

# Traditional Nutrition for an Aging Population

HOW THE  
PREVAILING DIETARY GUIDELINES  
INCREASE THE RISK FOR DEFICIENCIES OF  
VITAMINS A, B12 , CHOLINE & ZINC FOR SENIORS

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# KEY POINTS

- Significance of the “malnutrition” problem
- Health / Quality-of-Life statistics
- How nutrient insufficiencies accelerate aging
- Federal Dietary Guidelines / Regulations
- Nutrients commonly “underconsumed”
- Health threats connected to these nutrients
- How we can address with nourishing food

# Nutrition ↔ Aging

- Inadequate micronutrient status is linked to a **higher morbidity and frailty** in seniors
- Interferences with meeting nutritional needs:
  - Reduced intake
  - Reduced absorption
  - Medication interactions
  - Increased needs / catabolism of nutrients

**Bolzetta et al. *J Acad Nutr Diet.*2015;115.**

# Malnutrition Defined as:

An acute, subacute or chronic state of nutrition, in which a combination of varying degrees of overnutrition or undernutrition with or without inflammatory activity have led to a change in body composition and diminished function.

*E44.0 Moderate protein-calorie malnutrition*

*E64.1 Vitamin A deficiency*

*E 60 Dietary zinc deficiency*

***Curr Opin Clin Nutr Metab. 2009:12(5)***

# **ANOTHER KIND OF MALNUTRITION**

## **“HIDDEN HUNGER”**

**PLENTY OF CALORIES, NOT ENOUGH NUTRIENTS**

# SIGNIFICANCE OF THE “MALNUTRITION” PROBLEM FOR SENIORS

# MALNUTRITION: AN OLDER-ADULT CRISIS

WWW.DEFEATMALNUTRITION.TODAY



**\$51.3 Billion**

Estimated annual cost of disease-associated malnutrition in older adults in the US<sup>1</sup>

**Up to 60%**

of hospitalized older adults may be malnourished<sup>4</sup>



**300%**

The increase in healthcare costs that can be attributed to poor nutritional status<sup>5</sup>



**Up to 1 out of 2 older adults** are at risk for malnutrition<sup>2,3</sup>



**4 to 6 days**

How long malnutrition increases length of hospital stays<sup>6</sup>



**Chronic health conditions**

lead to increased malnutrition risk

**Malnutrition leads to more complications, falls, and readmissions<sup>6</sup>**



# Coalition Introduction

- What is DefeatMalnutrition.Today? And why the DOT?

Abbott Nutrition (*Ensure*)

AND (Dietitians)

Alzheimer's Foundation

ASPEN (Tube Feeding)

National Council on Aging

defeatmalnutrition.today

...vital to healthy aging

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## Just 3 steps can help improve older adult malnutrition care:

**Screen**  
all patients



**Assess**  
nutritional  
status



**Intervene**  
with appropriate  
nutrition



## Focusing on malnutrition in healthcare helps:



- ✓ Decrease healthcare costs<sup>1</sup>
- ✓ Improve patient outcomes<sup>1</sup>
- ✓ Reduce readmissions
- ✓ Support healthy aging
- ✓ Improve quality of healthcare

Reference: L. Philipson TJ, et al. Am J Manag Care. 2013;19(2):121-128.

Support policies across the healthcare system  
that defeat older-adult malnutrition.

**LEARN MORE AT [WWW.DEFEATMALNUTRITION.TODAY](http://WWW.DEFEATMALNUTRITION.TODAY)**

Adults should be considered at risk if they have any of the following (7):

1. Involuntary loss of 10% or more of usual body weight within 6 months, or involuntary loss of greater than or 5% or more of usual body weight in 1 month.
2. Involuntary loss or gain of 10 pounds within 6 months.
3. Body mass index less than 18.5 kg/m<sup>2</sup> or greater than 25 kg/m<sup>2</sup>.

Adults should be considered at risk if they have any of the following (7):

4. Chronic disease.
5. Increased metabolic requirements.
6. Altered diets or diet schedules.
7. Inadequate nutrition intake, including not receiving food or nutrition products for greater than 7 days.

***Consensus Statement: AND & ASPEN 2012***

## 3 etiology-based diagnoses in adults in clinical practice settings:

1. "**Starvation**-related malnutrition": chronic starvation without inflammation (e.g., anorexia nervosa)
2. "**Chronic disease**-related malnutrition": inflammation is chronic and of mild to moderate degree (e.g., organ failure, pancreatic cancer, rheumatoid arthritis or sarcopenic obesity)
3. "**Acute disease or injury**-related malnutrition": inflammation is acute and of severe degree (e.g., major infection, burns, trauma or head injury)

Edition: US ▾

FRONT PAGE POLITICS ENTERTAINMENT WHAT'S WORKING HEALTHY LIVING WORLDPOST HIGH

## THE BLOG

# Malnutrition: The New Senior Crisis

🕒 09/30/2015 01:03 pm ET | Updated Sep 30, 2015

199



“the hidden epidemic”  
“a diet that lacks essential nutrients”



Robert B. Blancato  
Aging Advocate



This week, September 28-October 2, 2015, is [Malnutrition Awareness Week](#). It is an opportunity to spotlight a growing but under-recognized problem facing older adults in America: the hidden epidemic of malnutrition. What is malnutrition? Simply stated, it means poor nutrition. It is related to an excessive or imbalanced diet, a diet that lacks essential nutrients, or it can be tied to clinical conditions that impair the body's absorption or use of food.

**FOLI**



defeat**malnutrition**.today

# ***“EIGHTY IS THE NEW SIXTY”***

**The over-80 crowd is the fastest growing demographic segment of the US population**, a finding that has profound implications for healthcare and every other sector of the economy. Barring war, natural disaster or extreme climate-change, half of all kids born today in the US and other wealthy countries will live a 100-year lifespan. **But, with lifestyle-driven chronic diseases emerging at earlier ages**, they'll spend a good portion of those years in suboptimal health. **Mortality rates are declining, but morbidity is soaring.**

**---Joseph Coughlin, Director, MIT's AgeLab, at the Population Health Colloquium**



**HEALTH / QUALITY-OF-LIFE STATISTICS FOR SENIORS IN USA**



U.S. Elderly population (65+) is growing

**2014: 14.5%**

**2040: 21.7% (projected)**

**2060: ~ 30%**

Average life expectancy stable at **78.7 years**

US ranks # 27 / OCED 36 countries in life expectancy

Switzerland highest at 82.8 years

“...life expectancy in the United States used to be one year above the OECD average in 1970, it is now more than one year below the average...”

U.S. years of Life expectancy at age 65

Men: **17.9 years**

Women: **20.5 years**



In 2015, rates for 8 of the 10 leading causes of death rose. Even more troubling to health experts: **the U.S. seems to be settling into a trend of no improvement at all.**

The United States **ranks below dozens of other high-income countries in life expectancy**, according to the World Bank. It is highest in Japan, at nearly 84 years.

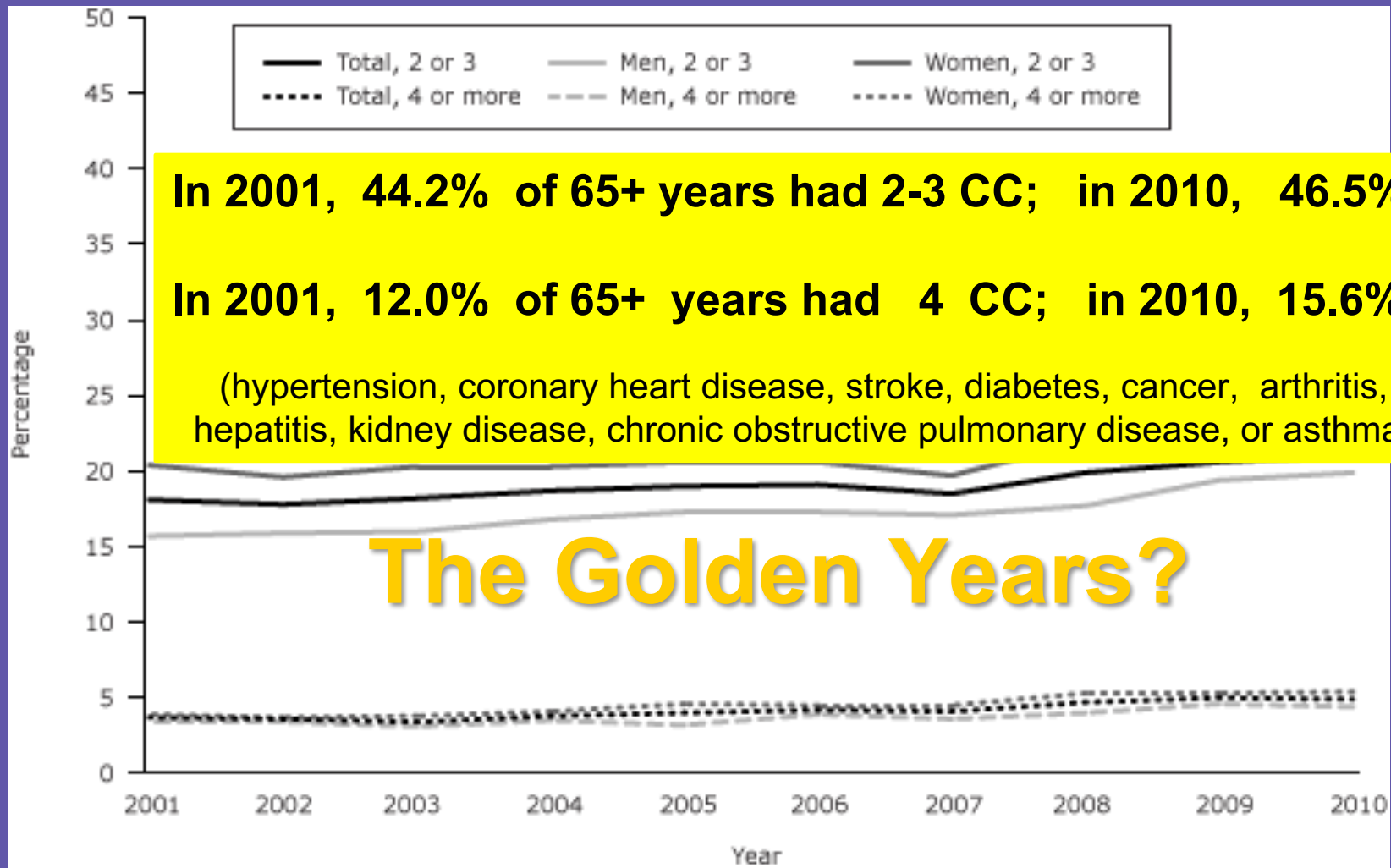
- The CDC report is based mainly on 2015 death certificates. There were more than 2.7 million deaths, or about 86,000 more than the previous year. The increase in raw numbers partly reflects the nation's growing and aging population.
- It was led by an unusual upturn in the death rate from the nation's leading killer, heart disease. Death rates also increased for chronic lower lung disease, accidental injuries, stroke, Alzheimer's disease, diabetes, kidney disease and suicide.
- The only clear drop was in cancer, the nation's No. 2 killer.
- But other research has shown death rates are rising sharply for poorer people — particularly white people — in rural areas but not wealthier and more highly educated and people on the coasts.
- “The troubling trends are most pronounced for the people who are the most disadvantaged,” said Jennifer Karas Montez, a Syracuse University researcher who studies adult death patterns.

