

Nutrition, Dietary Supplements and Oral Health



Tieraona Low Dog, MD

Founder: Medicine Lodge Ranch

National Geographic's: *"Life Is Your Best Medicine," "Healthy At Home,"*
and *"Fortify Your Life"*

www.DrLowDog.com

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"THE FOOD YOU EAT
CAN BE EITHER
THE SAFEST
&
MOST POWERFUL
FORM OF MEDICINE
or
THE SLOWEST
FORM OF POISON."

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Nutrition Matters

- Oral cavity is **intersection of medicine and dentistry** and window into the general health of an individual.
- Estimated **>100 systemic diseases and upward of 500 medications have oral manifestations**, typically more prevalent in elders.
- **Diabetes bidirectional relationship** with periodontal disease; **inflammation** impairs body's ability to use **insulin** and high blood sugar provides **ideal environment for infection**, including gum infections. Strong evidence that **treating one condition positively impacts the other**.

Garton BJ. Root caries and diabetes: risk assessing to improve oral and systemic health outcomes. *Aust Dent J*. 2012;57(2):114-122.

Alpert PT. Oral health: the oral-systemic health connection. *Home Health Care Manag Pract*. 2017;29(1):56-59.

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Obesity and Periodontal Disease

- There is **strong link between obesity and periodontal disease** in adults, children and various global geographic locations.
- NHANES: **overweight person with central obesity**, prevalence of **tooth loss increased 31%**, compared to person with similar BMI but no central obesity, and increased by **40%**, compared with **normal-weight person** without central obesity.
- **Oral microbiota** significantly altered and **less diverse** in obese individuals compared to non-obese controls.

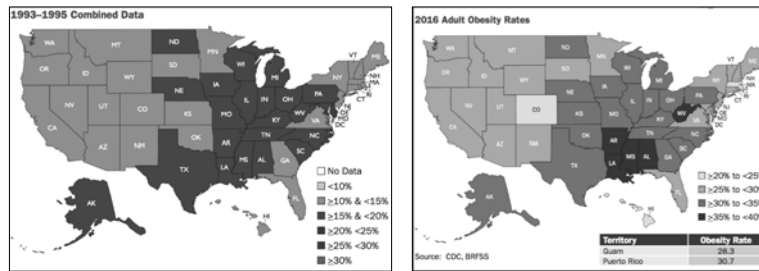
Kang J, et al. Association between central obesity and tooth loss in the non-obese people: Results from the continuous National Health and Nutrition Examination Survey (NHANES) 1999-2012. *J Clin Periodontol* 2019 Feb 21. doi: 10.1111/jcpe.13091.

Tam J, et al. Obesity alters composition and diversity of the oral microbiota in patients with type 2 diabetes mellitus independently of glycemic control. *PLoS One*. 2018 Oct 1;13(10):e0204724.

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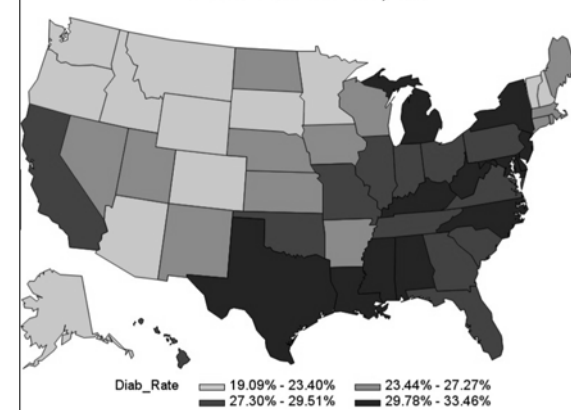
The Changing Landscape of Adult Weight



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Diabetes Period Prevalence, 2015



<https://www.cdwdata.org/web/guest/medicare-charts/medicare-chronic-condition-charts>

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SCIENTIFIC
AMERICAN.

PUBLIC HEALTH

The Hunger Gains: Extreme Calorie-Restriction Diet Shows Anti-Aging Results

A new study shows five days of hunger a month may reduce risk factors for aging and age-related diseases

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Caloric Restriction?



Canto is 27 year old monkey on CR diet, Owen is 29 year old on unrestricted diet.

news.wisc.edu/monkey-caloric-restriction-study-shows-big-benefit-contradicts-earlier-study/
Ravussin E, et al. *J Gerontol A Biol Sci Med Sci*. 2015;70(9):1097-104

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- 25 year study University of Wisconsin: **76 rhesus monkeys aged 7-14 years**, fed a diet reduced in calories by 30%.
- **Disease 3 fold greater in control group.** No evidence of diabetes in any caloric-restricted animal.
- 2-year study randomized 218 non-obese people to current diet or 25% caloric restriction (**11.7%** on average).
 - **Statistically significant reduction in inflammatory markers, weight loss, improved mood, sleep duration, etc.**

Fasting-Mimicking Diets (FMD)



Wei M, et al. Fasting-mimicking diet and markers/risk factors for aging, diabetes, cancer, and cardiovascular disease. *Sci Transl Med* 2017; 9(377).

- **100 healthy participants** 2 study arms tested FMD 5 consecutive days each month for 3 months.
 - **1100 calorie first day, 700 calories for 4 days (plant based, multivitamin).** Ate whatever they wanted rest of the month.
- Three FMD cycles reduced **body weight and total body fat; lowered blood pressure, cholesterol, triglycerides and IGF-1.** Lean muscle mass remained unchanged.
- Note: **25% drop-out rate**
- **Effects noted 3 months AFTER study ended.**

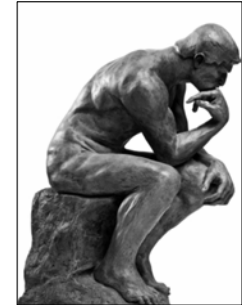
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Personalized Diets

- Personalized diets based on individual's genome to reduce disease risk is one of the biggest opportunities and challenges being discussed in scientific/nutrition community.
- *And it is the future.....*

Corella D, et al. Utilizing nutritional genomics to tailor diets for the prevention of cardiovascular disease: a guide for upcoming studies and implementations. *Expert Rev Mol Diagn* 2017 May;17(5):495-513.



