

Nutrition and Dietary Supplements What the Dental Team Should Know



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Chair: US Pharmacopeia Dietary
Supplement Admissions, Evaluation and
Labeling Expert Committee

Clinical Associate Professor of Medicine
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National Geographic's
Life Is Your Best Medicine
Healthy At Home
Fortify Your Life
Guide to Medicinal Herbs

www.DrLowDog.com

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Nutrition Matters

Nutrition problems single most important cause of death in the U.S.:

- Dietary factors
- Tobacco smoking
- High blood pressure
- High BMI
- High plasma glucose
- Elevated cholesterol



JAMA 2018

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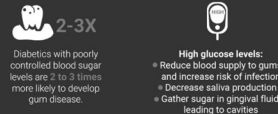
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Nutrition and Oral Health

- Oral health encompasses gingival status, well-being of teeth and jaw, salivary quantity and quality, and sensory dimensions of taste and pain.
- Oral cavity is intersection of medicine and dentistry and window into general health of individual. >100 systemic diseases and upward of 500 medications have oral manifestations.

Garton BJ, et al. *Aust Dent J*. 2012;57(2):114-122.

People with Type 1/2 & pre-diabetes should carefully monitor oral health



Some studies suggest it's more of a cycle



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One Thing in Common

Despite incredible variation in dietary patterns, **all have this in common:**

- **DRAMATIC** reduction/elimination of **ultra-processed foods**—industrial foods with little/no intact foods, often high in **added sugars, salts, artificial flavors, colors and other additives**.
- Individuals with **highest vs. lowest** intake of ultra-processed foods had a **31% increased likelihood of death** after adjusting for confounders.¹
- In US: **57% of total calories for adults**² and **67% of total calories for children**³ come from these foods.

1. Kim H, et al. Public Health Nutr 2019; 22(10):1777-1785

2. Juul F, et al. Am J Clin Nutr 2022; 115(1):211-221

3. Wang L, et al. JAMA 2021; 326(6):519-530

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Plant Based Diets

- Term can be misleading. **Poultry and eggs** relatively neutral, **dairy** may have beneficial metabolic benefits, especially reducing body fat and type 2 diabetes; **seafood** is linked to several health benefits.¹
- Many not so healthy **“plant based” foods**: white rice, doughnuts, French fries, white bread, cookies, etc. Many high in refined starch/sugar, representing ~42% of all calories in US compared to ~5% of calories from unprocessed red meats.²
- **Plant based meats?** Genetically engineered yeasts; new proteins; Impossible adds “heme” iron; many high in **saturated fat, sodium, ultra processed**.
- Most diet-related diseases are caused by **NOT EATING ENOUGH** fruits, nuts, seeds, beans, vegetables, whole grains, plant oils, seafood, and yogurt **AND TOO MUCH** ultra-processed foods high in salt, refined starch, or added sugar.

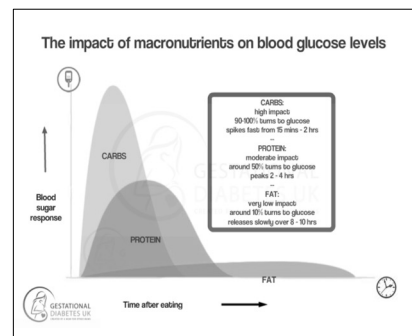
1. Mozaffarian D. Circulation 2016; 133(2): 187-225. 2. Shan Z, et al. JAMA 2019; 322(12):1176-1187

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Refined Carbohydrates

- Overdo processed/refined carbs, **blood sugar rises, insulin released, store extra glucose as fat, drive inflammation**.
- Blood sugar goes up and then can plummet, **leaving one tired and disrupting sleep/wake cycle**.
- **Eating lots of carbs** makes one **crave lots of carbs** (dopamine rush).
- High sugar diets cause **dysbiosis** and **degrade intestinal barrier**, leading to systemic inflammation.



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Sugars



- Table sugar (sucrose): bond **one glucose** molecule and **one fructose** molecule
- **High fructose corn syrup**: 55% fructose, 42% glucose, and 3% other sugars.
- Every cell in our 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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Carbohydrates and Dental Caries

- Relationship between caries and carbohydrates well understood; **dental hard tissues demineralized by acidic by-products** produced by bacteria in biofilm (dental plaque) via fermentation of dietary carbohydrates.
- Rapid fall in pH** (5.5 or below) of biofilm after carbohydrates are ingested. This lower pH affects balance of microbes leading to **higher proportion of acidic biofilm species**, compounding tooth demineralization.
- Sucrose most cariogenic sugar**, causes more dramatic drop in pH. **Lactose** is a sugar but **less cariogenic** because its fermentation produces smaller drop in pH.
- Higher glycemic load foods** produce greater acute plaque **pH decreases** and larger overall postprandial glucose responses compared to lower GL foods.

