The Under-Recognized Role of Essential Nutrients in Health and Health Care

Honolulu Subarea Health Planning Council
February 7, 2013

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Goals Today:

1. Make you aware of the importance of consuming ALL required essential nutrients and adequate Calories.

2. Show how nutrition affects both health maintenance and health care.

Got Nutrients?

Health and Nutrition Concepts

- What is Health?
- Essential Nutrients, Food Composition, and Bioavailability
- Nutrition Recommendations
- Examples of Common Conditions Affected by Inadequate Nutrients

Got Nutrients?

What is Health?

What is Health?

- **Health is the complete physical, mental, and social well-being of an individual.**
  - Boisfeuillet Jones, MD, The Health of Americans, 1970
- **An implicit goal of society is the enhancement of each person's opportunity for a healthy, reasonably happy, and productive life.**
  - Julius Richard, MD, The Health of Americans, 1970

Got Nutrients?

Health is …

… being physically, mentally, and emotionally able to live a full life.

What is Nutrition?

Nutrition is …

All interactions between a living organism and its food.

All of the interrelated steps by which an organism assimilates food and uses it for growth, tissue repair and replacement, or elaboration of products

Nutrition = homeostasis

Got Nutrients?

The SINGLE
MOST IMPORTANT
concept relating to both

HEALTH and NUTRITION

is HOMEOSTASIS

Homeostasis is defined as

- "Body components remain constant in amount and chemical composition even with constant turnover."
  - Rudolf Schoenheimer, MD
- Homeostasis is a Dynamic State

Got Nutrients?

Homeostasis allows the body to:

1. Regulate a constant internal environment (e.g. temperature, blood composition)

2. Repair and rejuvenate itself (e.g. gastro-intestinal tract, skin, hair and production of neurochemical)

3. Respond appropriately to both internal and environmental changes (thirst or a simple cut could cause a person to bleed to death because the mechanism to produce platelets and trigger blood clotting would take too long.

Got Nutrients?

How Does Homeostasis Occur?

- Through CATABOLISM
  - [constant breakdown of body components]
- and
- ANABOLISM
  - [constant build-up of body components]
- The body can seemingly remain the same but is constantly repairing and rejuvenating itself.

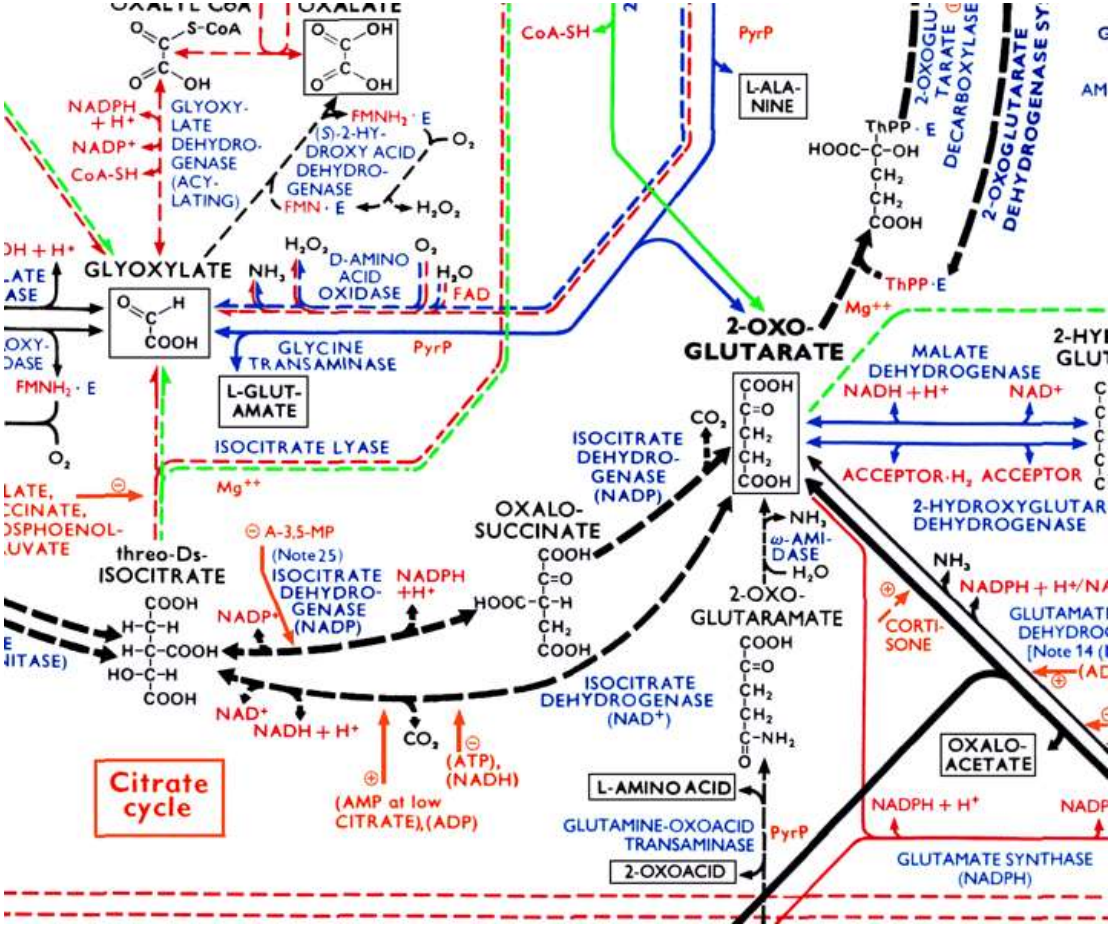
Got Nutrients?

Homeostasis Requires Metabolism

- **METABOLISM** is another term referring to **all of the life-sustaining chemical reactions in the body necessary to** maintain a state of homeostasis. Many of these chemical reactions require energy from the diet.

Got Nutrients?