# 7 Leading causes of death persons age 65 and over

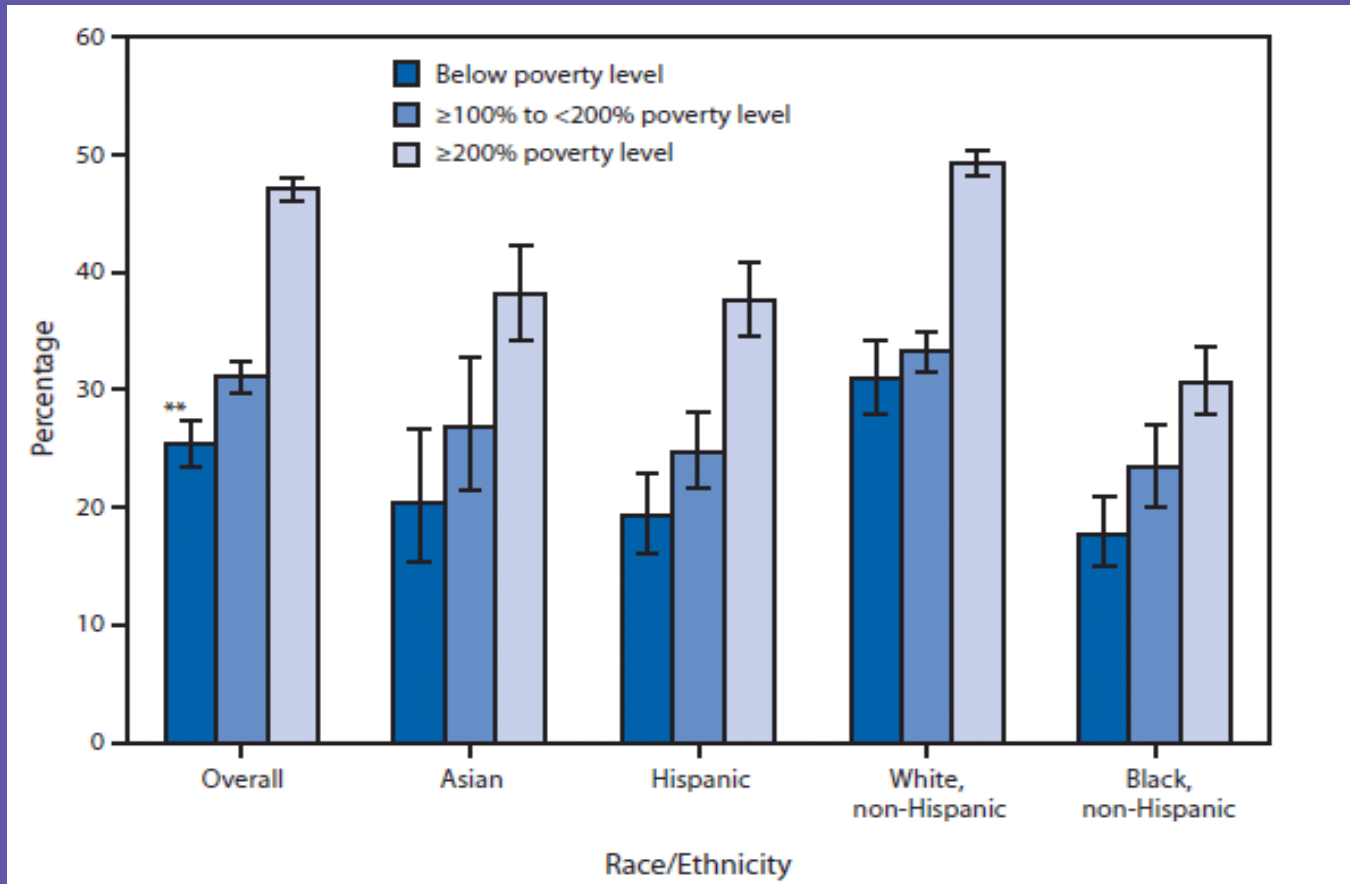
1. Heart disease
2. Cancer
3. Chronic lower respiratory disease
4. Stroke
5. Alzheimer's Disease
6. Diabetes
7. Influenza/pneumonia

**CDC 2013**

# More have Multiple Chronic Conditions (Nearly half US Adults have > 1 CC)



Percentage of Adults Aged  $\geq 65$  Years Who Reported **Excellent or Very Good Health**,\* by Selected Race/Ethnicity† and Poverty Status§ — National Health Interview Survey, 2009–2011



[Morbidity and Mortality Weekly Report \(MMWR\)](#)  
 May 31, 2013 / 62(21);431

## INDICATOR 27: Obesity

**Table 27. Percentage of people age 65 and over overweight and with obesity, by sex and age group, selected years, 1976–2014**

Sex and age group	1976–1980	1988–1994	1999–2002	2003–2006	2007–2010	2011–2014
<b>Overweight</b>						
Both sexes						
65 and over	—	60.1	68.8	69.5	72.0	70.9
65–74	57.2	64.1	73.3	73.8	75.7	73.5
75 and over	—	53.9	62.8	63.9	67.2	67.3
Men						
65 and over	—	64.4	72.8	73.0	75.7	74.2
65–74	54.2	68.5	76.2	78.0	77.5	76.1
75 and over	—	56.5	67.4	65.8	73.2	71.0
Women						
65 and over	—	56.9	65.9	66.7	69.1	68.4
65–74	59.5	60.3	70.9	70.3	74.2	71.2
75 and over	—	52.3	59.9	62.6	63.2	64.6
<b>Obese</b>						
Both sexes						
65 and over	—	22.2	29.6	30.1	35.1	34.7
65–74	17.9	25.6	35.7	34.8	40.8	38.6
75 and over	—	17.0	21.3	24.1	27.8	29.0
Men						
65 and over	—	20.3	26.2	29.3	35.3	32.6
65–74	13.2	24.1	31.6	33.0	41.5	36.2
75 and over	—	13.2	17.7	24.0	26.5	26.8
Women						
65 and over	—	23.6	32.0	30.8	34.9	36.4
65–74	21.5	26.9	39.0	36.4	40.3	40.7
75 and over	—	19.2	23.6	24.2	28.7	30.5

— Not available.

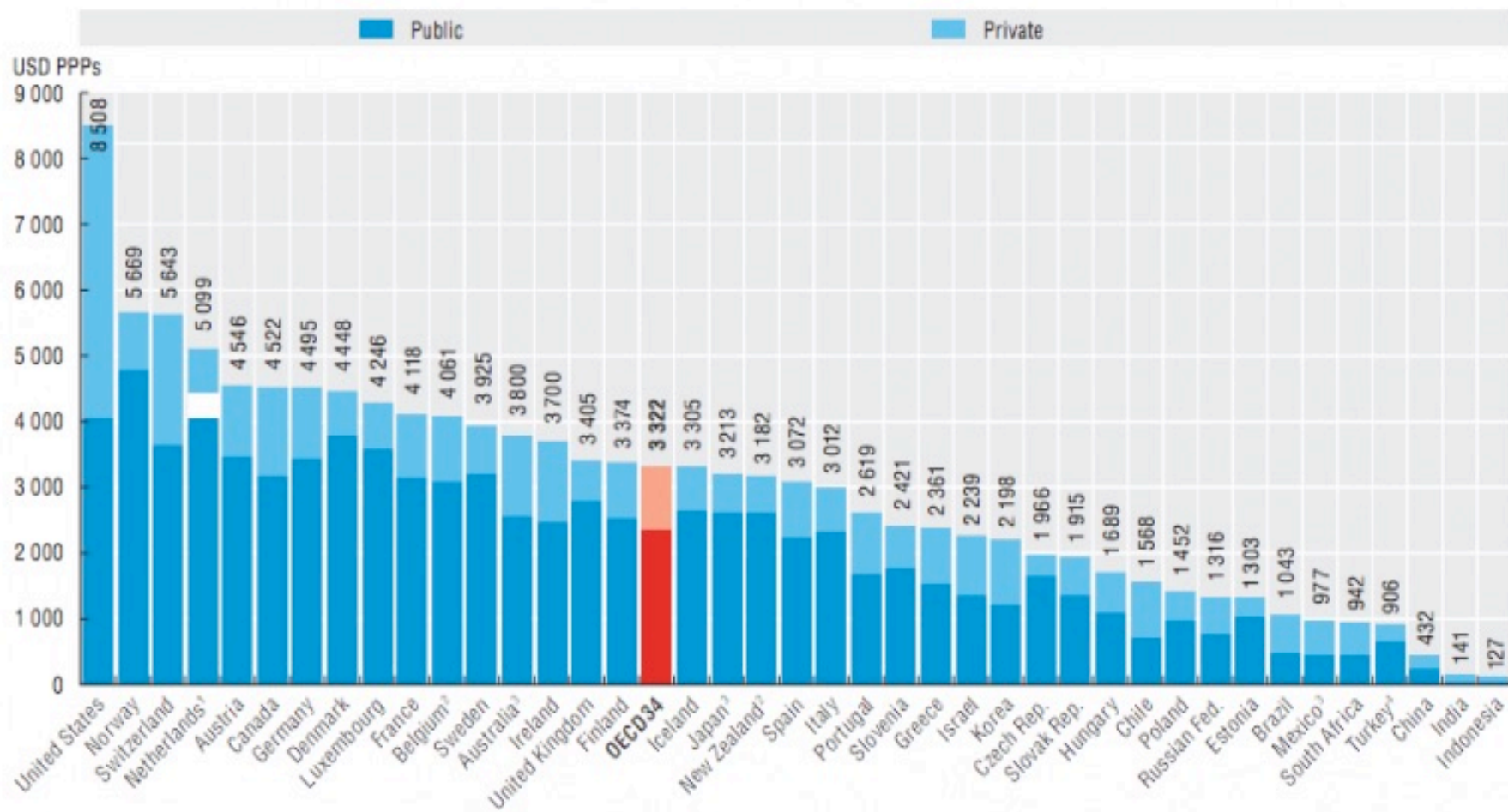
NOTE: Data are based on measured height and weight. Height was measured without shoes. Overweight is defined as having a body mass index (BMI) greater than or equal to 25 kilograms/meter<sup>2</sup>. Obese is defined by a BMI of 30 kilograms/meter<sup>2</sup> or greater. The percentage of people with obesity is a subset of the percentage of those who are overweight. See glossary for the definition of BMI. Beginning in 1999, the National Health and Nutrition Examination Survey has been in the field continuously with data released every 2 years. Some data have been revised and differ from previous editions of *Older Americans*.