Tinanoff N, et al. *Int J Paediatr Dent* 2019;29(3):238-48; Sheiham A et al. *J Dent Res* 2015;94(10):1341-7.
Palacios C, et al. *Caries Res* 2016;50(6):560-70; Atkinson FS, et al. *Nutrients* 2021 Aug 6;13(8):2711.

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The Oral Microbiome

- Balanced oral microbiome** important for the maintenance of oral health. Conditions associated with **salivary gland hypofunction, impaired oral clearance, low salivary pH** and **altered salivary composition**, often lead to perturbation of **function and composition** of the oral microbiome causing dysbiosis, and an associated risk of **oral disease**.
- Restriction of high GL foods, added sugars and inclusion of probiotic foods and hydration beneficial.**



Pedersen AML, et al. The role of natural salivary defences in maintaining a healthy oral microbiota. *J Dent* 2019 Jan;80 Suppl 1:S3-S12.

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Probiotic Lozenges

AEProBio Clinical Guide to Probiotic Products Available in USA						
Applications, Dosage Forms and Clinical Evidence to Date - 2022 Edition						
Introduction Adult Health Womens Health Pediatric Health Functional Foods References About						
PROBIOTIC APPLICATIONS IN ADULT HEALTH						
Show 30 entries						
Brand Name	Probiotic Strain	Applications (Level of Recommendation)	Dosage Form	CFU/Dose	No of Doses/Day	
BioGaia® Prodentis®	L. reuteri ATCC PTA 5289 L. reuteri DSM 17938	OH - Oral health (reductions of tonsillitis, laryngitis, and dental caries) (I)	Lozenge	200M/lozenge	1 lozenge	
OralBioce®	Streptococcus salivarius K12	OH - Oral health (reductions of tonsillitis, laryngitis, and dental caries) (II)	Lozenge	1B/lozenge	1-5 lozenges	

http://www.usprobioticguide.com/PBCAdultHealth.html?utm_source=adult_ind&utm_medium=civ&utm_campaign=USA_CHART

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Frequency of Consumption

- Frequent** sucrose consumption associated with **decreased species diversity** and increased abundance of *Streptococcus spp.* in the oral biofilm and is **more predictive of caries risk** than simply total sugar consumption.
- It takes approximately **30 minutes for pH to drop after sugar intake**, so additional sugar intake *within* that 30-minute period **less harmful** than additional intake *after* 30 minutes.



van Loveren C. Sugar Restriction for Caries Prevention: Amount and Frequency. Which Is More Important? *Caries Res* 2019;53(2):168-75.
Millen AE, et al. Dietary carbohydrate intake is associated with the subgingival plaque oral microbiome abundance and diversity in a cohort of postmenopausal women. *Scientific Reports* 2022; 12: 2643

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The Glycemic Index and Load



- Glycemic load measurement of impact of **carbs** on **blood sugar/insulin**.
- 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.
- Look for **100% whole grain or sprouted grain** on label.

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 Index Calculation



GI: how **rapidly a set amount of food** causes **blood sugar to rise**. Food containing **50 g carbohydrate** is given. Example below:

- **200 g** of spaghetti = **50 g** of carbs
- Blood samples taken baseline and then **every 15 minutes for first hour**, then every 30 minutes, graphed and **compared to 50 g of pure glucose** (GI of 100)
- **Retested 3 occasions** and **averaged with 8–10 other volunteers**
- Glycemic index **does not consider the serving size**

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Glycemic Load

Accounts for both GI and *serving size*

- $GI \times \text{amount of carbohydrate (g)} / 100 = GL$
- One teaspoon jam = **5 grams** and has **GI 51**
- $GL = (5 \times 51) / 100 = 2.5$

Foods that slow digestion lower the GL

- Presence of **fiber or fat**
- **Presence of acid**
- **Lemon, lime juice, vinegar**

Low	0–10
Moderate	11–19
High	20 +

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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			
Reese's cup	1 miniature	2	Kellogg's Frosted Flakes	¾ cup	20
White table wine	5 ounces	1	Kellogg's Special K	1 cup	14
Red table wine	5 ounces	1	Post Bran Flakes	¾ cup	12
Grape juice	6 ounces	12	Post Raisin Bran	1 cup	25

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Low/High GI Meals



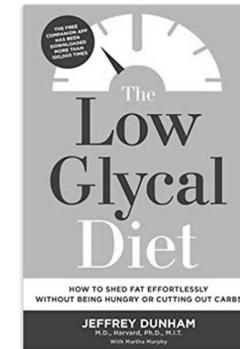
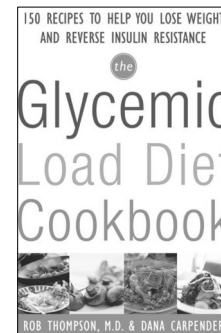
GI = 80 GL = 32