Nutritional Equilibrium - Homeostasis

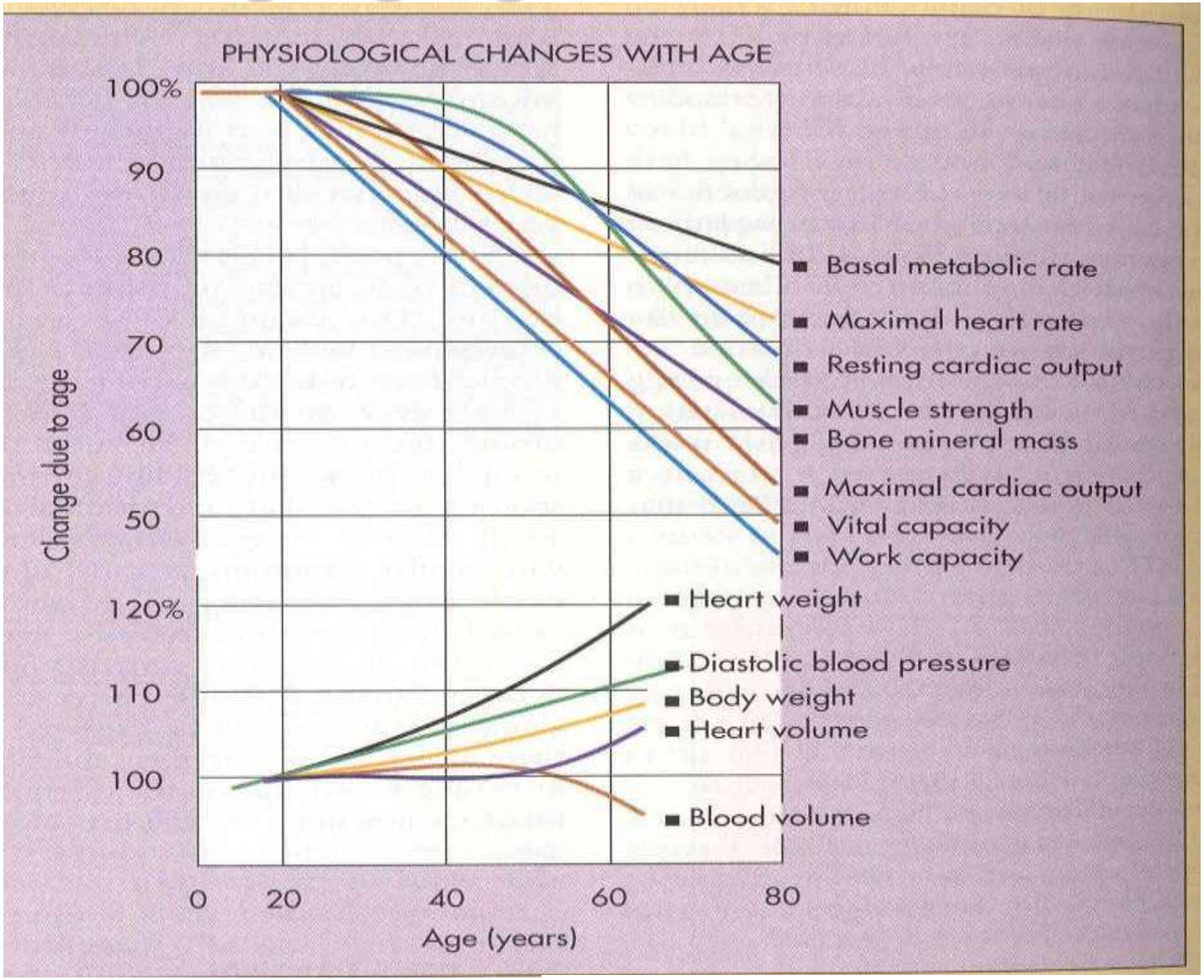


Health Requires …

- a continuous supply of nutrients to maintain homeostasis.

Got Nutrients?

During Aging →Homeostasis Changes



Guthrie and Picciano, Human Nutrition, Mosby 1995

Got Nutrients?

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Got Nutrients?

What Is An Essential Nutrient?

Essential Nutrients

Substances that the body requires for normal function but cannot make from other substances or cannot make enough to meet body needs

Got Nutrients?

If It Is An Essential Nutrient…

- 1) Inadequate intake of an essential nutrient results in a deficiency sign or symptom.
- 2) This sign or symptom is reversed when the nutrient is reintroduced and "healthy" body stores are at least partially replenished.

Got Nutrients?

Six Classes of Nutrients

- **Water**
- **Protein**
- **Carbohydrate**
- **Fat**
- **Vitamins**
- **Minerals**

Got Nutrients?

Main Functions of Nutrients

Nutrient	Source of Energy	Growth and Maintenance of Tissues	Regulation of Body Processes
Water		Yes	Yes
Protein	Yes	Yes	Yes
Lipid	Yes	Yes	Yes
Carbohydrate	Yes		
Vitamins			Yes
Minerals		Yes	Yes

Got Nutrients?

Approximate Energy Provided by Macronutrients and Alcohol

	KiloCalories / Gram	Kjoules / Gram
Protein	4	16.7
Carbohydrate	4	16.7
Lipid	9	37.6
Alcohol	2	29.3

Got Nutrients?

Macro- & Micro-Nutrients and Other Food Substances

MACRO-NUTRIENTS

Protein
Carbohydrate
Fat
Water

Micro-Nutrients
Vitamins
Water Soluble
B1, B2, Niacin, B6, Folate, B12
Biotin, Pantothenic Acid, C, Choline
Fat Soluble
A, D, E, K

Minerals (Ash)
Major Minerals
Calcium, Chloride
Magnesium, Phosphorus
Potassium, Sodium, Sulfur

Trace Minerals
Chromium, Cobalt, Copper,
Fluoride, Iron, Iodine,
Manganese, Molybdenum
Selenium, Zinc

Other Trace Minerals
Appear to be essential:
Arsenic, Boron, Nickel,
Silicon

Possibly essential:
Cadmium, Lead, Lithium,
Aluminum, Bromine,
Rubidium, Vanadium