Reference population: These data refer to the civilian noninstitutionalized population.

SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey.

“We're spending a lot on health care but, when it comes to life expectancy, not getting much back in return.”

7.1.1. Health expenditure per capita, 2011 (or nearest year)



Washington Post, 2013

**HOW DOES  
MICRONUTRIENT MALNUTRITION  
SHORTEN LIFE AND  
DECREASE QUALITY OF LIFE?**

# Missing Micronutrients

- IOM set DRIs for 29 vitamins and minerals
- **2 billion worldwide** have micronutrient deficiencies:  
**Vitamins A, C, E; zinc, iron, iodine**
  - poor growth, impaired intellect, increased mortality, susceptibility to infection (Katona . *Clin Infect Dis.* 2008;15)
- 2008 Copenhagen Consensus:  
**Vitamin A and zinc supplementation is the #1 investment** the world could make to improve the state of the planet. ([copenhagenconsensus.com](http://copenhagenconsensus.com))
  - Addressing malnutrition: 5 of top 10 priorities



# Missing Micronutrients

- **Subclinical deficiencies often not recognized**
- “Inadequate dietary intakes of vitamins and minerals are widespread.” (Ames B. *PNAS*. 2006)
- “All tissues need all nutrients, inadequate intakes adversely effect **every body system.**” (Ward E. 2014)
- “Low micronutrient intakes may accelerate the degenerative diseases of aging.” (Ames 2006)
- Human cells grown in culture ***short in one vitamin or mineral get DNA damage*** (Ames, quoted in “Vitmania”)

# Bruce Ames'

## Nutrient Triage Theory

I hypothesize that short-term survival was achieved by allocating scarce micronutrients by triage, in part through an adjustment of the binding affinity of proteins for required micronutrients.

If this hypothesis is correct, micronutrient deficiencies that trigger the triage response would accelerate cancer, aging, and neural decay but would leave critical metabolic functions, such as ATP production, intact.

The optimum intake of each micronutrient necessary to maximize a healthy lifespan remains to be determined and could even be higher than the current RDA, particularly for some populations.

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The **optimum intake of each micronutrient necessary to maximize a healthy lifespan** remains to be determined and **could even be higher than the current RDA**, particularly for some populations.

# Live for Today?

“It’s all about living for today.  
Nature favors survival today over tomorrow.  
Nutrient Triage Theory  
“makes sense...and will certainly prove correct.”

**Ames B. *Proc Natl Acad Sci.* 2006; 103(47)**

# Example of “Nutrient Triage”

## Vitamin C

- |                                 |          |
|---------------------------------|----------|
| 1. Collagen production (scurvy) | Survival |
| 2. Neurotransmitters            | Survival |
| 3. Carnitine                    | Survival |
| 4. Inflammation                 | Aging    |
| 5. Oxidative stress             | Aging    |

# Example of “Nutrient Triage”

## Vitamin K

1. Blood clotting
2. Bone modeling
3. Soft tissue integrity
4. Cancer prevention

Survival  
Growth/aging  
Growth/aging  
Aging

# FEDERAL DIETARY GUIDELINES & REGULATIONS



**VEGETABLE OILS**



**PLANT PROTEIN**

# DIETARY GUIDELINES FOR AMERICANS 2015-2020

**EIGHT EDITION**



**WHOLE GRAINS**



**LEAN POULTRY**



# Key Recommendations

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The *Dietary Guidelines'* Key Recommendations for healthy eating patterns should be applied in their entirety, given the interconnected relationship that each dietary component can have with others.

**Consume a healthy eating pattern that accounts for all foods and beverages within an appropriate calorie level.**

**A healthy eating pattern includes:<sup>[1]</sup>**

- A variety of vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other
- Fruits, especially whole fruits

**Oils are fats that contain a high percentage of monounsaturated and polyunsaturated fats and are liquid at room temperature.**

**Although they are not a food group, oils are emphasized as part of healthy eating patterns because they are the major source of essential fatty acids and vitamin E.**

- Oils

# New Advice re: Dietary Cholesterol?

*2010 Dietary Guidelines, KEY RECOMMENDATION:*

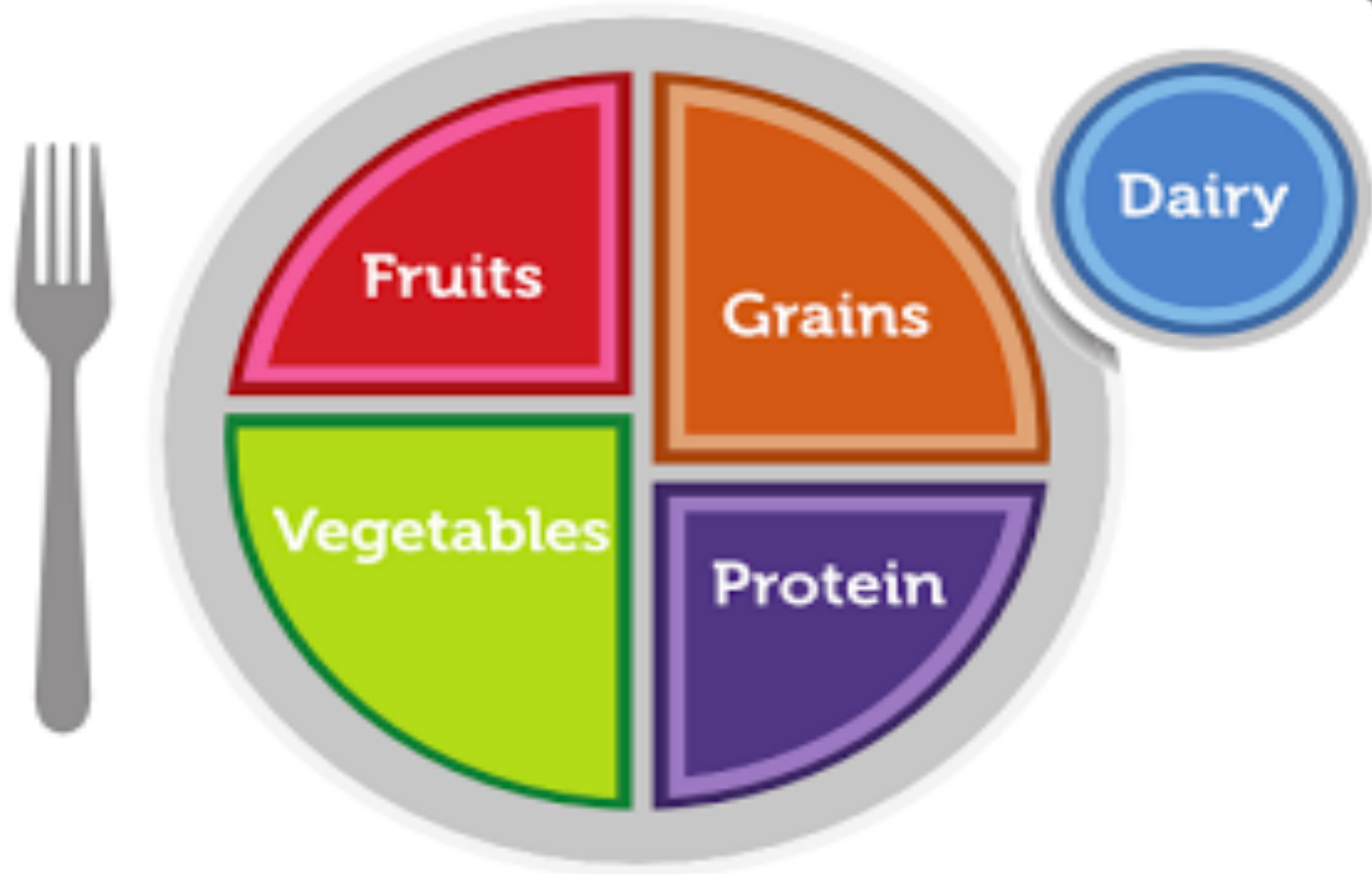
**“limit consumption of dietary cholesterol to 300 mg per day”**

*2015 Dietary Guidelines (not a KEY REC.):*

“As recommended by the IOM (2002/2005), **individuals should eat as little dietary cholesterol as possible** while consuming a healthy eating pattern. The USDA Food Patterns are limited in saturated fats, and because of the commonality of food sources of saturated fats and dietary cholesterol, the Patterns are also low in dietary cholesterol.”