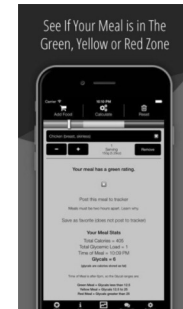
GI = 61 GL = 12

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Low Glycylal Diet Calculator



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Brand	pH
Simple Truth	5.0
Le Bleu	5.0
Dasani	5.0
Aquafina	5.0
Tap Water	6.5
The Mountain Valley	6.5
Spring Time	6.5
S. Pellegrino	6.5
Just Water	6.5
Icelandic Glacial	6.5
Voss	7.0
Smart Water	7.0
LifeWater	7.0
Kroger	7.0
Hydrogen Water	7.0
Fiji	7.0
Aqua Panna	7.0

Independent testing of various bottled waters.

<https://watertestingkits.com/7-facts-about-ph-of-bottled-water/>

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Protein Needs



- From Greek *protos*, "first." Build **new cells, maintain tissues** (e.g., muscles, inner bone, hair, nails), create **enzymes, make hemoglobin, lipoproteins to transport cholesterol; present in membrane of every living cell.**
- **Protein depravation studies:** breakdown of periodontal ligaments, degeneration of gingival tissues, and resorption of alveolar bone. Danish study: **inverse relationship high protein intake and periodontitis.**
- Sources: meat, poultry, seafood, eggs, soy products, nuts, nut butters, beans, peas, and seeds.
 - Choose seafood 2 x weekly (low in mercury, high in omega 3s, sustainable).
 - Include beans and peas often in your diet, as a side or main dish.
 - Chicken and poultry regularly, red meat 10 ounces per week. Avoid processed red meats.

Adegbeye AR, et al. Calcium, vitamin D, casein and whey protein intakes and periodontitis among Danish adults. *Public Health Nutr*. 2016; 19:503-51

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How Much Protein Do You Need Per Day



- ~0.8 g/kg body weight for adults
 - (Multiply weight in lb x 0.36)
 - 150 pounds = 55 g/d
 - 180 pounds = 65 g/d
- 1.0–1.2 g/kg for those over age 60*
 - 150 pounds = 69–81 grams
 - 180 pounds = 81–98 grams
- 1.2–1.5 g/kg competitive athletes

**Not for those with kidney disease.*

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Protein Rich Foods

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 (¼ 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) lettuce	2
Fruit	1 fruit or 125 mL (½ cup)	1

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Protein Powders

- **Whey** protein hydrosolate: digested quickly after workout.
- **Casein**: “time-release protein” take before bed for muscle recovery.
- **Egg white**: no fat, equal to whey. Allergy.
- **Soy**: complete protein, no carbs/fiber, highly absorbed. Allergy.
- **Hemp**: omega 3, fiber, less protein.

All the above are “complete proteins”

- **Brown Rice** - hypoallergenic
- **Pea** – see next page

Per 20g serving	Soy*	Rice**	Pea*	Hemp*
Calories (kcal)	80	88	72	77
Protein (g)	17	15.3	15.5	9
Fat (g)	1	1.2	1.1	1.9
Carbs (g)	0	2.4	1.5	6.5 (5.2g fiber)
Sodium (mg)	190	0	192	0
Cost (per 100g) In USD	2.3	4.32	3.96	2.82

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Pea Protein

	Pea protein	Whey protein
Calories	120	118
Protein	22.5 grams	27 grams
Carbs	1.5 grams	1 gram
Fat	2.25 grams	less than 1 gram
Cholesterol	0 grams	0.011 grams
Fiber	1.5 grams	0 grams
Sugar	0 grams	0 grams
Sodium	15% of the Daily Value (DV)	2% of the DV
Calcium	7% of the DV	10% of the DV
Potassium	1% of the DV	4% of the DV
Iron	42% of the DV	0% of the DV

- Good choice for those with **allergies** or who are **vegan/vegetarian**.

- Much higher in **iron**, making it a good choice for **menstruating or pregnant women**.

- **No methionine**.

- Usually made from **yellow split peas**, not if you have **gout**.