Other Food Substances
Caffeine
Cholesterol
Dietary Fiber
Other Phytochemicals

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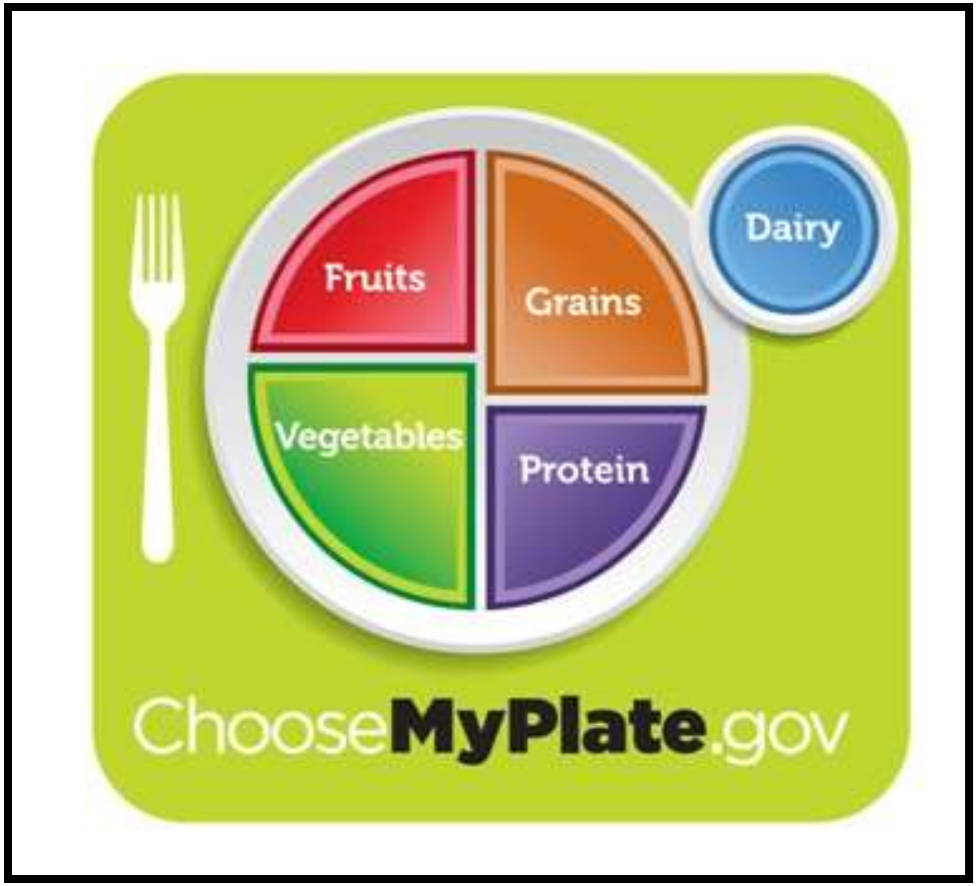
Got Nutrients?

Food Groups



Got Nutrients?

Each food group has a set of nutrients

Meat/Alternative	Milk Products	Grains	Fruit & Vegetable
Protein	Protein	Protein	
Fat	Fat		
	+/- Carbohydrate	Carbohydrate	Carbohydrate
		Fiber	Fiber
Thiamin		Thiamin	Thiamin
Riboflavin	Riboflavin	Riboflavin	
Niacin		Niacin	
Folate		Folate	
B12	B12		
Vitamin A	Vitamin A		
			Vitamin C
Vitamin D	Vitamin D		
	Calcium	Calcium	+/- Calcium
Heme Iron		Non-heme Iron	Non-heme Iron
Zinc	Zinc	Zinc	
Magnesium	Magnesium	Magnesium	Magnesium

Health and Nutrition Concepts

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Got Nutrients?

- Recommendations to Assure Nutrient Adequacy is too often based on **TOTAL** Nutrient Content rather than **BIOAVAILABILITY**

- **Result is Misleading and Potentially Harmful to Health**

Got Nutrients?

Nutrient Bioavailability

- **The amount of an ingested nutrient that can be digested, absorbed, and assimilated.**

- Amount consumed does **NOT** = amount absorbed into the body

Got Nutrients?

Spinach does not equal Beef in terms of Iron Bioavailability

- Total Iron = 2.43mg Iron / 3 oz

Approx. Bioavailability
2% =

0.049 mg Iron

- Total Iron = 2.21 mg Iron / 3 oz

Approx. Bioavailability
20 %

0.442 mg Iron

Got Nutrients?

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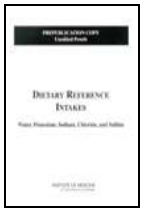
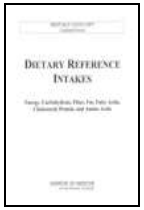
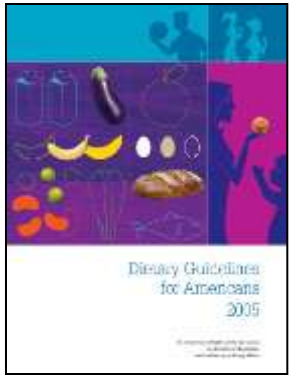
Got Nutrients?

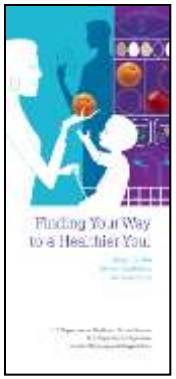

Dietary Reference Intakes


Dietary Reference Intakes


MyPyramid.gov
STEPS TO A HEALTHIER YOU


Fruits
Grains
Dairy
Vegetables
Protein
ChooseMyPlate.gov


Dietary Guidelines
for Americans
2005


Finding Your Way
to a Healthier You.

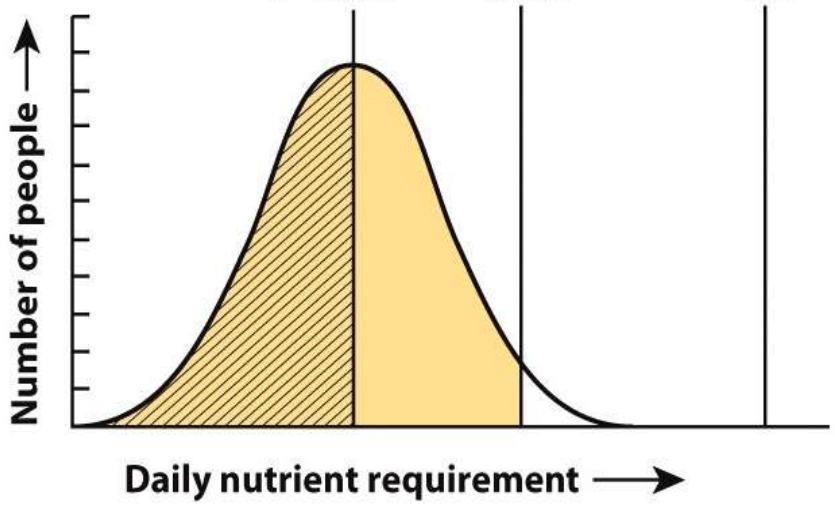

Nutrition Facts


Got
Nutrients?

Understanding Recommendation Jargon

The RDA is set by adding a safety factor to the EAR. About 97% of the population meets its needs by consuming this amount (shown as yellow shading). If nutrient intake meets the RDA, the risk of deficiency is very low. As intake falls, the risk of a deficiency increases.

