp
 - No significant amount of probiotic transfer into the BM
 - Probiotic DNA found in only a few of the mothers taking the fermented milk
- Probiotics were more likely to be found in infant gut
 - Effect of probiotic during pregnancy, not lactation

J Dairy Sci 101: 2(2018) 889-899

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Conclusions



Healthy dietary advice for lactation individuals include:

1. Eat fish 2-3 times a week, or other foods with omega 3 FFA, or take a DHA supplement
2. Give the infant vitamin D supplement, as we don't know the optimal dose of vitamin D for each lactating parent
3. Supplement with vitamin B12 or other vitamins if at risk for deficiency.
4. Eat a plant-based diet that is adequate in choline, carotenoids, fiber
5. Use iodized salt
6. There is no increased need for calcium during lactation
7. A strict keto diet is not safe during lactation

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