**Mean daily intakes (CDC 2007-2010)**

males 50+	323 mg	males 71+	274 mg
females 50+	217 mg	females 71+	189 mg



Choose **MyPlate**.gov

# MyPlate for Older Adults

## Fruits & Vegetables

Whole fruits and vegetables are rich in important nutrients and fiber. Choose fruits and vegetables with deeply colored flesh. Choose canned varieties that are packed in their own juices or low-sodium.

## Healthy Oils

Liquid vegetable oils and soft margarines provide important fatty acids and some fat-soluble vitamins.

## Herbs & Spices

Use a variety of herbs and spices to enhance flavor of foods and reduce the need to add salt.



## Fluids

Drink plenty of fluids. Fluids can come from water, tea, coffee, soups, and fruits and vegetables.

## Grains

Whole grain and fortified foods are good sources of fiber and B vitamins.

## Dairy

Fat-free and low-fat milk, cheeses and yogurts provide protein, calcium and other important nutrients.

## Protein

Protein rich foods provide many important nutrients. Choose a variety including nuts, beans, fish, lean meat and poultry.



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NUTRITION  
RESEARCH  
CENTRAL  
KIDMC

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AARP Foundation

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# How are Seniors affected by the Dietary Guidelines?

1. Free living
2. Home-delivered meals
3. Long-term care
4. Senior day care
5. Hospitals/rehabilitation centers

## OLDER AMERICANS ACT OF 2006

### TITLE III—GRANTS FOR STATE AND COMMUNITY PROGRAMS ON AGING

#### C – Nutrition Services

#### Subpart 2—Home Delivered Nutrition Services

#### Section. 339. NUTRITION.

(2) ensure that the project—

(A) provides meals that—

**(i) comply with the most recent Dietary Guidelines for Americans**

**(ii) provide to each participating older individual—**

**(I) a minimum of 33 1/3 percent of the dietary reference intakes established by the Food and Nutrition Board of the Institute of Medicine of the National Academy of Sciences, if the project provides one meal per day,**

**(II) a minimum of 66 2/3 percent of the allowances if the project provides two meals per day, and**

**(III) 100 percent of the allowances if the project provides three meals per day**



# Long Term Care Facilities – Regulations

## 42 CFR § 483.35 Dietary services

The facility must provide each resident with a nourishing, palatable, well-balanced diet that meets the daily nutritional and special dietary needs of each resident.

*(c) Menus and nutritional adequacy.* Menus must -

**(1) Meet the nutritional needs of residents in accordance with RDAs**

**(e) Therapeutic diets must be prescribed by the attending physician.**

Title 22 CCR §72341: **Prepare and follow menus that meet national dietary standards** (California)

# LTC Facilities - practice

“For many years I defended the practices I was taught as a clinical dietitian in nursing homes. I defended providing lowfat, low cholesterol diets, prescribing cans of Ensure for weight loss, and recommending margarine instead of butter. I believed in this health paradigm and in the ADA [now AND]...I suggested the idea of introducing cod liver oil into the nursing home environment, the request was denied due to cost.”

**Kim Rodriquez, RD. *Wise Traditions Journal* 2011**

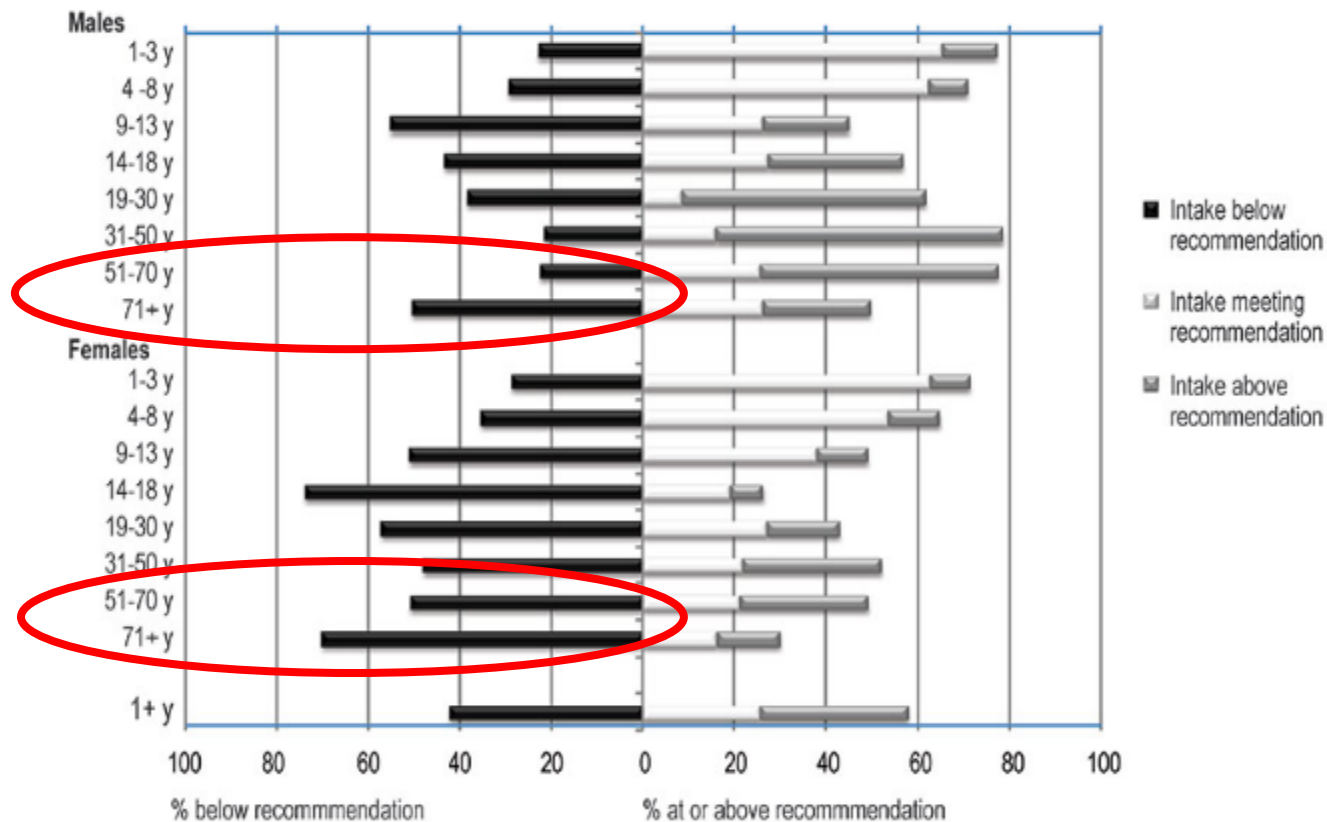
# LTC Facilities - practice

“I do find most nursing home residents are **eating much better than they had been at home**. Prior to admission, diets typically consisted of convenience foods and packaged cereals. **Protein intake for these elders had usually been inadequate** because of the cost and preparation effort involved, or avoided from **fear of the fat content.**”