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INFLAMMATION.....



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Dietary Inflammatory Index (DII)

- Anti-inflammatory diet may reduce **sub-chronic inflammation** and improve **cardiovascular, metabolic, and neurologic parameters.**
- **Dietary Inflammatory Index** based on measuring inflammation in the body in response to specific foods (many clinical trials).
- You can take test by **downloading the app for Dietary Inflammatory Index** (iTunes: DII Screener)

Cancel Question #3 Next

1 of 25

What was your average intake of bananas over the last year?

1 banana = 1 medium banana

Small Serving	Medium Serving	Large Serving
Never		
1 Per Month		
2-3 Per Month		
1 Per Week		
2 Per Week		
3-4 Per Week		
5-6 Per Week		
1 Per Day		
2+ Per Day		

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Inflammatory Food Ratings

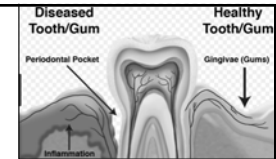
200 or higher	Strongly anti-inflammatory
101 to 200	Moderately anti-inflammatory
0 to 100	Mildly anti-inflammatory
-1 to -100	Mildly inflammatory
-101 to -200	Moderately inflammatory
-201 or lower	Strongly inflammatory

FOOD	SERVING SIZE	SERVING SIZE (GRAMS)	IF RATING
AGAVE NECTAR	1 TBSP	21	-74
ALMOND BUTTER	¼ CUP	64	100
CHEESE, CHEDDAR	1 OUNCE	28.35	-20
CHICKEN BREAST, RSTD	3 OUNCES	85	-19
MILK, WHOLE	1 CUP	246	-46
OLIVE OIL	1 TBSP	14	74
ONIONS, COOKED	½ CUP	105	240
RICE, WHITE	1 CUP	158	-153
SPINACH	1 CUP	30	75
SALMON, SOHO BAKED	3 OUNCES	85	450
TURMERIC	½ TSP	1.5	338

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Inflammation and the Oral Cavity



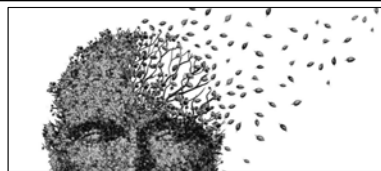
- Inflammation and periodontal disease well established.
- Tobacco and alcohol major risk factors for oral and pharyngeal cancers, but in large cohort, **higher DII scores increased risk of oral/pharyngeal cancer.**
- NHANES – those with highest DII score had **16% more teeth lost compared to those with lowest scores.**

Shivappa N, et al. Inflammatory potential of diet and risk of oral and pharyngeal cancer in a large case-control study from Italy. *Int J Cancer* 2017; 141(3):471-479; Kotsakis GA, et al. Diet-borne systemic inflammation is associated with prevalent tooth loss. *Clin Nutr* 2018 Aug;37(4):1306-1312.

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Mediterranean Dietary Pattern Inflammation & Memory



- **Mediterranean diet associated with lower dementia risk.**
- Researchers evaluated inflammatory potential of diet in relation to mild cognitive impairment/dementia risk using the **DII during an average follow up of 9.7 years during Women's Health Initiative Memory Study.**
- **Higher inflammatory scores** were significantly associated with **greater cognitive decline and earlier onset of cognitive impairment.**

Hayden KM, et al. The association between an inflammatory diet and global cognitive function and incident dementia in older women: The Women's Health Initiative Memory Study. *Alzheimers Dement* 2017 May 19. pii: S1552-5260(17)30185-1.

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Mediterranean Dietary Pattern

- **13 meta-analyses observational studies + 16 meta-analyses of randomized controlled trials** investigated association between Mediterranean diet and 37 different health outcomes **>12,800,000 subjects.**
- Robust evidence (P-value<0.001) show greater adherence to Mediterranean diet associated with **reduced risk of overall mortality, cardiovascular disease, heart attack, overall cancer incidence, diabetes, neuro-degenerative diseases and lower inflammatory markers.**

Dinu M, et al. Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomized trials. *Eur J Clin Nutr* 2017; May 10. doi: 10.1038/ejcn.2017.58.

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Turmeric (*Curcuma longa*)

- Family: Zingiberaceae (ginger family)
- Part Used: Rhizome
- Perennial plant tropical areas, most grown in India, they consume 80% of crop. Used in meat, fish and vegetable curries.
- Long history of medicinal use ~4,000 years.
- In ancient Ayurvedic literature, called Jayanti, meaning “one who is victorious over disease.”

www.ncbi.nlm.nih.gov/books/NBK92752/ Accessed September 2, 2018



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Turmeric: the Curcuminoids

- Potent anti-inflammatory.
- Studies suggest **beneficial for osteoarthritis, gut inflammation, improving microbial diversity, and topically for wounds.**

Gupta S, et al. Curcumin, a Component of Turmeric: From Farm to Pharmacy. *Biofactors* 2013; 39(1):2-13

Bannuru RR, et al. Efficacy of curcumin and Boswellia for knee osteoarthritis: Systematic review and meta-analysis. *Semin Arthritis Rheum* 2018 Mar 10. pii: S0049-0172(18)30002-7



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Turmeric and Oral Health

- Systematic review: two studies were categorized as low and three as moderate risk of bias. **Turmeric/curcumin applied topically as a gel or as a mouthwash.**
- Patients treated with turmeric/curcumin experienced reduced grade of mucositis, pain, erythema intensity, and ulcerative area.
- **Current evidence suggests that topical application of turmeric or curcumin is effective in controlling signs and symptoms of oral mucositis.**
- **Very limited data** suggest that topical turmeric/curcumin may have some benefit for oral lichen planus.

Normando AGC, et al. Effects of turmeric and curcumin on oral mucositis: A systematic review. *Phytother Res* 2019 Mar 6. doi: 10.1002/ptr.6326.