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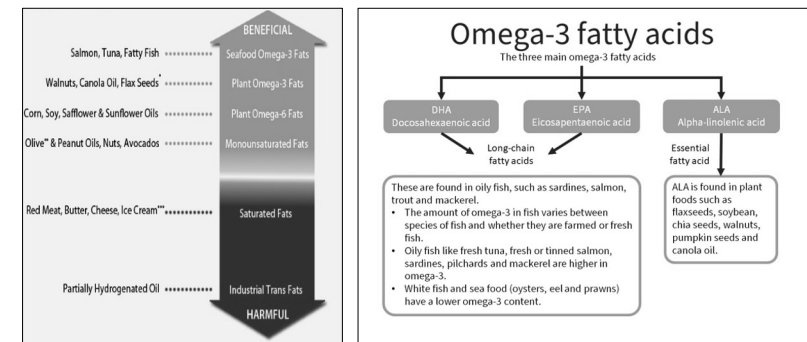
Favorite Protein Bars

- **RX Bar** (12 g protein, 0 g added sugar, 5 g fiber)
- **Aloha Plant Based** (14 g protein, 13 g fiber)
- **Layers Protein Bar** (15 g protein, 3 g added sugar)
- **Epic Meat Bars** (9-15 g protein, 0 added sugar)
- **Clif Bar Whey Protein** (14 g protein, 3 g fiber, 5 g sugar)
- **Kind Protein** (12 g protein, 5 g fiber, 6 g sugar)
- **Naked Nutrition Peanut Butter** (15 g protein, 6 grams fiber, 13 grams sugar)



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Fish concentrate EPA and DHA from algae, their primordial source.

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Global Omega-3 Status Map shows low levels for most of the world



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EPA & DHA Health Benefits

- Crucial for brain/eye development of baby first 1,000 days of life
- Lower triglycerides (but non-LDL-C)
- Mildly lower blood pressure
- Reduces inflammation
- Reduces risk of heart disease
- May improve cognitive function, depression, and ADHD

Mohan D, et al. JAMA Intern Med 2021 May 1;181(5):631-649.

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Greater Longevity with a Higher Omega-3 Index



Postmenopausal women with an Omega-3 Index over 8% were 30% less likely to die than those with an Index under 4% over 15 years.

Recovering from a Heart Attack with Omega-3s: The OMEGA-REMODEL Study



Patients who had recently had a heart attack and were then treated with omega-3 fatty acids for 6 months had healthier hearts if their Omega-3 Index reached 11% compared to those with lower levels.

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The Omega-3 Index and Risk for Fatal CHD



Data from 10 prospective cohort studies including >24,000 subjects showed that an Omega-3 Index of 8% or greater was associated with the lowest risk for fatal CHD.

Total Mortality and the Omega-3 Index: Heart and Soul



People with the highest Omega-3 Index levels lived longer than those with the lowest levels.

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Omega 3 and Periodontitis

- Increasing **omega-3** intake associated with **lower gum inflammation**.
- Harvard study: **55 adults** with moderate periodontitis randomized to receive **81 mg per day aspirin** plus either **2,000 mg/d DHA or placebo** (soy/corn oil) for 3 months.
- In active group: DHA levels increased from 3.6% to 6.2%, no increase observed in placebo group.
- Improvements noted in **pocket depth and gingival index**, as well as reduction in **CRP and IL-1-beta in the oral cavity**.

Naeqi AZ, et al. Docosahexaenoic acid and periodontitis in adults: a randomized controlled trial. *J Dent Res* 2014 Aug;93(8):767-73.

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Fish Oil: What Type is Best?

- Supplementation is an **alternative** to eating fish; however, not all **supplements are equal**.
- Randomized, crossover study of 35 healthy individuals compared four popular brands/types of omega 3 fatty acids:
 - **Concentrated triglyceride (rTG)** – Nordic Naturals ProOmega
 - **Ethyl ester (EE)** – Minami MorEPA
 - **Phospholipid krill oil (PL)** – Source Natural Arctic Pure
 - **Triglyceride salmon oil (TG)** – New Chapter Whole Mega Salmon

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

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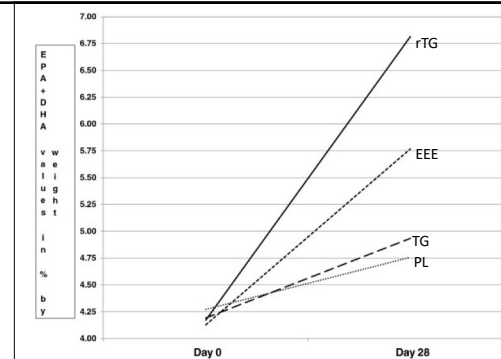
Dosing According to Manufacturer's Recommendations

TRT	Product	EPA & DHA per capsule*	Tested values	Label use: caps/day	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	Minami MorEPA®	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			2	
	Wholemega® Salmon	90 mg EPA	96.4 mg EPA		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.**”
- FDA: safe supplemental level **2 g/d** and **total EPA/DHA at 3 g/d**.