Kim Rodriguez, RD. *Wise Traditions Journal* 2011

Source: What We Eat in America, NHANES 2007-2010

**Figure D1.20 Total Protein foods: Estimated percent of persons below, at, or above recommendation**

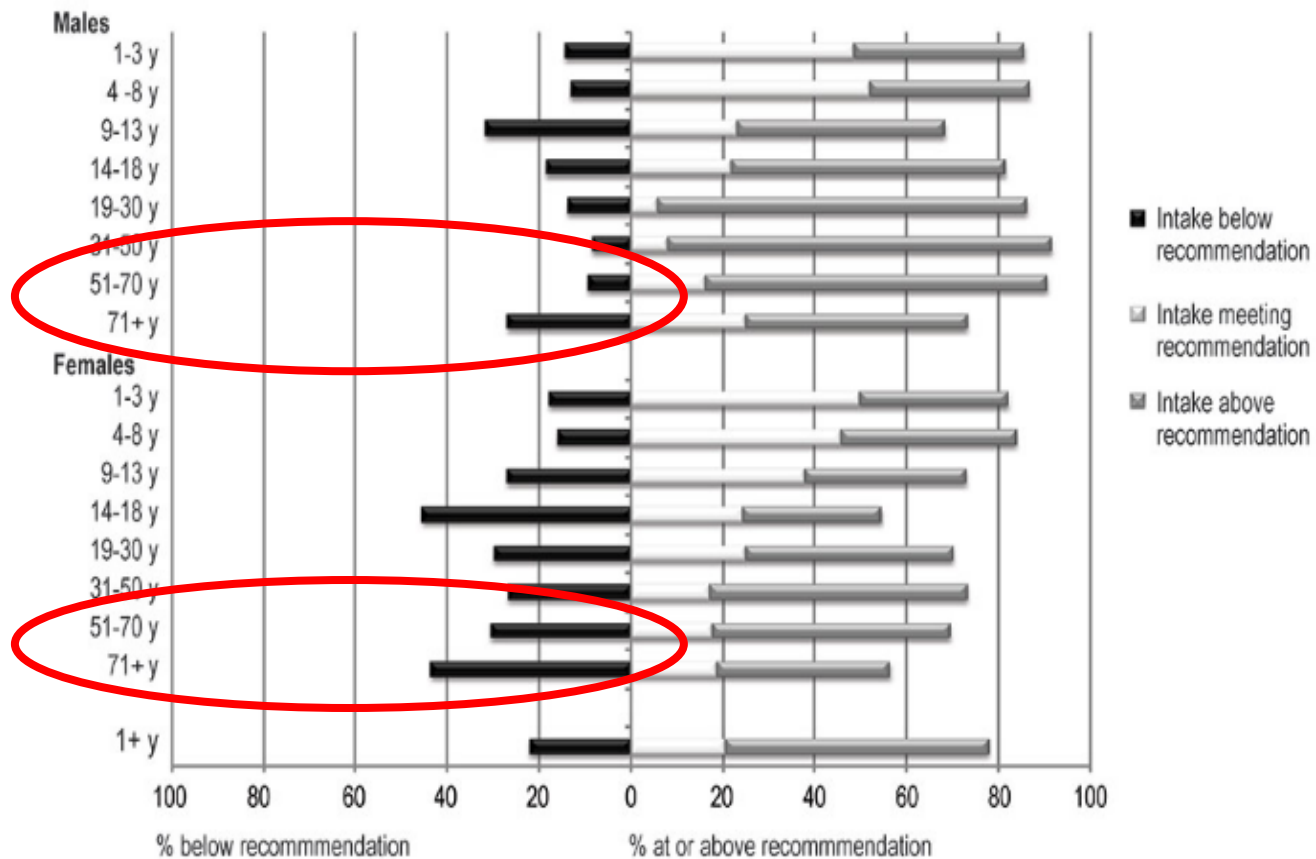


Source: What We Eat in America, NHANES 2007-2010

**From the 2015 Scientific Report of DGAC**

Source: What We Eat in America, NHANES 2007-2010

**Figure D1.21 Meat, poultry, eggs: Estimated percent of persons below, at, or above recommendation**



Source: What We Eat in America, NHANES 2007-2010

**From the 2015 Scientific Report of DGAC**

# Child and Adult Care Food Program = CACFP

...the regulations under which the Secretary of Agriculture will carry out the Child and Adult Care Food Program. Section 17 of the Richard B. Russell National School Lunch Act, as amended, authorizes assistance to States through grants-in-aid and other means to:

initiate, maintain, and expand nonprofit food service programs for children and **adult participants in non-residential institutions which provide care.** The Program is intended to provide aid to child and adult participants and family or group day care homes **for provision of nutritious foods** that contribute to the wellness, healthy growth, and development of young children, and **the health and wellness of older adults** and chronically impaired persons.

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## BREAKFAST MEAL PATTERN FOR CHILDREN AND ADULTS

Fluid milk, vegetables or fruit, or portions of both, and grains are required components of the breakfast meal. <b><u>Meat and meat alternates may be used to meet the entire grains requirement a maximum of three times per week.</u></b> Minimum amounts of food components to be served at breakfast are as follows:	Ages 1-2	Ages 3-5	Ages 6-12	Ages 13-18 <sup>1</sup> (at-risk afterschool programs and emergency shelters)	Adult
Food Components and Food Items <sup>2</sup>	Minimum Quantities				
Fluid milk <sup>3</sup>	4 fl oz	6 fl oz	8 fl oz	8 fl oz	8 fl oz.
Vegetables, fruits, or portions of both <sup>4</sup>	¼ cup	½ cup	½ cup	½ cup	½ cup.
Grains (oz eq) <sup>567</sup>					
Whole grain-rich or enriched bread	½ slice	½ slice	1 slice	1 slice	2 slices.
Whole grain-rich or enriched bread product, such as biscuit, roll, muffin	½ serving	½ serving	1 serving	1 serving	2 servings.
Whole grain-rich, enriched or fortified cooked breakfast cereal, <sup>8</sup> cereal grain, and/or pasta	¼ cup	¼ cup	½ cup	½ cup	1 cup.
Whole grain-rich, enriched or fortified ready-to-eat breakfast cereal (dry, cold) <sup>89</sup>					
Flakes or rounds	½ cup	½ cup	1 cup	1 cup	2 cups.
Puffed cereal	¾ cup	¾ cup	1 ¼ cup	1 ¼ cup	2 ½ cups.
Granola	⅛ cup	⅛ cup	¼ cup	¼ cup	½ cup.

<sup>1</sup>Larger portion sizes than specified may need to be served to children 13 through 18 year olds to meet their nutritional needs.

<sup>2</sup>Must serve all three components for a reimbursable meal. Offer versus serve is an option for only adult and at-risk afterschool participants.

<sup>3</sup>Must be unflavored whole milk for children age one. Must be unflavored low-fat (1 percent) or unflavored fat-free (skim) milk for children two through five years old. Must be unflavored low-fat (1 percent), unflavored fat-free (skim), or flavored fat-free (skim) milk for children six years old and older and adults. For adult participants, 6 ounces (weight) or ¾ cup (volume) of yogurt may be used to meet the equivalent of 8 ounces of fluid milk once per day when yogurt is not served as a meat alternate in the same meal.



LUNCH AND SUPPER MEAL PATTERN FOR CHILDREN AND ADULTS

Fluid milk, meat and meat alternates, vegetables, fruits, and grains are required components in the lunch and supper meals. <b>The minimum amounts of food components</b> to be served at lunch and supper are as follows:	Ages 1-2	Ages 3-5	Ages 6-12	Ages 13-18 <sup>1</sup> (at-risk afterschool programs and emergency shelters)	Adult
Food Components and Foot Items <sup>2</sup>	Minimum Quantities				
Fluid milk <sup>3</sup>	4 fl oz	6 fl oz	8 fl oz	8 fl oz	8 fl oz. <sup>4</sup>
Meat/meat alternates					
Edible portion as served:					
Lean meat, poultry, or fish	1 ounce	1½ ounces	2 ounces	2 ounces	2 ounces.
Tofu, soy products, or alternate protein products <sup>5</sup>	1 ounce	1½ ounces	2 ounces	2 ounces	2 ounces.
Cheese	1 ounce	1½ ounces	2 ounces	2 ounces	2 ounces.
Large egg	½	¾	1	1	1.
Cooked dry beans or peas	¼ cup	⅜ cup	½ cup	½ cup	½ cup.
Peanut butter or soy nut butter or other nut or seed butters	2 Tbsp	3 Tbsp	4 Tbsp	4 Tbsp	4 Tbsp.
Yogurt, plain or flavored unsweetened or sweetened <sup>6</sup>	4 ounces or ½ cup	6 ounces or ¾ cup	8 ounces or 1 cup	8 ounces or 1 cup	8 ounces or 1 cup.
The following may be used to meet no more than 50 percent of the requirement:					
Peanuts, soy nuts, tree nuts, or seeds, as listed in program guidance, or an equivalent quantity of any combination of the above meat/meat alternates (1 ounce of nuts/seeds = 1 ounce of cooked lean meat, poultry or fish)	½ ounce = 50%	¾ ounce = 50%	1 ounce = 50%	1 ounce = 50%	1 ounce = 50%.
Vegetables <sup>7</sup>	⅓ cup	¼ cup	½ cup	½ cup	½ cup.
Fruits <sup>7,8</sup>	⅓ cup	¼ cup	½ cup	½ cup	½ cup.
Grains (oz eq) <sup>9,10</sup>					
Whole grain-rich or enriched bread	½ slice	½ slice	1 slice	1 slice	2 slices.
Whole grain-rich or enriched bread product, such as biscuit, roll, muffin	½ serving	½ serving	1 serving	1 serving	2 servings.
Whole grain-rich, enriched or fortified cooked breakfast cereal, <sup>11</sup> cereal grain, and/or pasta	¼ cup	¼ cup	½ cup	½ cup	1 cup.

<sup>1</sup>Larger portion sizes than specified may need to be served to children 13 through 18 year olds to meet their nutritional needs.

<sup>2</sup>Must serve all five components for a reimbursable meal. Offer versus serve is an option for only adult and at-risk

# Meat Alternates

- *(iv) Tofu and soy products.* **Commercial tofu and soy products may be used to meet all or part of the meat and meat alternate component** in accordance with FNS guidance and appendix A of this part. Non-commercial and non-standardized tofu and soy products cannot be used.
- *(v) Beans and peas (legumes).* **Cooked dry beans and peas may be used to meet all or part of the meat and meat alternate component.** Beans and peas include black beans, garbanzo beans, lentils, kidney beans, mature lima beans, navy beans, pinto beans, and split peas. Beans and peas may be counted as either a meat alternate or as a vegetable, but not as both in the same meal.
- *(vi) Other meat alternates.* **Other meat alternates, such as cheese, eggs, and nut butters may be used to meet all or part of the meat and meat alternate component.**

# Meat Alternates

- (iv) *Tofu and soy products*. **Commercial tofu and soy products may be used to meet all or part of the meat and meat alternate component** in accordance with FNS guidance and appendix A of this part. Non-commercial and non-standardized tofu and soy products cannot be used.
- (v) *Beans and peas (legumes)*. **Cooked dry beans and peas may be used to meet all or part of the meat and meat alternate component.** Beans and peas include black beans, garbanzo beans, lentils, kidney beans, mature lima beans, navy beans, pinto beans, and split peas. Beans and peas may be counted as either a meat alternate or as a vegetable, but not as both in the same meal.
- (vi) *Other meat alternates*. **Other meat alternates, such as cheese, eggs, and nut butters may be used to meet all or part of the meat and meat alternate component.**

# **NUTRIENTS COMMONLY UNDERCONSUMED**

# Shortfall Nutrients per US government

## FDA:

Most Americans don't get enough dietary fiber, **vitamin A, vitamin C, calcium, and iron** in their diets.

## USDA, 2015 DGAC Report:

Nutrient intake data from a representative sample of the U.S. population ages 2 years and older indicate that: **vitamin A, vitamin D, vitamin E, folate, vitamin C, calcium, and magnesium** are under-consumed relative to the EAR.