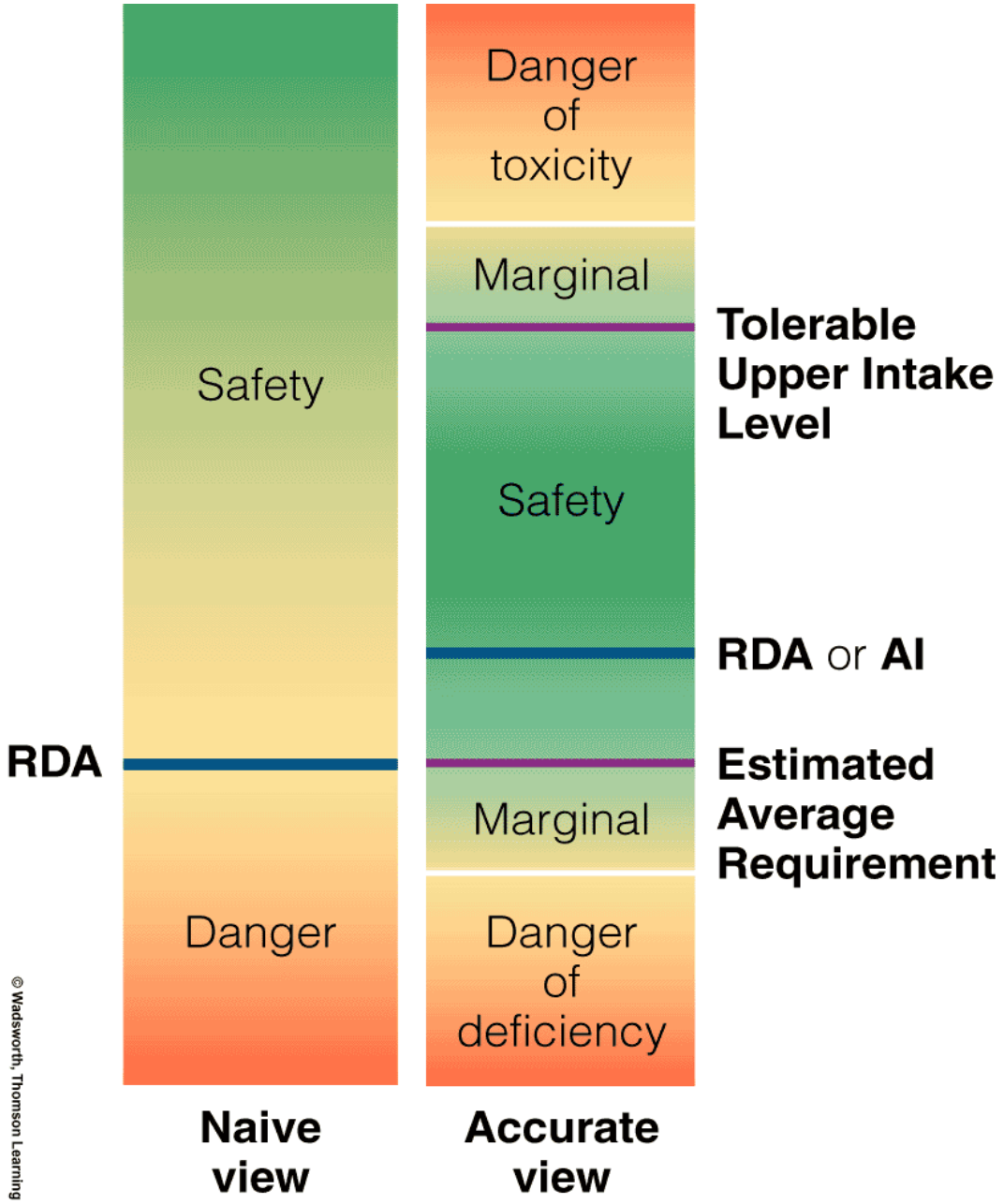
An EAR is the average amount of a nutrient required for good health. If everyone in the population consumed this amount, only 50% would obtain enough of the nutrient to meet their requirements (shown as diagonal lines).



The UL is set well above the needs of everyone in the population and represents the highest amount of the nutrient that will not cause toxicity symptoms in the majority of healthy people. As intake rises above the UL, the likelihood of toxicity increases.

Fig 2.4

DRI



Got Nutrients?

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Got Nutrients?

Iron Deficiency

Iron deficiency (ID) is the most prevalent micronutrient deficiency worldwide **including the United States.**

An estimated 2 billion people are ID and as many as 1 in 5 females of reproductive age.

Main Causes

- Insufficient dietary iron
- Low bioavailability of iron from foods
- Blood Loss

Got Nutrients?

Increased Iron Demands

- Pregnancy
- Infancy/adolescence
- Blood Loss
- Inadequate gastrointestinal absorption
- Malabsorption syndromes
- Drugs / OTC – (NSAIDS, calcium, zinc)
- Low bioavailability foods (coffee, tea, colored beans, red wine, alcohol, milk, calcium fortified)
- Sweat Loss

Got Nutrients?