White CM, et al. Curcumin, a turmeric extract, for oral lichen planus: A systematic review. *Oral Dis* 2019 Jan 7. doi: 10.1111/odi.13034.

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Turmeric: Cardiovascular

- **Meta-analysis 20 studies** found a significant decrease in **serum triglycerides and elevation of HDL-C.**
- A 12 week randomized, placebo controlled trial in 118 people with type-2 diabetes found that **1000 mg curcumin + 10 mg piperine/d** led to **significant reduction in serum total cholesterol, non-HDL-C and lipoprotein (a)**

Simental-Mendia LE, et al. Lipid-modifying activity of curcuminoids: A systematic review and meta-analysis of randomized controlled trials. *Crit Rev Food Sci Nutr* 2017 Nov 29:1-10.

Panahi Y, et al. Curcuminoids modify lipid profile in type 2 diabetes mellitus: A randomized controlled trial. *Complement Ther Med* 2017 Aug;33:1-5.

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Macro and Micronutrients

- Relationship between nutrition and oral health well known. Variety of nutrients have a major impact on periodontal health.
- Two types of nutrients we will discuss today: **macronutrients and micronutrients**.
 - Macronutrients** required in large quantities (proteins, carbohydrates, and fats)
 - Micronutrients**: components of food required in small/trace amounts (e.g., vitamin A, B6, D, etc.)

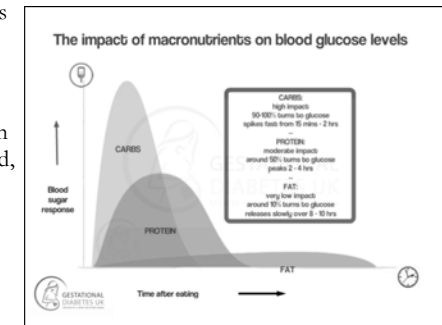


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Carbohydrates

- Provide majority calories most diets
 - Body's preferred fuel source
- Largest contributor to the control of **blood sugar**
- Half** of carbohydrates in North American diet come from: bread, soft drinks, cakes, cookies, donuts, quick breads, sugars, syrups, jams, white potatoes (including chips) and breakfast cereal.

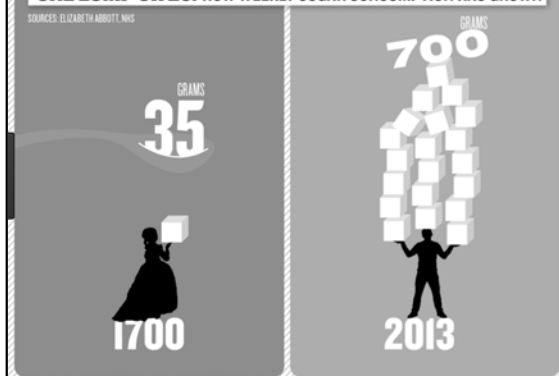


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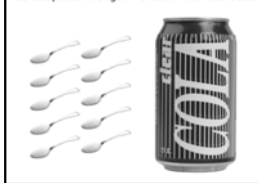
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ONE LUMP OR 20: HOW WEEKLY SUGAR CONSUMPTION HAS GROWN

SOURCES: ELIZABETH ABBOTT, MMS



10 teaspoons of sugar = 1 can of non-diet soda



This equals 32 pounds of sugar per year simply from 1 can soda per day

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Sugar Consumption and Tooth Decay

- Sugars contribute to dental caries and periodontal disease:** bacteria ferment them and produce acid, demineralizing tooth structure.
- Children who consume sugary drinks and sweets, particularly as snacks, have **higher incidence of dental decay**.
- Canada (2015), average daily total sugars consumption **101 grams (24 teaspoons) for children aged 1-8, 115 grams (27 teaspoons) children aged 9-18, and 85 grams (20 teaspoons) for adults**.

Skafida V, et al. Positive association between sugar consumption and dental decay prevalence independent of oral hygiene in pre-school children: a longitudinal prospective study. *J Public Health* 2018; 40(3): e275-e283.

Langlois K, et al. Change in total sugars consumption among Canadian children and adults. *Health Rep* 2019 Jan 16;30(1):10-19.

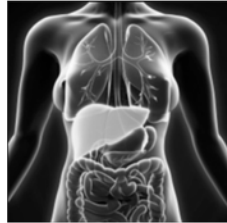
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Sugars



- Table sugar (sucrose): **one glucose + one fructose** molecule
- **High fructose corn syrup**: 55% fructose, 42% glucose and 3% other sugars.
- Every cell in body readily converts glucose into energy. But *liver cells are one of few types of cells that can convert fructose to energy.*
- Large amounts of “free” fructose *taxes the liver and increases risk of non-alcoholic fatty liver disease.*



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Glycemic Index/Load

Low Glycemic Diet
Calculator

- **Glycemic load** is measurement of impact of carbohydrates on **blood sugar/insulin**.
- International **consensus** conference concluded that given **consistency of scientific evidence**, diets **low in glycemic index/load** should be promoted in the **prevention and management of *diabetes*** and **coronary heart disease**, and are **particularly important** in individuals with **insulin resistance**.

Augustin LS, et al. Glycemic index, glycemic load and glycemic response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). *Nutr Metab Cardiovasc Dis* 2015 Sep;25(9):795-815.



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Glycemic Load and Mood

- 82 healthy weight and healthy overweight or obese, adults enrolled in randomized, crossover controlled feeding study.
- Compared to a low GL diet, consumption of **high GL diet** resulted in:
 - 38% higher score for **depressive symptoms** ($P = 0.002$)
 - 55% higher score for **total mood disorder** ($P = 0.05$)
 - 26% higher score for **fatigue/inertia** ($P = 0.04$), compared to low GL diet.



Bresmeyer KL, et al. *Appetite* 2016; Dec 1;107:253-259.