The EAR is the best measure of population adequacy of nutrient intake as it is “**the average daily intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group.**”

# Shortfall Nutrients per US government

## FDA:

Most Americans don't get enough **dietary fiber, vitamin A, vitamin C, calcium, and iron** in their diets.

## USDA, 2015 DGAC Report:

Nutrient intake data from a representative sample of the U.S. population ages 2 years and older indicate that: **vitamin A, vitamin D, vitamin E, folate, vitamin C, calcium, and magnesium** are underconsumed relative to the EAR. The EAR is the best measure of population adequacy of nutrient intake as it is “the average daily intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group.”

# Shortfall Nutrients per US government

## FDA:

Most Americans don't get enough dietary fiber, **vitamin A**, **vitamin C**, **calcium**, and **iron** in their diets.

## USDA, 2015 DGAC Report:

Nutrient intake data from a representative sample of the U.S. population ages 2 years and older indicate that: **vitamin A**, **vitamin D**, **vitamin E**, **folate**, **vitamin C**, **calcium**, and **magnesium** are underconsumed relative to the EAR.

**The EAR is the best measure of population adequacy of nutrient intake as is it is “the average daily intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group.**

# Keep in mind that...

- Seniors are often deficient in vitamin D
  - Not a nutrient discussed in depth today
  - Synergistic with vitamins A & K2
- Almost  $\frac{3}{4}$  US seniors take one or more supplements
  - 40% of US adults take vitamin D
  - More than half of US seniors take multivitamins

Kantor et al. *JAMA*. 2016;316

Wallace et al. *J Am Coll Nutr*. 2014;33

Kennedy et al. *Ecol Food Nutr*. 2013;52



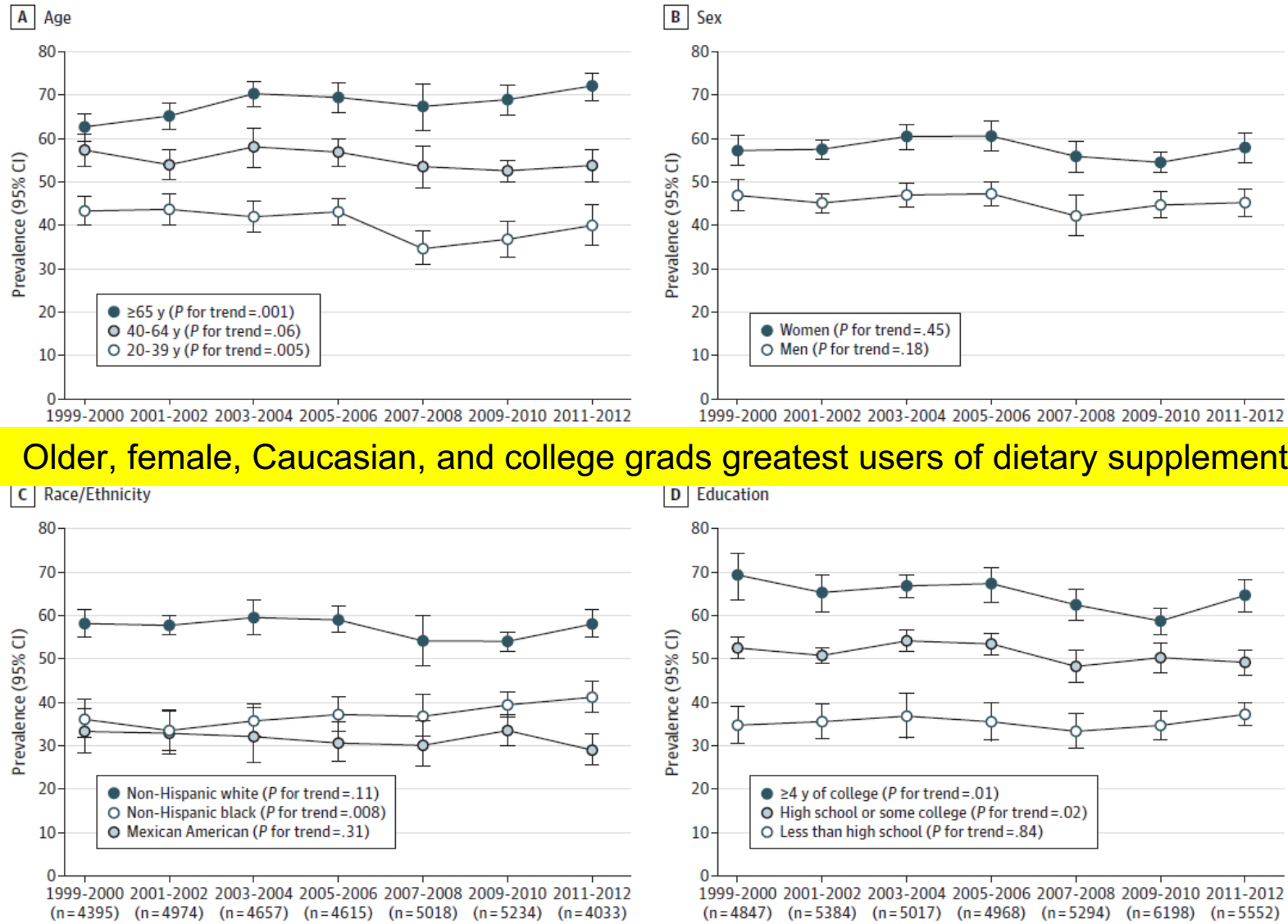
### Table 2.13.c.3. Serum 25-hydroxyvitamin D: Prevalence

Prevalence (in percent) of low serum 25-hydroxyvitamin D concentration (< 40 nmol/L) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
<b>Total, 1 year and older</b>	16,604	17.2 (14.7 – 20.0)	49,431,000
<b>Age group</b>			
1–5 years	1,799	2.7 (1.8 – 4.0)	541,000
6–11 years	1,768	5.7 (4.2 – 7.7)	1,358,000
12–19 years	4,044	17.1 (13.8 – 21.0)	5,729,000
20–39 years	3,262	19.7 (16.4 – 23.4)	15,722,000
40–59 years	2,660	20.0 (16.6 – 23.9)	16,400,000
60 years and older	3,071	17.8 (15.5 – 20.4)	8,602,000
<b>Gender</b>			
Males	8,145	14.6 (12.3 – 17.4)	20,576,000
Females	8,459	19.6 (16.9 – 22.7)	28,869,000
<b>Race/ethnicity</b>			
Mexican Americans	4,275	24.4 (20.1 – 29.3)	6,635,000
Non-Hispanic Blacks	4,349	51.6 (46.7 – 56.5)	17,968,000
Non-Hispanic Whites	6,698	9.4 (7.9 – 11.2)	18,114,000

**40 nmol/L = 16 ng/dL**

Figure 1. Trends in Any Supplement Use by Age, Sex, Race/Ethnicity, and Education Among US Adults

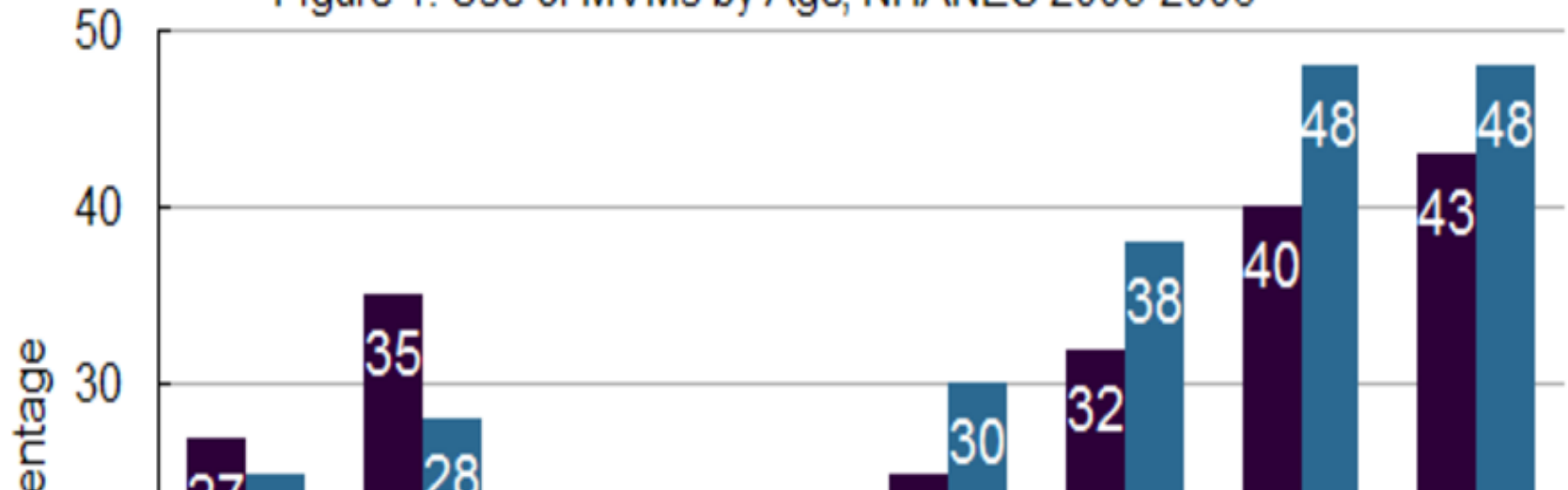


Older, female, Caucasian, and college grads greatest users of dietary supplements

Data are weighted to be nationally representative. Error bars indicate 95% CIs.