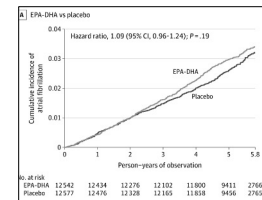
EFSA Journal 10(7): doi:10.2903/j.efsa.2012.2815

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Heart Arrhythmias?



Albert CM, et al. Effect of Marine Omega-3 Fatty Acid and Vitamin D Supplementation on Incident Atrial Fibrillation: A Randomized Clinical Trial. JAMA. 2021 Mar 16;325(11):1061-107.

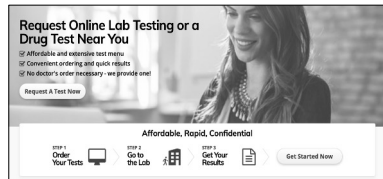
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- Omega 3's have been said to **reduce and increase** the risk of heart arrhythmias.
- Randomized clinical trial **25,119 women/men aged 50 years or older** without cardiovascular disease, cancer, or AF **failed to show any effect (positive or negative)** with **1 gram/d marine omega-3, 2,000 IU vitamin D, or combo.**

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Where Can You Get Tested?

- Talk to your health care practitioner about potential concerns around micronutrient deficiencies.
- Most lab tests are readily available through LabCorp or Quest.
- If you order your own tests, www.requestatest.com, Vibrant America, **EveryWell**, and SpectraCell are commonly used.



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Micronutrient Status of Americans

- **31% population** at risk for *at least one vitamin deficiency* or anemia.
- **Deficiency risk most common in women (37% overall): 19–50 years (41%), and pregnant or breastfeeding women (47%).**
- Those who **did NOT** take dietary supplements had **highest risk** of any deficiency (**40%**), compared to users of **full-spectrum MVI-mineral supplements (14%)**.
- Individuals consuming an **adequate diet** based on EAR had a **lower risk of any deficiency (16%)**, compared to those with **inadequate diet (57%)**.

Bird JK, et al. *Nutrients* 2017 Jun 24;9(7):655.

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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 scurvy (by serum levels)
- 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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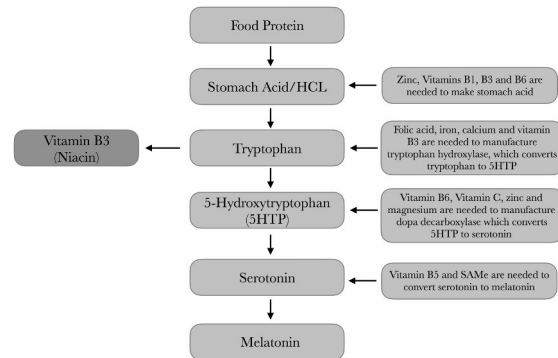
B-Vitamins Fast Facts

- **8 B-vitamins** partner together, best to take them together.
- Vitally important for **energy, and maintenance of healthy brain, nervous and cardiovascular systems.**
- Low levels of vitamin B6 and B12, increase risk for *depression and impair cognition, attention, and memory.*
- Subset of women taking birth control pills are **deficient in vitamin B6.**
- **2/3rd of those with B12 deficiency are over age 50.**
- Women may not get sufficient folate, significant if pregnancy occurs.

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Serotonin and Melatonin Pathways



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Table 1. Effect of deficiency of vitamin B complex on oral structures.

Deficient Vitamin	Oral Manifestation(s)
Vitamin B ₁	Cracked lips, angular cheilosis
Vitamin B ₂ , B ₃	Angular cheilosis, glossitis
Vitamin B ₆	Burning sensation in the oral cavity related with glossitis and stomatitis, and cheilosis
Vitamin B ₉	Recurrent aphthous stomatitis (RAS)
Vitamin B ₁₂	Angular cheilosis, painful ulcers in the oral cavity, glossodynia (sore tongue) and RAS

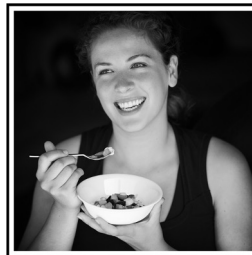
Kaur K, et al. Micronutrients and bioactive compounds in oral inflammatory diseases. *J Nutr Internat Metab* 2019; 18: 100105

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Oral Contraceptives & Vitamin B6

- Majority of women on OCPs have **low serum B6** levels, even when meeting dietary RDA.¹
- Oral contraceptive** use in US 2017–2019:²
 - 19.5% of women aged 15–19
 - 21.6% aged 20–29
 - 10.9% aged 30–39
 - 6.5% of women aged 40–49
- Low B6: microcytic anemia, depression, poor concentration, fatigue, etc.
- Women who discontinue OCs and become pregnant may be at **increased risk for preterm birth, early pregnancy loss, and difficulty conceiving.**^{3,4}