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Glycemic Load

Individual Food Portion

Low	0-10
Moderate	11-19
High	20+

Whole Day

Low	< 80
Moderate	80-120
High	>120

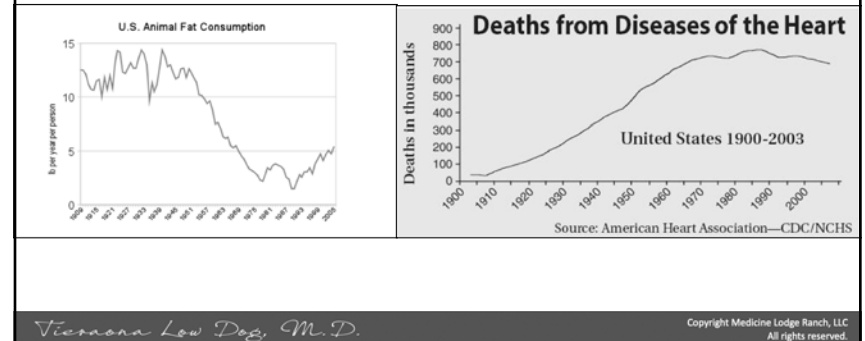
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Food	Serving Size	Glycemic Load	Food	Serving Size	Glycemic Load
Grapefruit	½ large	3	Spaghetti	1 cup	38
Apple	1 medium	6	Brown rice	1 cup	23
Banana	1 large	14	White rice	1 cup	33
Raisins	1 small box	20	White bread	1 slice	10
Watermelon	1 cup	8	Whole grain bread	1 slice	5
Carrots	1 large	5	Bagel, cinnamon raisin	1 3.5 inch	24
Orange	1 medium	6	Pumpernickel bread	1 slice	6
Sweet potato	1 cup	17	Macaroni and cheese	1 cup prepared	31
Baked potato	1 medium	28	Chocolate doughnut	1 doughnut (80 g)	25
French fries	1 medium serving	26	Glazed doughnut	1 doughnut (80 g)	12
Snickers	1 bar	35	Kellogg's Frosted Flakes	¾ cup	20
Reese's cup	1 miniature	2	Kellogg's Special K	1 cup	14
White table wine	5 ounces	1	Post Bran Flakes	¾ cup	12
Red table wine	5 ounces	1	Post Raisin Bran	1 cup	25
Grape juice	6 ounces	12			

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Animal/Saturated Fat and Heart Disease



Saturated Fat Debate

- Three large meta analyses (21 studies, 12 studies, and 76 studies) **failed to show significant evidence that saturated fat increases risk for heart disease.**
- Failed to find significant evidence that **increasing polyunsaturated fats and decreasing saturated fats lowers heart risk.**



Siri-Tarino, *Amer J Clin Nutr* 2010; 91 (3): 535-46.
Schwingshackl L, et al. *BMJ Open* 2014; 4(4):e004487.
Chowdhury R, et al. *Ann Intern Med* 2014; 160(6):398-406.

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Red Meat and Cancer

- **American Institute for Cancer Research recommendations** red meats (beef, lamb, pork) based upon data linking to increased risk of colon cancer:
 - **Limit red meats to < 18 ounces per week.**
 - **Avoid processed red meats** (e.g., bologna, hot dogs, corned beef)
 - **No limitations set for white meat**

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Fish and Seafood



- Excellent source of protein high in **omega 3 fatty acids**. Provide **vitamin D** and **contribute valuable nutrients: selenium, iodine, magnesium, iron and copper**.
 - Fish/seafood have **positive effect on oral health**
 - **Help reduce atherosclerosis and maintain healthy blood pressure**
 - **Promote brain health** and may help reduce the risk of **depression**.
 - Necessary for the health of the **eyes**. Can help reduce **dry eye syndrome**.
 - Crucial for health **pregnancy** and **childhood development**.
 - **Quells inflammation**

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Different Types of Fish Oil

- Supplementation is alternative to eating fish; supplements are not equal.
- Randomized, crossover study of 35 healthy individuals compared four popular brands/types of omega 3 fatty acids:
 - Concentrated triglyceride (rTG)
 - Ethyl ester (EE)
 - Phospholipid krill oil (PL)
 - Triglyceride salmon oil (TG)

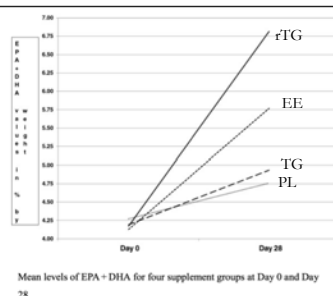
Laidlaw M, et al. Lipids Health Dis 2014; 13:99

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Dosing According to Manufacturer's Recommendations

TRT	Product	EPA & DHA per capsule*	Tested values	Label use: capsules	Daily dosage of EPA + DHA
rTG	Nordic Naturals ProOmega®	325 mg EPA	329.6 mg EPA	2	EPA: 650 mg
	Triglyceride	225 mg DHA	226.0 mg DHA		DHA: 450 mg
EE	Mizumi MacEPA®	756 mg EPA	774.2 mg EPA	1	EPA: 756 mg
	Platinum Ethyl Ester	228 mg DHA	233.7 mg DHA		DHA: 228 mg
PL	Source Naturals ArcticPure®	75 mg EPA	78.0 mg EPA	2	EPA: 150 mg
	Krill Oil Phospholipid	45 mg DHA	46.7 mg DHA		DHA: 90 mg
TG	New Chapter				
	Wholemega® Salmon	90 mg EPA	96.4 mg EPA	2	EPA: 180 mg
	Oil Triglyceride	110 mg DHA	109.5 mg DHA		DHA: 220 mg



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Omega 3 and Prostate Cancer?

- SELECT trial raised concerns about potential link between omega 3s and increased prostate cancer/aggressive cancer.
- European Food Safety (EFSA) concluded, “**there is no evidence for a role of EPA and/or DHA intake in the development of prostate cancer.**”
- Also, “**supplemental intake of EPA and DHA combined at doses up to 5 g/d does not give rise to safety concerns for adults.**”

EFSA Journal 10(7): doi:10.2903/j.efsa.2012.2815

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Protein Is Important

- A recent study conducted in Denmark suggested an inverse relationship between high protein intake and periodontitis.