Kantor et al. *JAMA*. 2016;316

Figure 1: Use of MVMMs by Age, NHANES 2003-2006



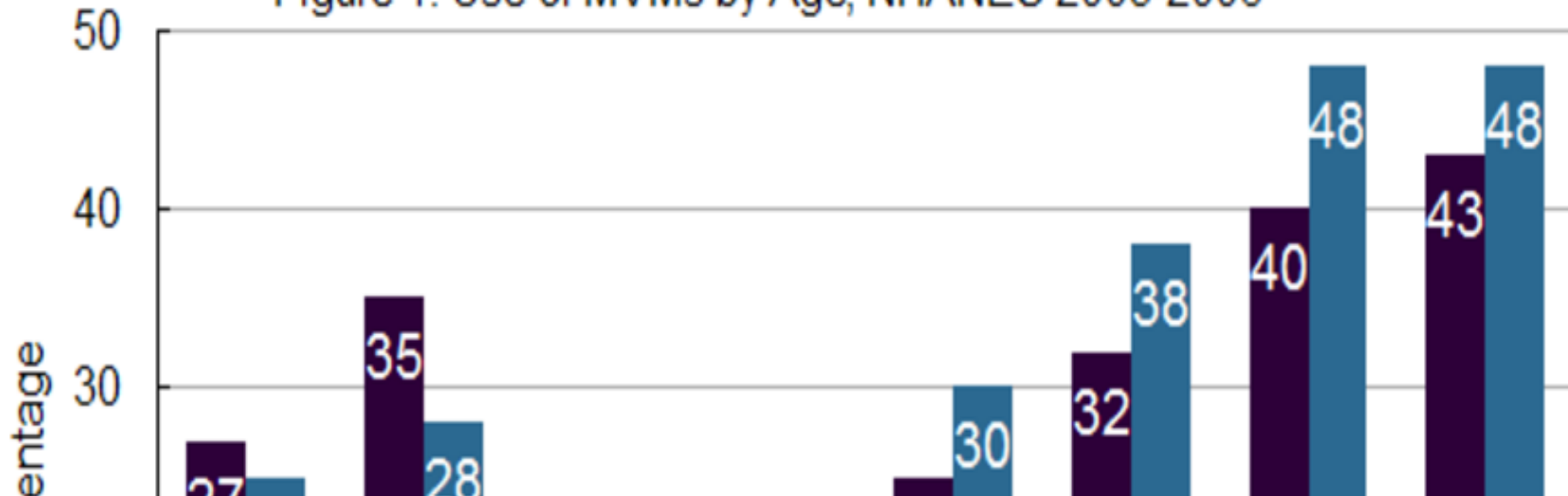
Large portions of the population had total usual intakes (food and MVMM supplement use) below the estimated average requirement for **vitamins A (35%), C (31%), D (74%), and E (67%)** as well as calcium (39%) and magnesium (46%).

Only **0%, 8%, and 33%** of the population had total usual intakes of **potassium, choline, and vitamin K** above the adequate intake when food and MVMM use was considered.

Wallace et al. *J Am Coll Nutr.* 2014;33.

Age (years)    ■ Males    ■ Females

Figure 1: Use of MVMs by Age, NHANES 2003-2006



**“The populations at highest risk of nutritional inadequacy who might benefit the most from MVMs are the least likely to take them.”**

[G]reater likelihood of supplement use:

female, older, white, having higher level of education, non-SNAP participation, and living in a food-secure household.”

Kennedy et al. *Ecol Food Nutr.* 2013

Age (years) ■ Males ■ Females

Graph: NIH Office of Dietary Supplements

# Nutrients older Americans (n~5,400) are under-consuming from diet

A weekly serving of liver could easily address these vitamin shortfalls: A & B12.

	Vit A	mcg RAE/d *		Vit B12	mcg/d		Choline	mg/d		Zinc	mg/d		
	% below EAR	EAR	RDA	% below EAR	EAR	RDA	% above AI			% below EAR			
Males 51-70 y	49	625	900	< 3	2	2.4	10	Keep our cholesterol intake low? Eggs # 1 source choline, also liver.		17	Legumes, nuts, seeds have anti-nutrients that can interfere with zinc absorption		
Males > 71 y	42	625	900	< 3	2	2.4	< 3		550	326			30
Females 51-70 y	37	500	700	8	2	2.4	4		425	274	14	6.8	8
Females > 71 y	37	500	700	7	2	2.4	< 3		425	240	23	6.8	8



“Jack Sprat could eat no fat, his wife could eat no lean,  
and so between the two of them they presented quite  
an array of nutritional deficiencies.”

West Virginia Academy Nutrition &  
Dietetics

# HEALTH THREATS FROM LOW INTAKES OF:

VITAMIN A

VITAMIN B<sub>12</sub>

CHOLINE

ZINC

# Vitamin A



- $\beta$ -carotene absorption depends on food matrix (10-90%); and its conversion to vitamin A varies widely among individuals
- Vitamin A is poorly utilized from low-fat diets
- Zinc and protein intakes positively affect vitamin A metabolism
- Use of acid suppressing medications reduces  $\beta$ -carotene uptake

Combs. *The Vitamins*, 4<sup>th</sup> ed.



# Vitamin A

from diet

ages 51 +

- EAR
  - Males 625 mcg RAE 42-49% below
  - Females 500 mcg RAE 37% below
- RDA
  - Males 900 mcg RAE
  - Females 700 mcg RAE

- As retinol activity equivalents (RAEs). 1 RAE = 1  $\mu$ g retinol, 12  $\mu$ g  $\beta$ -carotene, 24  $\mu$ g  $\alpha$ -carotene, or 24  $\mu$ g  $\beta$ -cryptoxanthin. The RAE for dietary provitamin A carotenoids is two-fold greater than retinol equivalents (RE), whereas the RAE for preformed vitamin A is the same as RE.

**625 mcg RAE = 2,080 IU**  
**900 mcg RAE = 3,000 IU**

**500 mcg = 1,670 IU**  
**700 mcg = 2,333 IU**

**TABLE 1** Usual intake from NHANES 2003–2006 compared to DRI from naturally occurring nutrients, enrichment/fortification, and dietary supplements in individuals aged  $\geq 2$  y<sup>1</sup>

Nutrient	Usual intake	Percentiles					<EAR	$\geq$ UL
		10	25	50	75	90		
	<i>Mean <math>\pm</math> SEM</i>						<i>% <math>\pm</math> SEM</i>	<i>% <math>\pm</math> SEM</i>
Vitamin D, <sup>2</sup> $\mu$ g/d								
Naturally occurring	1.9 $\pm$ 0.4	0.8	1.1	1.7	2.5	3.3	100 $\pm$ 0	0.0 $\pm$ 0.0
+ Enriched/fortified	4.9 $\pm$ 0.1	1.7	2.7	4.2	6.4	8.9	93.3 $\pm$ 0.6	0.0 $\pm$ 0.0
+ Dietary supplements	8.2 $\pm$ 0.2	2.0	3.3	6.0	11.7	16.3	69.5 $\pm$ 0.9	0.1 $\pm$ 0.1
Calcium, <sup>2</sup> mg/d								
Naturally occurring	883 $\pm$ 9	476	624	828	1084	1361	54.2 $\pm$ 0.9	0.1 $\pm$ 0.04
+ Enriched/fortified	939 $\pm$ 9	504	662	881	1152	1449	48.9 $\pm$ 0.8	0.3 $\pm$ 0.1
+ Dietary supplements	1091 $\pm$ 10	551	735	1000	1342	1740	38.0 $\pm$ 0.8	2.4 $\pm$ 0.2
Vitamin A, $\mu$ g RAE/d								
Naturally occurring	412 $\pm$ 5	211	281	380	509	653	74.4 $\pm$ 1.0	0.1 $\pm$ 0.01
+ Enriched/fortified	601 $\pm$ 8	286	395	551	752	979	45.1 $\pm$ 1.0	1.4 $\pm$ 0.1
+ Dietary supplements	1010 $\pm$ 20	306	440	687	1316	1952	34.0 $\pm$ 1.1	4.7 $\pm$ 0.2
Vitamin C, mg/d								
Naturally occurring	72.5 $\pm$ 1.2	26.7	40.9	63.0	93.6	130	45.9 $\pm$ 1.1	0.0 $\pm$ 0.0
+ Enriched/fortified	85.3 $\pm$ 1.3	31.8	48.5	74.2	110	152	37.0 $\pm$ 1.1	0.0 $\pm$ 0.0
+ Dietary supplements	188 $\pm$ 7	36.7	59.2	101	172	394	25.3 $\pm$ 1.0	0.6 $\pm$ 0.1
Vitamin E, mg AT/d								

Serum retinol is not a reflection of the vitamin A liver stores because it is homeostatically controlled and it does not drop until liver reserves are very low.

(Tanumihardjo, WHO 2012 )

Normal values range from 50 to 200 µg/dl < 20µg/dl is deficient, < 40 is suboptimal (WHO)