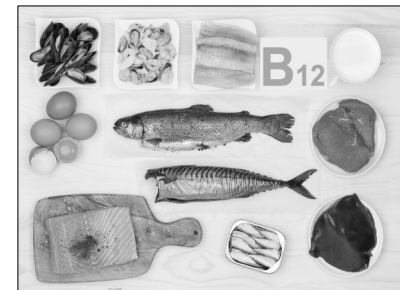
- Morris MS, et al. *Am J Clin Nutr* 2008; 87(5):1446-54
- www.cdc.gov/nchs/products/databriefs/db388.htm
- Wilson SMC. *Nutr Rev* 2011 Oct; 69(10):572-83
- Ho CL, et al. *Nutrients* 2016; Sep 1;8(9).

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Vitamin B12

- 18 million Americans** deficient
- Geriatric population** prevalence 21%
- Risk for deficiency:
 - Inadequate intake
 - Veganism
 - Malabsorption (e.g., IBD)
 - Medications (PPI, metformin)
 - Obesity or bariatric surgery
 - Aging (especially over 70 years old)
- 25–250 mcg per day** if at risk



Singh NN, et al. Vitamin B-12 Associated Neurological Disease. 2018; Oct 22 <https://emedicine.medscape.com/article/1152670-overview#af>
Langan RC, Goodbred AJ. *Am Fam Physician* 2017 Sep 15;96(6):384-389

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Prevalence of Vitamin C Deficiency and Low Vitamin C Concentration in US Population

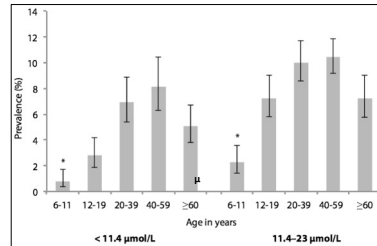


Figure H.11.f. Prevalence estimates of vitamin C deficiency (serum concentrations less than 11.4 μmol/L) and low vitamin C concentrations (11.4-23 μmol/L) in the U.S. population aged 6 years and older by age group, National Health & Nutrition Examination Survey, 2003-2006.

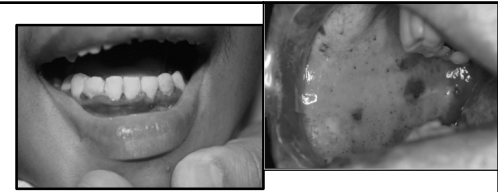
Error bars represent 95% of confidence intervals. *Prevalence in children is significantly lower than prevalence in persons 20 years and older (p < 0.05).

Scurvy induced when dietary vitamin C intake < 10 mg/d and/or plasma vitamin C levels **below 11 μmol/L**

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Vitamin C



- Deficiency increases risk for **periodontitis** and **xerostomia**. Inflammation of **gingiva** followed by **bleeding**, **ulceration**, **bad breath**, followed by **loss of bone** and **loosening of teeth**.
- Skin changes, **easy bruising**, **slow healing wounds**, **dry mouth**, **dry eyes**. Emotionally **labile**. **Weakened capillaries**. Hemorrhage is hallmark of scurvy and hair follicles are common site of cutaneous bleeding.
- Low ascorbic acid levels found in **healthy subjects with gingivitis** and in **diabetics with periodontitis**. 250 mg BID improved symptoms.¹

1. Gokhale NH et al. *J Diet Suppl.* 2013;10:93-104.

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‘Picky’ Eater?

- Healthy 4-year-old boy** seen by ortho/rheumatology with **right-leg pain** and **progressively worse limping**, became **unable to weight bear**.
- Intermittent **non-blanching rash** **arms and legs** past 2 years, topical emollients not effective. **Bleeding when brushing teeth**, **gingivitis**.
- Diet** primarily **waffles**, **yogurt**, **pasta with butter**, **goldfish crackers**, **peanut butter**, **chicken nuggets**, and **water**.
- Workup negative **except for iron, vitamins C and D deficiencies**.
- 100 mg ascorbic acid q 8 hours x 7 days**, then **1 x daily with iron and vitamin D**.
- Limp and rash completely disappeared within weeks**.

Nastro A, et al. Scurvy Due to Selective Diet in a Seemingly Healthy 4-Year-Old Boy. *Pediatrics* September 2019; 144 (3) e20182824.