- Adegboye AR, et al. Calcium, vitamin D, casein and whey protein intakes and periodontitis among Danish adults. *Public Health Nutr.* 2016;19:503-510. doi: 10.1017/S1368980015001202.

Food	Portion Size	Protein (g) (approximate)
Meat, fish, or poultry	75g (2 ½ oz) / 125 ml (½ cup)	21
Firm tofu	150g / 175 ml (¾ cup)	21
Egg, chicken	2 large	13
Cheese	50 g (1 ½ oz)	12
Fortified soy beverage	250 ml (1 cup)	6-8.5
Cooked dried beans, peas, or lentils	175 ml (¾ cup)	12
Cow's milk	250 ml (1 cup)	9
Yogurt	175 ml (¾ cup)	8
Peanut butter or other nut spread	30 ml (2 Tbsp)	8
Nuts or seeds	60 ml (¾ cup)	7
Bread	1 slice (35g)	3
Cereals, cold	30 g	3
Cereals, hot	175 ml (¾ cup)	3
Pasta or rice	125 ml (½ cup)	3
Vegetables	125 ml (½ cup) or 250 ml (1 cup)	2
Fruit	1 fruit or 125 ml (½ cup)	1

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Protein Maintains Healthy Bones

- Framingham Osteoporosis Study found **higher protein intakes** (60-83g/d versus 46g/d) in older men/women (mean 75 years) associated with **37% decreased risk of hip fracture**.
- Systematic review: **29 studies found protein intakes above the current RDA have a beneficial role in preventing hip fractures and BMD loss.**



Misra D, et al. *Osteoporosis Int* 2011; 22(1):345-349.
Readey JM, et al. *Am J Clin Nutr* 2014; 99(4):934-940.
Calver J, et al. *Eur J Clin Nutr* 2012;66(3):281-295.
Wallace TC, et al. *J Am Coll Nutr* 2017; 36(6):481-496.

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Protein Intake and Fracture in Men

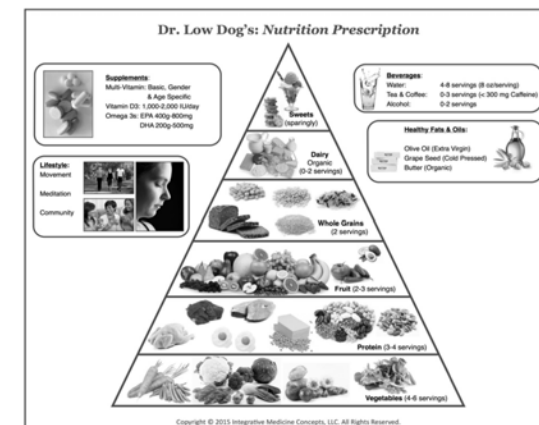
- Osteoporotic Fractures in Men Research** (5,875 men; mean age 73.6 years), **higher protein** intake associated with **8% decreased risk of major osteoporotic fracture**.
- Increased **dairy protein** and **non-dairy animal protein** associated with **20% and 16% decreased risk of hip fracture**.
- Plant protein was not associated** with decreased risk of hip fracture in men.



Langsetmo L, et al. The Association Between Protein Intake by Source and Osteoporotic Fracture in Older Men: A Prospective Cohort Study. *J Bone Miner Res* 2017; Mar;32(3):592-600

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Real State of Our Nutrition

- **90 million** Americans are **vitamin D deficient** (using the Endocrine Society guidelines $< 20\text{ng/mL}$)
- **30 million** are **deficient in vitamin B6**
- **18 million** people have **B12 deficiency**
- **16 million** have **vitamin C deficiency**
- 13% of Latinas and 16% of African American women (ages 12-49) are **iron deficient**
- Women **25-39** overall have **borderline iodine insufficiency**



CDC: 2nd National Report on the Biochemical Indicators of Diet and Nutrition in the U.S. population

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Position on Nutrient Supplementation by the Academy of Nutrition and Dietetics

- Nutrient supplementation can be used to help meet nutrient requirements for those:
 - **Older** adults
 - **Pregnant** women
 - People who are **food insecure**
 - **Alcohol** dependent individuals
 - **Strict vegetarians and vegans**
 - Those with **increased needs** due to a **health condition or the chronic use of a medication** that decrease nutrient absorption/increase metabolism or excretion.

Marra and Boyar. *J Am Diet Assoc* 2009

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Position on Nutrient Supplementation by the Academy of Nutrition and Dietetics

- Restricting energy intake for **weight loss/control**
- **Not consuming an adequate amount of food** to meet energy requirements as a result of poor appetite or illness
- **Eliminating one or more food groups** from their diet on a regular basis
- **Consuming a diet low in nutrient rich foods** despite adequate or excessive energy intakes.

Marra and Boyar. *J Am Diet Assoc* 2009

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65-year old man complains of persistent **tingling and numbness in his legs (bilateral)** and **chronic sore throat** during a routine oral care visit. Dentist notes **beefy red and deeply fissured tongue**. Other than **cataract** in his right eye, no known medical problems. **Vegetarian and lactose intolerant**.

Which of the following nutrient deficiencies would best explain his symptoms?

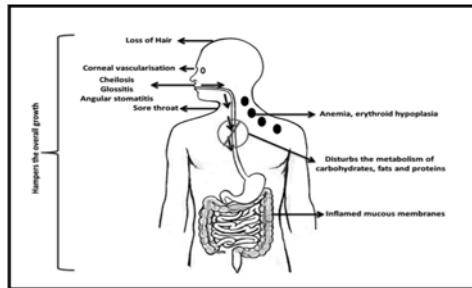
- A. Vitamin B2
- B. Vitamin B6
- C. Vitamin C
- D. Vitamin B12



From McLaren DS: *A colour atlas and text of diet-related disorders*, ed 2, London, 1992, Mosby-Year Book.

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Riboflavin (B2) deficiency causes ariboflavinosis, which manifests as cracked lips, inflammation of tongue, dryness/burning of oral cavity, and sore throat.