Blood Loss

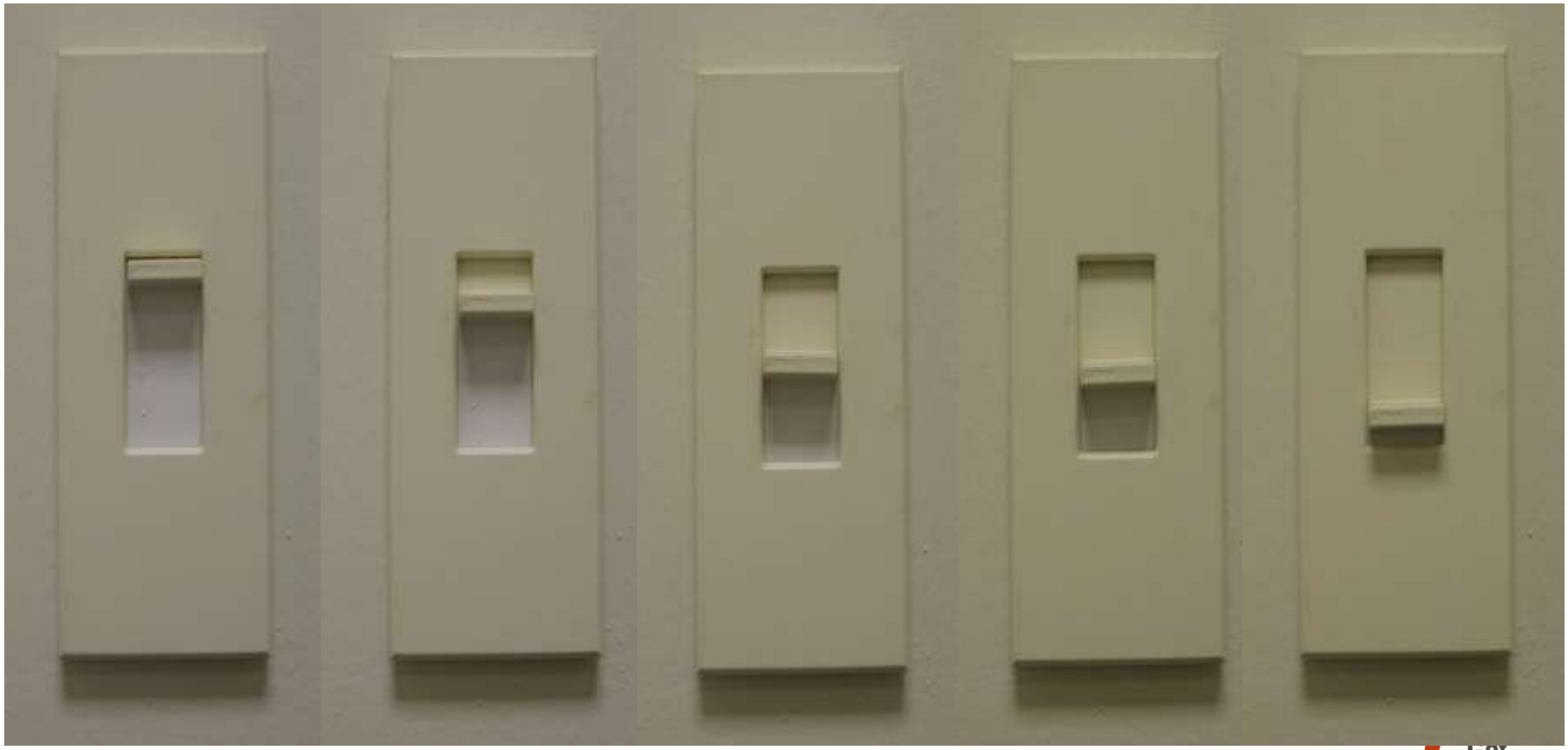
- Menstruation
- Blood donation
- Birth
- Trauma
- Surgery
- Gastrointestinal bleeding
- Dialysis

Got Nutrients?

Overly Simplistic View of Nutrient Deficiency Symptoms

Got Nutrients?

Malnutrition is Gradual



Got Nutrients?

What are Examples of Common Conditions Affected by Inadequate Consumption of a Single Essential Nutrient - Iron?

Got Nutrients?

Common Medical Conditions That Could Be Related to Iron Deficiency

- ADHD / ADD
- Anemia
- Autism
- Cognitive Function
- Depression
- Esophageal Reflux
- Fatigue
- Gall Bladder
- Headaches
- Hypothyroid
- Immune System
- Insomnia
- Insulin Resistance
- Respiratory Problems
- Restless Legs Syndrome
- Weight Gain

Got Nutrients?

Examples of Non-Hematological Functions of Iron

- **Thyroid** – formation of thyroid hormones
- **Brain** – formation of brain chemicals – dopamine & serotonin
- **Liver** – Heme-containing cytochrome P450s & cytochrome b5 enzymes; also Carnitine synthesis
- **Heart** – uses carnitine in the transport of long-chain fatty acids across the mitochondrial matrix to be used for energy.
- Without proper synthesis of carnitine, the beta oxidation of fatty acids declines and so does the heart's primary source of fuel.

Got Nutrients?

Physiological States Affecting Iron Bioavailability

Medical Belief

Adequate Body Iron Stores are Identified using Anemia Indices

Physiological Reality

Standard Blood Tests May or May Not Be Reliable Indices of Iron Status

Got Nutrients?

Non-Anemic Iron Deficiency is NOT Always Recognized by Medical Practice Standards

- **NHANES II data**
  - Females - missed 65% of the time
  - Males missed 20% of the time.
- **NHANES III data**
  - Females – missed 45% of the time
  - Male missed 41% of the time.

Ferritin < 11µg/L

- **Hill, B. et al. 2008**

Got Nutrients?

Nutrition. 2005 Apr;21(4):438-45.

Sodium depletion and hemoconcentration: overlooked complications in patients with anorexia nervosa?

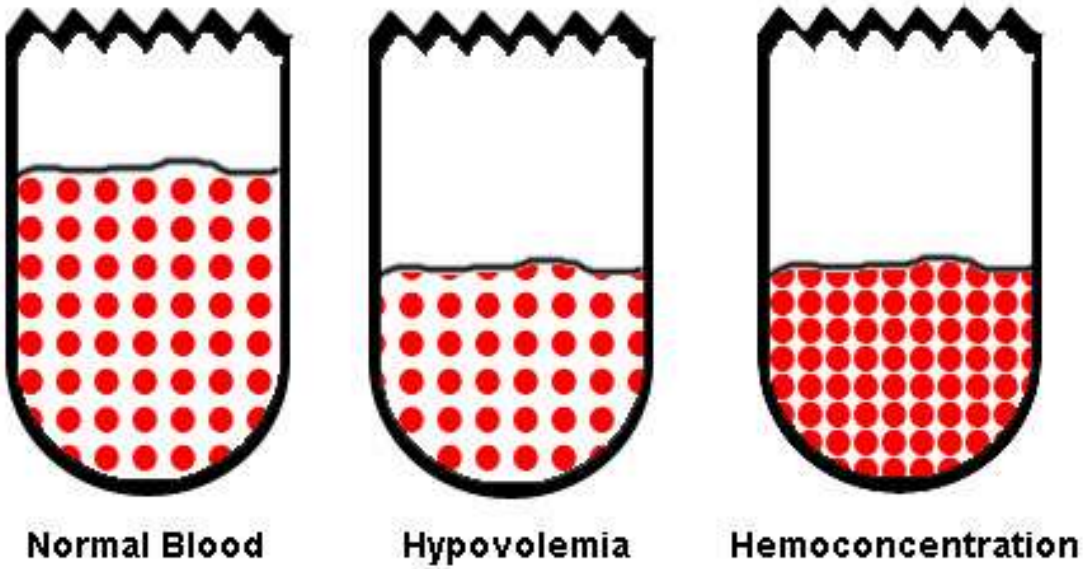
Caregaro L, Di Pascoli L, Favaro A, Nardi M, Santonastaso P.

Department of Clinical and Experimental Medicine, University of Padua, Padua, Italy. lorenza.caregaro@unipd.it

"Conclusions: Plasma volume depletion and hypovolemic hyponatremia are common in the most severely malnourished patients with anorexia nervosa. Clinicians should be aware that because of malnutrition, the common indexes of hemoconcentration may be within normal range and that hemoconcentration may mask anemia."