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MAIN FUNCTIONS

- Antioxidant defense
- Enhances immune function
- Needed to make collagen, carnitine, and the neurotransmitters serotonin and norepinephrine

DAILY RECOMMENDATION

400
mg

All Adults

GOOD SOURCES

Fruit

- Kiwifruit, 1 medium-sized, 90 mg



- Strawberries (whole), 1 cup, 85 mg



Vegetables

- broccoli • kale • tomatoes
- Sweet Red Pepper, ½ cup chopped, 95 mg



mg = milligrams

SPECIAL NOTES

- Heat destroys vitamin C. Try to eat fresh foods and cook by steaming, microwaving, or stir-frying.
- Vitamin C in food is identical to vitamin C in supplements.
- The Daily Recommendation listed is specific to the LPI based on extensive review of the scientific evidence. The Institute of Medicine's Recommended Dietary Allowance (RDA) is 90 mg/day for men and 75 mg/day for women.

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Vitamin D and Oral Health

- Beneficial effects: direct effects on **tooth mineralization**, **anti-inflammatory** functions and stimulation of **anti-microbial peptides**.
- Animal data suggest **calcium and vitamin D deficiency** may result in **dysfunction of salivary glands**.
- Overall, data supports a protective role in periodontal disease.
- Vitamin D deficiency, *synergistically* with other genetic or environmental factors, may increase the risk of **oral squamous carcinoma**.

Khammissa RAG, et al. The Biological Activities of Vitamin D and Its Receptor in Relation to Calcium and Bone Homeostasis, Cancer, Immune and Cardiovascular Systems, Skin Biology, and Oral Health. *Biomol Res Int* 2018 May 22;2018:9276380.

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Vitamin D

- Deficiency common globally, more **severe in elders** due to environmental/biological factors.
- **75% elders** in nursing homes **severely** vitamin D **deficient** (25(OH)D < 10 ng/mL).
- **Obesity, dark skin, living northern latitudes, use of sunscreen**, all increase **deficiency risk**.
- Vitamin D increases **innate immunity** via secretion of **antiviral peptides**, strengthening **mucosal defenses** and **reducing risk of respiratory infections**.



Lips P, et al. *Eur J Endocrinol*. 2019;180:23–54.
Ali N. *J Infall Public Health* 2020; Oct; 13(10): 1373–1380.

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Vitamin D & 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.

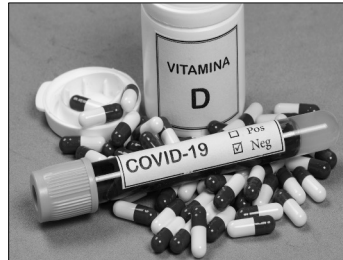
- Acute respiratory infection kills **~2.65 million people/year**.
- Vitamin D releases antimicrobial peptides in the lungs, helps to mount immune response.
- **25 eligible randomized controlled trials** (n=10,933, aged 0–95 years).
- Supplementation **reduced risk of acute respiratory infection** among all participants (NNT=33) and **those who were vitamin D deficient** experienced the most benefit (NNT=4).

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Vitamin D & COVID

- 212 cases COVID-19: **vitamin D deficient patients had 19.6-fold higher risk of critical outcome** compared to those with sufficient levels ($p < 0.001$).¹
- Retrospective study: **780 confirmed cases SARS-CoV-2** infection found those vitamin D deficient **~13 times more likely to die**.²
- Israeli data: **26% of COVID** patients died if vitamin D deficient soon before hospitalization, compared to **3% who had normal levels of vitamin D**.
- Hospitalized patients who were vitamin D deficient **14 times more likely to end up in severe or critical condition than others**.³



1. Alipo, M. Vitamin D Supplementation Could Possibly Improve Clinical Outcomes of Patients Infected with Coronavirus-2019 (COVID-2019). *SERV Educ J*. 2020; doi:10.2139/ssrn.3571484;
 2. Rahmawan P, et al. Patterns of COVID-19 Mortality and Vitamin D: An Indonesian Study. *SERV*. 2020; doi: 10.2139/ssrn.3585561
 3. <https://www.tiempooficial.com/1-in-4-hospitalized-covid-patients-who-lack-vitamin-d-die-israeli-study/>

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Vitamin D Deficiency

- **Serum 25(OH)D level** used to determine vitamin D status. American Endocrine Society:
 - Preferable level **40–60 ng/mL** (100–150 nmol/L)
 - **Sufficiency is 30 ng/mL** (75 nmol/L) and above
 - **Insufficiency** defined as **20–29 ng/mL**
 - **Deficiency** defined as **<20 ng/mL** (<50 nmol/L)
 - **Severe deficiency** **<12 ng/mL** (<30 nmol/L)
- **66.8 million Americans** 1 year and older: levels between **12–20 ng/ml**
- **23 million Americans** 1 year and older: levels **less than 12 ng/ml**
 - Most at risk were *women and non-Hispanic blacks*.
- **2,000–4,000 IU per day** appears necessary to maintain sufficient levels.