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Riboflavin Deficiency: At Risk Groups

- **Alcoholics**
- Those with **chronic infection or liver disease** (increased demand)
- **Inflammatory bowel disease** (decreased absorption)
- **Diabetics** (increased excretion)
- **Elders** (decreased absorption, dietary intake)
- **Vegans** (insufficient dietary intake)
- **Pregnant and breastfeeding women** (increased demand – low riboflavin increases risk for pre-eclampsia)
- **Adolescents, particularly girls** (increased demand)
- **Athletes** (increased demand)
- **Hyperthyroidism** (increased demand)

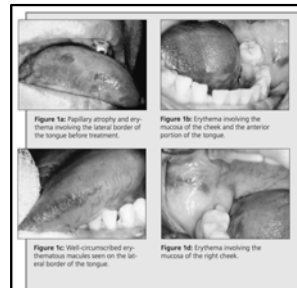
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Case: 41-year old Female

- **Disturbance of taste** (unable to sense flavor of variety of fruits and vegetables), fatigue after simple daily activities, **paresthesia of the anatomic structures innervated by the mandibular division** of the trigeminal nerve on her left side, disturbance of memory and slowing mental faculty. **No meds. Vegan for 2.5 years.** No significant medical or dental history.

Pontes HA, et al. *J Can Dent Assoc* 2009; 75(7):533-7.



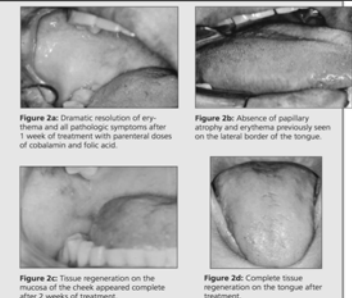
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Laboratory Tests & After Treatment

Test	Normal range (female)	Patient's values
RBC count (cells/ μ L)	3.90–5.03	1.63
Hemoglobin (g/dL)	12.0–15.5	7.2
MCV (fL)	80–100	144
Hematocrit (%)	36–45	23.4
RDW (%)	13 \pm 1.5	25
Serum folate (ng/mL)	3–16	7.73
Serum cobalamin (pmol/L)	118–716	71.8

MCV = mean corpuscular volume; RBC = red blood cell; RDW = red cell distribution width.



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Vitamin B12 Deficiency



- **Inverse** association between serum vitamin B₁₂ levels and severity of periodontitis.
- Risk for deficiency increases with age: **decline in gastric acid makes hard** to absorb food-bound B12.
 - 7% those 51–70 years old; 15% >70 years
- Institute of Medicine recommends adults > 50 get B12 from **fortified foods/supplements**
- Risks: **inadequate intake, malabsorption, medications (PPIs, metformin), vegan, obesity, and aging.**

Bird JK, et al. Risk of Deficiency in Multiple Concurrent Micronutrients in Children and Adults in the United States. *Nutrients* 2017; doi: 10.3390/nu9070655

Zong G, et al. Serum vitamin B12 is inversely associated with periodontal progression and risk of tooth loss: A prospective cohort study. *J. Clin. Periodontol.* 2016;43:2-9.

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Metformin and PPIs Lower B12

- 2015 meta-analysis: **80% increased risk B12 deficiency after 10 months of regular PPI use.**
- Meta analysis 29 studies: **245% increased risk B12 deficiency metformin use. Low B12 shown to increase progression of diabetic neuropathy.**
- B12 deficiency: **difficulty walking, tingling/numbness in hands and feet, fatigue, shortness of breath, loss of appetite, joint pain, depression, loss of taste and smell, cognitive impairment, and dementia.**
- **B12 should be monitored every 1-2 years if taking these medications.**

ung SB, et al. Association between vitamin B12 deficiency and long-term use of acid-lowering agents: a systematic review and meta-analysis. *Intern Med* 2015; 45(4):409-16.

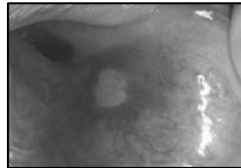
Choi M, et al. Long-term treatment with metformin in type 2 diabetes and methylmalonic acid: Post hoc analysis of a randomized controlled 4.3 year trial. *J Diabetes Complications* 2018; 32(2):171-178; Nisfar M, et al. *Intern Emerg Med* 2015; 10(1):93-102

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Zinc and Oral Health

- Zinc necessary for **sense of smell, which accounts ~80% of sense of taste.**
- Zinc can help protect taste changes in those **undergoing chemotherapy or radiation.**
- “moderate quality evidence zinc supplements **improve overall taste improvement in patients with zinc deficiency/idiopathic taste disorders.**”
- Zinc deficiency detected in **28% of recurrent aphthous stomatitis patients compared to controls.**



Nagaj SK, et al. *Cochrane Database Syst Rev* 2014; 2014 Nov 26;11:CD010470.
Ozler GS. *J Laryngol Otol* 2014; 128(6):531-3
Najafizade N, et al. *J Res Med Sci* 2013; 18(2):123-6

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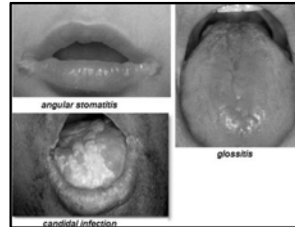
A **26-year old African American woman** comes in for her routine dental exam. She mentions that **she craves ice all the time**, even in the winter. Dentist notes **generalized oral mucosal atrophy and pallor**. What nutrient deficiency is most likely?

- Folate
- Iron
- Calcium
- Selenium

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- Review of Systems May Yield
 - Shortness of breath, fatigue
 - Sensitivity to cold
 - Muscular weakness
 - Low blood pressure
 - Restless legs
 - Pica (chew ice or non-food items)
- Physical Exam Findings
 - Angular cheilitis
 - Atrophic glossitis
 - Generalized oral mucosal atrophy
 - Mucosal pallor
 - Stomatitis
 - Nonspecific pallor of the mucous membranes



Correct answer is B: Iron

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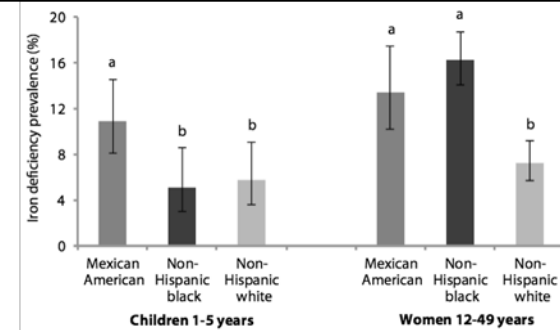


Figure H.3.a. Age-adjusted prevalence estimates of low body iron stores (<0 mg/kg) in U.S. children and women by race/ethnicity, National Health and Nutrition Examination Survey, 2003-2006.