Got Nutrients?

Potential effects of hydration status/ protein status/ sodium status on blood composition



Got Nutrients?

Non-Anemic Iron Deficiency Can Be Extremely Costly

- Delayed appropriate treatment for ID deficiency is costly both to the individual and to an already overburdened medical system
- Appropriate dietary iron recommendations are now more important than ever.

Got Nutrients?

Scandinavian Journal of Primary Health Care, 2005; 23: 28–33

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Symptom panorama in upper secondary school students and symptoms related to iron deficiency

Screening with laboratory tests, questionnaire and interventional treatment with iron

JÖRGEN MÅNSSON[1–3], GUNILLA JOHANSSON[1], MONA WIKLUND[1], AMIR BAIGI[2] & BERTIL MARKLUND[2,3]

[1]*Aranässkolan, Kungsbacka, Sweden,* [2]*Research and Development Unit, Primary Health Care, Halland, Sweden, and* [3]*Department of Primary Health Care, The Sahlgrenska Academy at Göteborg University, Sweden*

Symptoms Panorama in upper secondary school students and symptoms related to iron deficiency

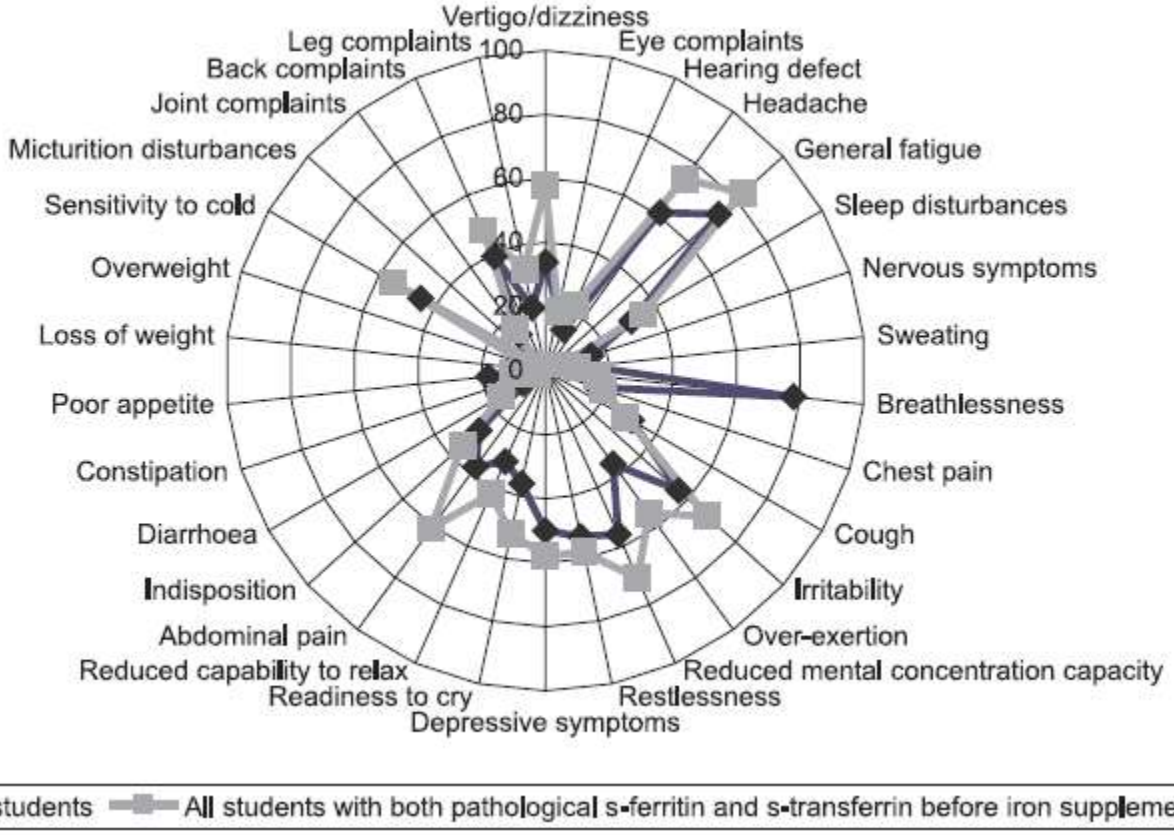
Iron deficiency in students is a common condition in school healthcare and general practice.

- Abnormal laboratory tests were found in 61% of the students and in 12% of the students two or more tests were abnormal.
- Symptoms of vertigo/dizziness were significantly more common in students with iron deficiency.
- The laboratory tests were significantly improved after iron supplementation and symptoms of vertigo/dizziness, irritability, depressive symptoms, and indisposition were reduced.

Scandinavian Journal of Primary Health Care, 2005; 23: 28–33

Got Nutrients?

Symptoms Panorama in …students …



Scandinavian Journal of Primary Health Care, 2005; 23: 28–33 s?

Effect of iron supplementation on fatigue in nonanemic menstruating women with low ferritin: a randomized controlled trial

Paul Vaucher DiO MSc, Pierre-Louis Druais MD, Sophie Waldvogel MD, Bernard Favrat MD

Abstract

Background: The true benefit of iron supplementation for nonanemic menstruating women with fatigue is unknown. We studied the effect of oral iron therapy on fatigue and quality of life, as well as on hemoglobin, ferritin and soluble transferrin receptor levels, in nonanemic iron-deficient women with unexplained fatigue.

Methods: We performed a multicentre, parallel, randomized controlled, closed-label, observer-blinded trial. We recruited from the practices of 44 primary care physicians in France from March to July 2006. We randomly assigned 198 women aged 18–53 years who complained of fatigue and who had a ferritin level of less than 50 ug/L and hemoglobin greater than 12.0 g/dL to receive either oral ferrous sulfate (80 mg of elemental iron daily; $n = 102$) or placebo ($n = 96$) for 12 weeks. The primary outcome was fatigue as measured on the Current and Past Psychological Scale. Biological markers were measured at 6 and 12 weeks.

Results: The mean score on the Current and Past Psychological scale for fatigue decreased by 47.7% in the iron group and by 28.8% in the placebo group (–18.9%, 95%CI –34.5 to –3.2; $p = 0.02$), but there were no significant effects on quality of life ($p = 0.2$), depression ($p = 0.97$) or anxiety ($p = 0.5$). Compared with placebo, iron supplementation increased hemoglobin (0.32 g/dL; $p = 0.002$) and ferritin (11.4 μg/L; $p < 0.001$) and decreased soluble transferrin receptor (–0.54 mg/L; $p < 0.001$) at 12 weeks.