CDC: 2nd National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population. All rights reserved.
 Holick MF, et al. *J Clin Endocrinol Metab* 2011; 96(7):1911-30

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Calcium and Oral Health

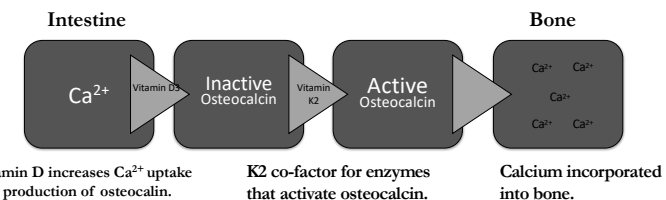
- Necessary for bone health, and data from NHANES III suggests **lower dietary intake leads to progression of periodontal disease**.
- Intervention trials: beneficial effect of **combined calcium and vitamin D** supplementation on progression and maintenance of **periodontal disease**.
- Randomized clinical trial healthy adults (>65years): calcium supplementation + vitamin D improved periodontal health and retention of teeth compared to placebo.

Suellan JBF, et al. The potential role of systemic calcium in periodontal disease *Dentistry* 2015; 2(5)

Perayil J, et al. Influence of vitamin D & calcium supplementation in the management of periodontitis *J. Clin. Diagn. Res.* 2015; 9(6): ZC35-ZC38

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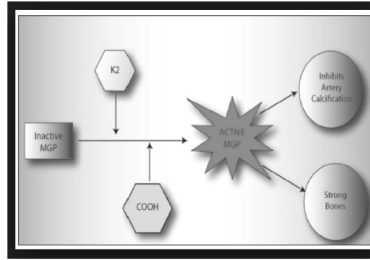
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Don't Forget the Vitamin K

- Calcium, magnesium, and vitamins D and K, contribute independently and collectively to bones.
- Beneficial role of vitamin K, particularly **vitamin K2**, in **bone and cardiovascular health** well **supported scientifically**, with several preclinical, epidemiological, and clinical studies published over the last decade.
- Vitamin K2 (MK-7) 100–200 mcg per day.



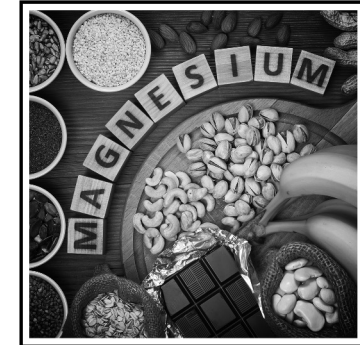
Karpinski M, et al. Roles of Vitamins D and K, Nutrition, and Lifestyle in Low-Energy Bone Fractures in Children and Young Adults. *J Am Coll Nutr* 2017 Jul;36(5):399-412.

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Magnesium

- **Low magnesium** intakes and serum levels associated with **type 2 diabetes, metabolic syndrome, inflammation, high blood pressure, atherosclerotic vascular disease, sudden cardiac death, chronic pain, osteoporosis, migraine, asthma, and colon cancer.**
- **50% of U.S. population** consumes less than the required amount of daily magnesium.
- Deficiency associated with negative effects on **calcium and vitamin D homeostasis.**



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Magnesium Deficiency

- Magnesium deficiency: **menstrual cramps, leg cramps, increased pain, migraines, fatigue, anxiety, insulin resistance, heart arrhythmia, etc.**
- **Severe cases** of deficiency, **seizures, tingling and numbness in arms and legs, bizarre muscle movements (especially of eyes and face), personality changes, and coronary spasms** can occur.
- Magnesium **citrate, malate, glycinate** are much better tolerated than **magnesium oxide.**
- **Supplementing 300–600 mg/d** very safe. Larger doses should not be used in those with impaired kidney function.

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Zinc and Oral Health

- Case-control and cross-sectional studies establish link between **serum zinc levels and periodontitis in both healthy and diabetic patients.**
- Lower plasma zinc levels associated with **further deterioration of periodontal disease in type 2 DM**, compared to healthy individuals.
- Evidence supports safety and efficacy of **Zn carnosine (PepZin GI)** for prevention and treatment of **oral mucositis**, as well as **taste disorders.**
- Zinc deficiency more common in **recurrent aphthous stomatitis** and **supplementation improves resolution.**

Pashparani DS, et al. *J Indian Soc Periodontol* 2014; 18(2): 187-193; Hewlings S, et al. *Nutrients* 2020 Mar; 12(3): 665. Yildirimyan N. *Oral Health Prev Dent* 2019;1-4.

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Resources

- *Fortify Your Life* and *Guide to Medicinal Herbs* with National Geographic
- Dietary Supplement Label Database: dslid.nlm.nih.gov
- NIH National Center for Complementary & 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 Research Collaboration
<https://naturalmedicines.therapeuticresearch.com>

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