Error bars represent 95% of confidence intervals. Bars not sharing a common letter differ within children and women ($p < 0.05$). Age adjustment was done using direct standardization.

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- Marked differences between women in menstrual blood loss (10-250 mL per menses).
- Low iron levels *are the most common cause of anemia* in adolescent girls and can be very detrimental to *mood and cognition*, as well as *physical* well-being.
- Heavy menstrual bleeding is a significant risk for iron deficiency and is often overlooked.
- Data from cycle 2 (2009 to 2011) of Canadian Health Measures Survey, depleted iron stores were found in **13% of females aged 12-19** and **9% of females aged 20 -49**.

Iron



Blüher J, et al. *Gynecol Endocrinol* 2014;30(8):542-8.
Nelson AL, et al. *Am J Obstet Gynecol* 2015; 213(1):97.e1-6.
Cooper M, et al. *Health Rep* 2012;23(4):41-8.

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To Get 18mg of Iron in Food

- 4 cups of raisins
- 3-5 cups instant oatmeal
- 3 cups Special K cereal**
- 3 cups cooked lentils
- 2.2 cups canned white beans
- 10 ounce beef liver
- 45 ounce chicken breasts
- 15 cups broccoli OR
- 3 cups cooked spinach



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- Potent antioxidant, activates folate, cofactor in synthesis of carnitine, thyroxine, serotonin, norepinephrine, dopamine and immune cells
- Levels decline rapidly during periods of emotional and physical strain, and illness.
- Deficiency: skin changes, easy bruising, gum disease, loose teeth, slow healing wounds, dry mouth, dry eyes. emotionally labile.
- Inflammation of interdental and marginal gingiva followed by bleeding, ulceration, and bad breath.

Vitamin C



Herrila H, et al. *Cochrane Database Syst Rev* 2013; Jan 31;1:CD.000980

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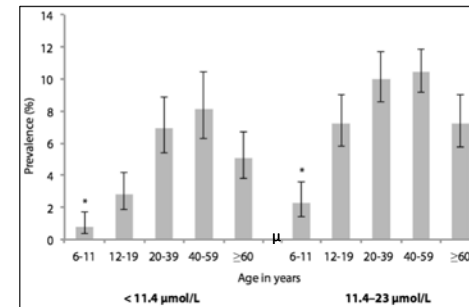


Figure H.1.f. Prevalence estimates of vitamin C deficiency (serum concentrations less than 11.4 µmol/L) and low vitamin C concentrations (11.4-23 µmol/L) in the U.S. population aged 6 years and older by age group, National Health & Nutrition Examination Survey, 2003-2006.

Error bars represent 95% of confidence intervals. *Prevalence in children is significantly lower than prevalence in persons 20 years and older ($p < 0.05$).

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Calcium and Vitamin D: Fracture

- Meta-analysis National Osteoporosis Foundation: eight studies (n= 30,970 participants): ***all studies showed calcium plus vitamin D supplementation produced statistically significant 15 % reduced risk of total fractures and 30% reduced risk of hip fractures.***
- Calcium, vitamins D, K2 and magnesium contribute independently and collectively to bone health.



Weaver CM, et al (2016). Calcium plus vitamin D supplementation and risk of fractures: an updated meta-analysis from the National Osteoporosis Foundation. *Osteoporos Int*, 27: 367-376

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Vitamin D and Respiratory Infection



Martineau AR, et al. Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data. *BMJ* 2017; 356: i6583.

- Acute respiratory infection kills ~2.65 million people/year.
- 25 eligible randomized controlled trials (n=10,933, aged 0-95 years).
- Vitamin D supplementation reduced risk of acute respiratory infection among all participants (NNT=33) and those who were vitamin D deficient experienced the most benefit (NNT=4).

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Probiotics and Prebiotics




Hao Q, Dong BR, Wu T. Probiotics for preventing acute upper respiratory tract infections. *Cochrane Database Syst Rev*. 2015 Feb 3(2):CD006895.

- Review: 12 studies with children, adults, and elders not at high risk for URTI.
- Moderate-quality evidence shows fewer people develop URTI when taking probiotics
- Moderate quality evidence probiotics probably reduces duration of a URTI by approximately 2 days.

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Clinical Resource Tool: www.usprobioticguide.com