Interpretation: Iron supplementation should be considered for women with unexplained fatigue who have ferritin levels below 50 μg/L. We suggest assessing the efficiency using blood markers after six weeks of treatment. Trial registration no. EudraCT 2006–000478–56.

Got Nutrients?

ORIGINAL PAPER

THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE

Effect of iron supplementation in women with chronic cough and iron deficiency

C. Bucca,[1] B. Culla,[2] L. Brussino,[3] F. L. Ricciardolo,[4] A. Cicolin,[5] E. Heffler,[3] M. Bugiani,[6] G. Rolla[3]

Int J Clin Pract doi: 10.1111/ijcp.12001

What's known

Chronic cough is more frequent and severe in women than in men. Women often have decreased iron stores, because of menses and pregnancies. Low body iron stores may decrease mucosa defences and impair neural function. Brain areas with great iron-dependent metabolic activity are involved in the neural control of cough.

What's new

Our findings indicate that in women with unexplained chronic cough unresponsive to targeted treatment, cough and airway hyperresponsiveness may be sustained by iron deficiency. Healthy women with chronic cough should be checked for iron deficiency, as iron repletion may resolve cough.

ot
trients?

Unexplained chronic cough and vitamin B-12 deficiency[1–3]

Caterina B Bucca, Beatrice Culla, Giuseppe Guida, Savino Sciascia, Graziella Bellone, Antonella Moretto, Enrico Heffler, Massimiliano Bugiani, Giovanni Rolla, and Luisa Brussino

ABSTRACT

Background: Chronic cough is characterized by sensory neuropathy. Vitamin B-12 (cobalamin) deficiency (Cbl-D) causes central and peripheral nervous system damage and has been implicated in sensory neuropathy and autonomic nervous system dysfunction.

Objective: We evaluated whether Cbl-D has a role in chronic, unexplained cough.

Results: Cbl-D patients had a higher prevalence of laryngeal hyperresponsiveness than did Cbl-N patients (92.6% compared with 66.7%; $P = 0.03$) After cobalamin supplementation, symptoms and laryngeal, bronchial, and cough thresholds were significantly improved in Cbl-D but not in Cbl-N patients.

Conclusions: This study suggests that Cbl-D may contribute to chronic cough by favoring sensory neuropathy as indicated by laryngeal hyperresponsiveness and increased NGF expression in pharyngeal biopsies of Cbl-D patients. Cbl-D should be considered among factors that sustain chronic cough, particularly when cough triggers cannot be identified. *Am J Clin Nutr* 2011;93:542–8.

Published in final edited form as:
Nutr Today. 2007 ; 42(4): 181–186.

Choline:

Dietary Requirements and Role in Brain Development

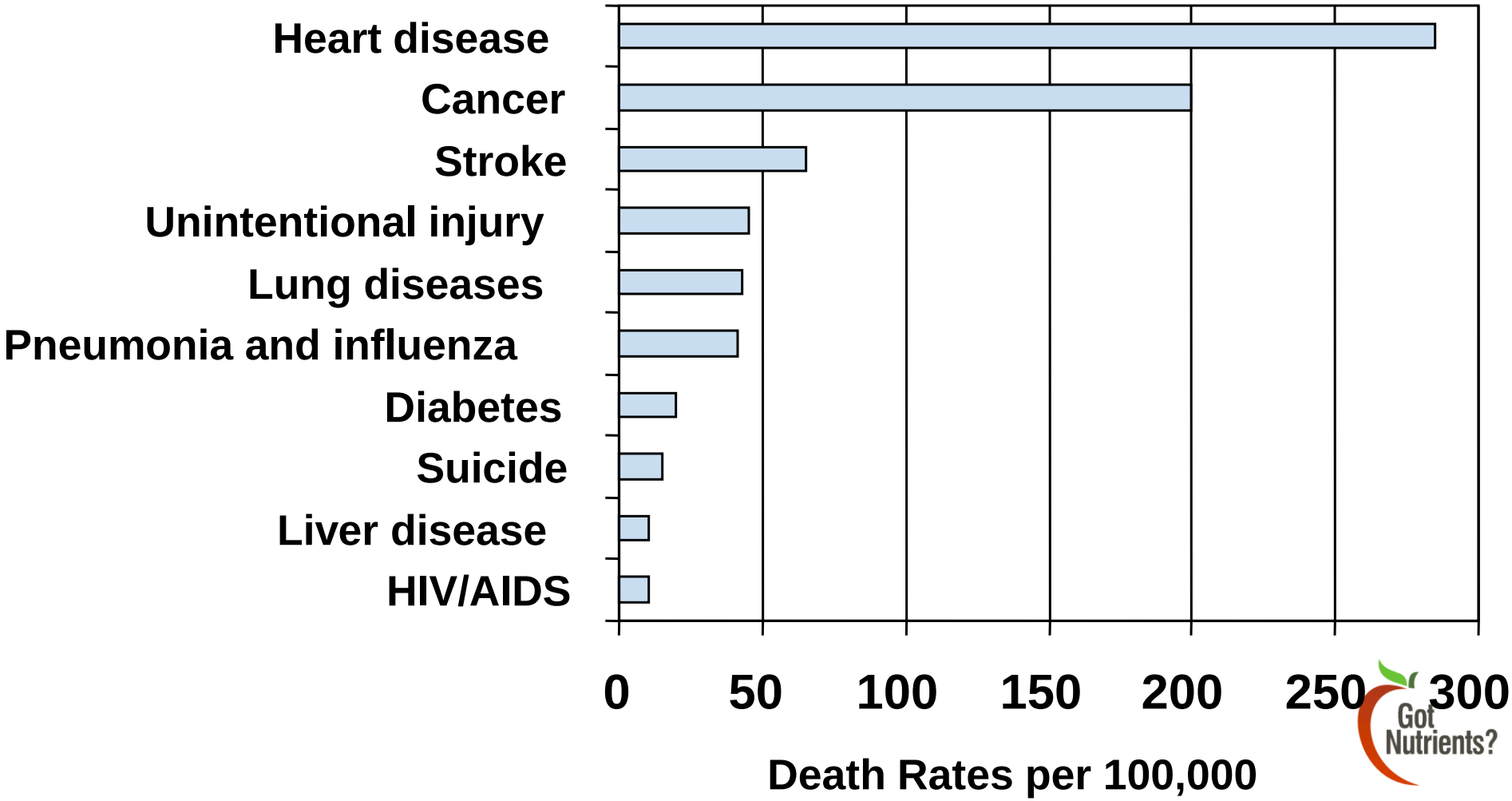
Lisa M. Sanders, PhD, RD and Steven H. Zeisel, MD, PhD

Abstract

Choline is needed for the maintenance of the structural integrity and signaling functions of cell membranes, for neurotransmission, and for transport of lipids and as a source of methyl groups. Choline can be made de novo in the body, but some individuals must also obtain choline in the diet to prevent deficiency symptoms. A number of environmental and genetic factors influence dietary requirements for choline, and average intakes in the population vary widely. Therefore, certain individuals may be at greater risk of choline deficiency. Choline is critical during fetal development, particularly during the development of the brain, where it can influence neural tube closure and lifelong memory and learning functions.