Clinical Guide to Probiotic Products Available in USA

Indications, Dosage Forms and Clinical Evidence to Date - 2019 Edition

INDICATIONS FOR PEDIATRIC HEALTH

Show	Brand Name	Probiotic Strain	Dosage Form	CFU/Dose	No. of Doses/Day	Indications (Level of Evidence)
	Bio-Kult Infantly TM	L. casei P2008 327 TM L. rhamnosus P2008 328 TM Streptococcus thermophilus P2008 329 TM L. acidophilus P2008 330 TM B. breve P2008 331 TM L. reuteri sp. infantis P2008 332 TM B. infantis P2008 333 TM	Sachet	100billion	1x-1 sachet	CDAD - Clostridium difficile associated diarrhea (I) Colic - Colic (I) HP - Helicobacter pylori - Adjunct to standard eradication therapy (I)
(I)	BioGaia ProTectly Baby Drops with Vitamin D ₃	L. reuteri DSM 17938	Drops	100billion	5 drops	AAD - Antibiotic associated diarrhea - Prevention (I) C - Constipation (I) CDAD - Clostridium difficile associated diarrhea (I) CID - Common infectious disease - community acquired (I) Colic - Colic (I) EBHP - Infantile bowel dysfunction/functional abdominal pain (I) ID - Infectious diarrhea (I) Regurg - GI Ref - Reduces regurgitation/improves gastrointestinal motility (I)
(I)	BioGaia ProTectly TM	L. reuteri DSM 17938	Chewable Tablets	100billion	1 tablet	AAD - Antibiotic associated diarrhea - Prevention (I) C - Constipation (I) CDAD - Clostridium difficile associated diarrhea (I) CID - Common infectious disease - community acquired (I) Colic - Colic (I) EBHP - Infantile bowel dysfunction/functional abdominal pain (I) ID - Infectious diarrhea (I) Regurg - GI Ref - Reduces regurgitation/improves gastrointestinal motility (I)
(I)	Gerberly Good Startly Soothe Powder Infant Formula (G)	L. reuteri DSM 17938	Powder	100billion	5 drops	AAD - Antibiotic associated diarrhea - Prevention (I) C - Constipation (I) CDAD - Clostridium difficile associated diarrhea (I) CID - Common infectious disease - community acquired (I) Colic - Colic (I) EBHP - Infantile bowel dysfunction/functional abdominal pain (I) ID - Infectious diarrhea (I) Regurg - GI Ref - Reduces regurgitation/improves gastrointestinal motility (I)
(I)	Gerberly Soothe Probiotic Gels (Drops)	L. reuteri DSM 17938	Drops	100billion	5 drops	AAD - Antibiotic associated diarrhea - Prevention (I) C - Constipation (I) CDAD - Clostridium difficile associated diarrhea (I) CID - Common infectious disease - community acquired (I) Colic - Colic (I) EBHP - Infantile bowel dysfunction/functional abdominal pain (I) ID - Infectious diarrhea (I) Regurg - GI Ref - Reduces regurgitation/improves gastrointestinal motility (I)

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①	DanActive / Adimell TM (a)	L. casei sp. Paracasei CNCM 1-1518	Firm, milk lg.	100billion	1-2 servings	CID - Common infectious disease - community acquired (I) HP - Helicobacter pylori - Adjunct to standard eradication therapy (I) ID - Infectious diarrhea (I)
②	FlorastorKiddly TM	Saccharomyces boulardii lyo CNCM 1-145	Sachet Capsule	50billion	1-2 sachets	AAD - Antibiotic associated diarrhea - Prevention (I) CDAD - Clostridium difficile associated diarrhea - Prevention (II) HP - Helicobacter pylori - Adjunct to standard eradication therapy (I) ID - Infectious diarrhea (I)
③	Fortify TM Kids Probiotic TM	L. acidophilus NCFM® B. animalis subsp. lactis B-07	Sachet Chewable tablet	100billion	1 sachet	CID - Common infectious disease - community acquired (I)
④	Genestra Brandly HMF Fit for Schodly TM (80 mg vitamin C, 1000IU vitamin D)	L. acidophilus CUL-40 L. acidophilus CUL-21 B. animalis subsp. lactis CUL-34 B. bifidum CUL-20	Chewable tablet	12.5billion	1 chewable tablet	CID - Common infectious disease - community acquired (I)
⑤	Gerberly Gerberly Everyday Probiotic Drops TM	B. lactis B012	Drops	10billion	5 drops	AAD - Antibiotic associated diarrhea - Prevention (I) CID - Common infectious disease - community acquired (I)
⑥	Gerberly Good Startly Extensive HMB Infant Formula (G) Extensively hydrolyzed whey formula (EHMF)	B. lactis B012	Powder	10billion	EHMF when an alternative to breast milk is required	AAD - Antibiotic associated diarrhea - Prevention (I) CID - Common infectious disease - community acquired (I)

http://www.usprobioticguide.com/PBCPediatricHealth.html?utm_source=pediatric_ind&utm_medium=civ&utm_campaign=USA_CHART Accessed January 17, 2019

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Click next to brand name to see evidence.....

Colic - Colic	I	82. Savino, F., E. Pelle, E. Palumeri, R. Oggero, and R. Miniero. "Lactobacillus reuteri (American Type Culture Collection Strain 55730) versus simethicone in the treatment of infantile colic: a prospective randomized study." <i>Pediatrics</i> 119.1 (2007): e124-e130. 85. Chau, K., E. Lau, S. Greenberg, S. Jacobson, P. Yazdani-Bajani, N. Verma, and G. Koren. "Probiotics for infantile colic: a randomized, double-blind, placebo-controlled trial investigating Lactobacillus reuteri DSM 17938." <i>The Journal of pediatrics</i> 196.1 (2015): 74-78. 84. Sung, V., H. Hirokawa, M.L.K. Tang, F.K. Mensah, M.L. Naton, C. Satoh, R.G. Heine, A. Stock, R.G. Barr, and M. Waike. "Treating infant colic with the probiotic Lactobacillus reuteri: double blind, placebo controlled randomised trial." <i>BMJ</i> 349 (2014): g2107. 83. Savino, F., L. Cordaro, V. Tarasco, E. Palumeri, R. Oggero, S. Roca, and D. Maltagliu. "Lactobacillus reuteri DSM 17938 in infantile colic: a randomized, double-blind, placebo-controlled trial." <i>Pediatrics</i> 126.3 (2010): e526-e533.
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Evidence is ranked using grading system of I, II, III. You can then see the references for your review.

http://www.usprobioticguide.com/PBCPediatricHealth.html?utm_source=pediatric_ind&utm_medium=civ&utm_campaign=USA_CHART Accessed January 17, 2019

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Resources

- *Fortify Your Life*, Tieraona Low Dog, MD with National Geographic
- Dietary Supplement Label Database: dslid.nlm.nih.gov
- NIH National Center for Complementary and Integrative Health (NCCIH): nccih.nih.gov
- Office of Dietary Supplements: ods.od.nih.gov
- Linus Pauling Institute: lpi.oregonstate.edu
- Consumer Labs: www.ConsumerLabs.com
- Natural Medicines Comprehensive Database: NaturalDataBase.com

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