Got Nutrients?

Leading Causes of Death in US: 1990



Got Nutrients?

Present Health Recommendations often promote:

- Quantity of food rather than Bioavailability or Nutrient Density

- Decreased Caloric Intake
  - Promote decreased Protein
  - Going more Meatless

Got Nutrients?

Average Calories / gram Protein

Protein Sources	kcal / g protein
Lean Beef, Chicken, Fish, Egg + Cottage Cheese	8
Dairy + Tofu	16
Beans	24
Grains	30
Nuts	36

Got Nutrients?

Per Capita Calories from Foods

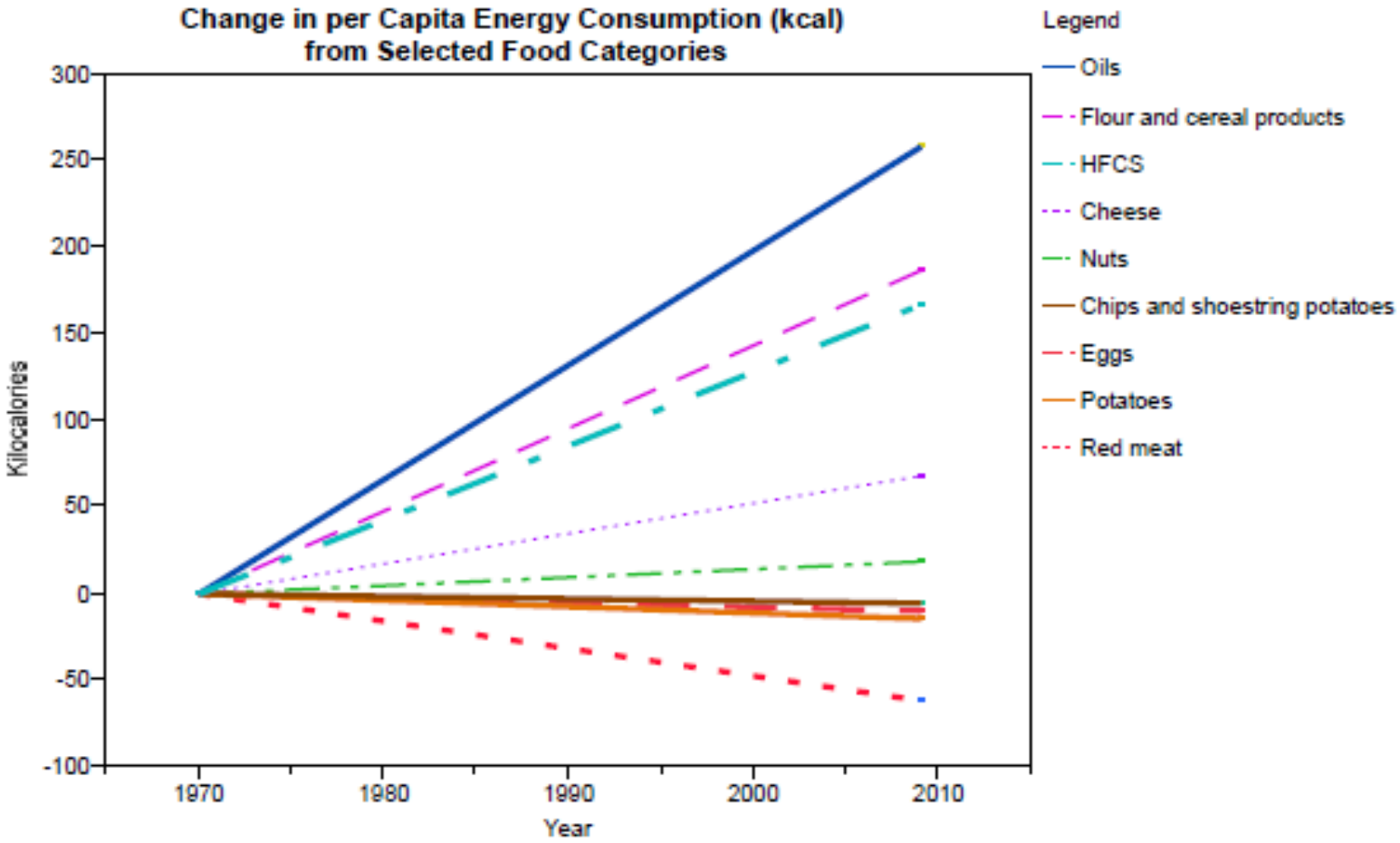


Figure Note: The legend is in the same order as the lines in the graph from top to bottom.

Got Nutrients?

Health Care Recommendations Should Primarily be based on:

- Nutrition Science
  - Identify essential nutrients for growth, repair and reproduction .
  - Determine amounts of essential nutrients that are required to prevent deficiencies and to determine effectiveness of therapeutic and preventive measures.
- Nutritional Epidemiology
  - Should be used to detect relationships and trends between exposures and health and estimate health services.
  - Nutrition Recommendations based SOLELY on Nutritional Epidemiology can be problematic.

Got Nutrients?

Got Nutrients?

Intergeneration Nutrition Essentials For Health

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College of Tropical Agriculture and Human Resources | Honolulu Subarea Health Planning

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Today's Daily Tip

Today's Daily Tip:

February, 07, 2013
A new analysis of data from the Sydney Diet Heart Study (conducted between 1966 and 1973) found some interesting results. The group middle-aged men that consumed the most polyunsaturated vegetable oils (high in linoleic acid) had an increased risk of dying from cardiovascular disease and other causes. This was despite the fact that they had lower blood cholesterol levels.

Consumer Related Article:
Re-Analysis Refutes Diet Guidelines Favoring Vegetable Fats

Research Related Article:
BMJ 2013;346:e8707.

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Got Nutrients

- Is the first step to maintaining and regaining health.
- And, goes along with Exercise to achieve longterm health.

"Let medicine be thy food and let food be thy medicine."—

Hippocrates

Got Nutrients?

Mahalo

Questions