### Table 2.1.a.2. Serum vitamin A: Total population

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for the total U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean		Selected percentiles (95% conf. interval)			Sample size			
	(95% conf. interval)		10th	50th	90th				
<b>Males and Females</b>									
Total, 6 years and older	54.7	(53.8 – 55.6)	36.6	(35.8 – 37.4)	55.2	(54.2 – 56.1)	80.0	(78.1 – 82.2)	7,254
6–11 years	36.4	(35.6 – 37.2)	28.0	(27.5 – 29.1)	36.6	(35.9 – 37.3)	47.5	(45.7 – 50.1)	860
12–19 years	46.5	(45.4 – 47.7)	35.2	(33.9 – 35.9)	46.0	(44.6 – 47.5)	63.2	(60.7 – 66.9)	1,954
20–39 years	54.3	(53.3 – 55.3)	38.1	(36.5 – 39.2)	54.7	(53.5 – 55.6)	77.7	(74.1 – 81.6)	1,688
40–59 years	58.7	(57.7 – 59.7)	41.2	(39.5 – 43.0)	59.5	(58.1 – 60.4)	81.0	(79.0 – 85.2)	1,365
60 years and older	64.4	(62.8 – 66.1)	46.4	(44.7 – 47.9)	64.9	(63.1 – 67.0)	88.4	(86.0 – 91.7)	1,387
<b>Males</b>									
Total, 6 years and older	57.2	(56.3 – 58.2)	38.5	(37.8 – 39.2)	58.0	(57.1 – 59.0)	81.8	(79.7 – 85.0)	3,547
6–11 years	36.4	(35.4 – 37.3)	28.1	(26.4 – 29.1)	36.3	(35.0 – 37.2)	47.5	(45.7 – 51.6)	427
12–19 years	48.2	(46.9 – 49.6)	36.4	(35.3 – 37.7)	48.1	(46.3 – 49.8)	64.5	(62.9 – 67.4)	980
20–39 years	59.1	(57.7 – 60.5)	44.4	(42.3 – 46.0)	58.4	(56.8 – 60.2)	80.9	(76.8 – 84.5)	738
40–59 years	61.8	(60.7 – 63.0)	44.2	(41.6 – 47.1)	63.2	(62.4 – 64.2)	84.5	(80.1 – 92.0)	673
60 years and older	66.0	(63.9 – 68.1)	48.4	(46.0 – 50.0)	66.4	(63.7 – 68.7)	90.4	(86.3 – 97.2)	729
<b>Females</b>									
Total, 6 years and older	52.4	(51.3 – 53.5)	35.6	(34.3 – 36.4)	52.4	(50.8 – 53.8)	77.5	(75.0 – 79.0)	3,707
6–11 years	36.5	(35.3 – 37.8)	28.0	(27.5 – 29.4)	36.9	(35.9 – 38.0)	47.0	(45.1 – 52.3)	433
12–19 years	44.7	(43.5 – 45.9)	33.7	(33.3 – 35.0)	43.8	(42.7 – 45.1)	60.7	(57.0 – 66.6)	974
20–39 years	50.0	(48.7 – 51.3)	34.5	(32.7 – 36.1)	49.3	(48.3 – 50.9)	72.6	(69.5 – 75.9)	950
40–59 years	55.9	(54.1 – 57.7)	39.9	(36.9 – 41.2)	55.8	(53.8 – 58.5)	78.4	(74.2 – 82.8)	692
60 years and older	63.2	(61.3 – 65.2)	45.1	(43.0 – 47.2)	63.9	(62.5 – 65.7)	87.7	(84.0 – 91.2)	658

Hepatic vitamin A stores must be depleted before changes in circulating retinols occur.  
(Combs. *The Vitamins*, 4<sup>th</sup> ed.)

Normal values range from 50 to 200 µg/dl < 20µg/dl is deficient, < 40 is suboptimal (WHO)

### Table 2.1.a.4. Serum vitamin A: Non-Hispanic blacks

Geometric mean and selected percentiles of serum concentrations (in µg/dL) for non-Hispanic blacks in the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 2005–2006.

	Geometric mean (95% conf. interval)	Selected percentiles (95% conf. interval)			Sample size
		10th	50th	90th	
<b>Males and Females</b>					
Total, 6 years and older	48.3 (47.3 – 49.3)	32.0 (31.2 – 32.8)	48.1 (47.0 – 49.5)	72.1 (70.0 – 75.1)	1,891
6–11 years	35.6 (34.0 – 37.3)	26.6 (24.0 – 28.5)	35.7 (34.5 – 36.8)	47.3 (44.6 – 51.8)	240
12–19 years	41.1 (40.0 – 42.2)	30.5 (29.4 – 31.3)	40.9 (39.7 – 42.6)	54.2 (52.8 – 57.5)	665
20–39 years	47.3 (45.8 – 48.9)	32.3 (29.8 – 35.3)	47.9 (44.9 – 50.5)	67.7 (63.6 – 71.6)	368
40–59 years	53.2 (51.4 – 55.0)	35.4 (33.3 – 37.2)	53.7 (50.3 – 57.2)	77.1 (72.8 – 85.7)	335
60 years and older	59.9 (56.3 – 63.7)	40.1 (36.2 – 45.6)	60.7 (56.6 – 64.5)	85.1 (78.8 – 91.4)	283
<b>Males</b>					
Total, 6 years and older	51.2 (49.9 – 52.5)	34.0 (32.9 – 35.2)	51.9 (50.2 – 53.6)	74.8 (70.9 – 79.0)	949
6–11 years	35.4 (34.1 – 36.8)	26.2 (23.2 – 28.7)	35.3 (33.5 – 36.6)	46.2 (43.7 – 51.9)	128
12–19 years	42.2 (40.8 – 43.7)	30.6 (28.8 – 32.0)	42.0 (39.7 – 44.7)	58.1 (55.1 – 60.7)	343
20–39 years	53.3 (52.1 – 54.5)	38.9 (35.7 – 40.4)	54.1 (52.3 – 55.5)	71.2 (65.9 – 77.7)	170
40–59 years	57.3 (54.9 – 59.8)	39.0 (35.8 – 42.6)	58.4 (54.0 – 62.9)	84.8 (74.8 – 92.7)	156
60 years and older	60.8 (57.0 – 64.9)	40.0 (33.9 – 46.7)	62.5 (59.9 – 64.7)	86.0 (78.4 – 110)	152
<b>Females</b>					
Total, 6 years and older	45.9 (44.7 – 47.1)	31.1 (29.4 – 32.1)	44.9 (43.5 – 46.7)	70.1 (65.9 – 74.6)	942
6–11 years	35.8 (33.0 – 39.0)	26.7 (19.8 – 28.8)	36.1 (33.0 – 38.8)	47.6 (44.2 – 54.2)	112
12–19 years	39.9 (38.7 – 41.2)	30.1 (29.4 – 30.8)	40.2 (38.7 – 41.7)	51.1 (49.9 – 53.1)	322
20–39 years	42.7 (41.1 – 44.3)	29.2 (24.3 – 32.0)	42.4 (40.4 – 44.5)	60.4 (57.4 – 63.5)	198
40–59 years	49.9 (46.8 – 53.3)	33.4 (31.9 – 34.3)	48.8 (45.9 – 53.5)	73.3 (68.1 – 84.7)	179
60 years and older	59.3 (55.4 – 63.4)	39.8 (36.7 – 43.8)	60.3 (54.6 – 64.5)	84.9 (77.9 – 90.2)	131

# Vitamin A Roles

- **Immunity**
- **Integrity of surface tissues**
- **Cell replication/programmed death**
- **Lipid stability**
- **Neurological**
- **Bone metabolism**
- **Vision**

# Vitamin A: Anti-infective

- Innate and adaptive immunity - **an immune enhancer** that potentiates the cellular and antibody response
  - **protective role against infections**
- Maintains and restores the **integrity and function of all mucosal surfaces**
  - enhance antibody responses, especially IgA antibody responses in mucosal tissues
  - IgA is secreted into the gut lining and provides **protection against harmful pathogens**

# Vitamin A: Anti-infective

- Vitamin A termed the “fourth signal” of the antibody response
- **Episodes of acute infection associated with substantive (e.g. 8-fold) urinary excretion of retinol**
- Vitamin A treatment can greatly reduce morbidity and mortality rates in measles and respiratory diseases

Combs. *The Vitamins*, 4<sup>th</sup> ed.

# Vitamin A Deficiency

- Causes **dryness and keratinization in epithelial cells** of the skin, the respiratory, gastrointestinal, and urogenital tracts
  - **disrupts initial preventative systems vs. infection**
- Disrupts neutrophil development, increases inflammatory cytokine release by macrophages, and decreases the number of natural killer cells and their lytic activity
  - **decrease in the body's ability to eliminate infectious agents**
- Communities that suffer from vitamin A deficiency may also have a **high prevalence of infection**

**Albahrani & Geaves. *Clin Biochem Rev.*2016;37**



# Vitamin A: Anti-Lipid Oxidation

- Retinol and tocopherols, especially found in animal products like liver, eggs, cheese and milk,  
**prevent lipid peroxidation and  
protect against cell damage  
caused by oxidative stress.**

**Jeurnink et al. *Int J Cancer*. 2015; 136**

# Vitamin A: Anti-Cancer

- **Growth and differentiation** of rapidly renewing tissues of the body
  - epithelial linings
  - Regulate cell division and programmed death
  - Retinoids, natural or synthetic compounds with structural or functional resemblance to retinol, play **prominent roles in cell differentiation & apoptosis**

Leanders et al. *Int J Cancer*. 2014; 135

# Vitamin A: Anti-Cancer

- **Higher vitamin A intake**
  - reduces the genotoxic effect of several chemical carcinogens
  - Enhances bioavailability of selenium, essential component of glutathione-dependent enzymes
- In studies on colorectal cancer, strong inverse associations for plasma levels of retinol and disease risk

Combs. *The Vitamins*, 4<sup>th</sup> ed.

Leanders et al. *Int J Cancer*. 2014; 135

# Vitamin A: Anti-Alzheimer's Disease?

- Retinoid signaling plays an important role in function of the mature brain (not just in early development)
- Alzheimer's disease
  - **Amyloid b deposition was detected in brains of 1-year-old *retinoid-deficient* rats**
- Deficiency in rats led to spatial learning and memory impairments:
  - loss of retinoid signaling in the brain and cognitive decline, **reversed by supplementing with retinoids**

Corcoran et al. *Eur J Neuroscience*. 2004;20.

# Vitamin A Deficiency – Signs

- Impaired dark adaptation first sign
- Keratinization of skin, mucous membranes
- Weakness
- Loss of appetite
- Other ocular changes – xerthalmia, Bitot's spots
- Dry eyes
- Sensitivity to light

Combs. *The Vitamins*, 4<sup>th</sup> ed.

[mayoclinic.org](http://mayoclinic.org)

# Vitamin B<sub>12</sub>



# Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States 2007-2010

	<b>Vit B12</b>	mcg/d	
	<b>% below EAR</b>	EAR	RDA
<b>Males 51-70 y</b>	<b>&lt; 3%</b>	2.0	2.4
<b>Males &gt; 71 y</b>	<b>&lt; 3%</b>	2.0	2.4
<b>Females 51-70 y</b>	<b>8%</b>	2.0	2.4
<b>Females &gt; 71 y</b>	<b>7%</b>	2.0	2.4

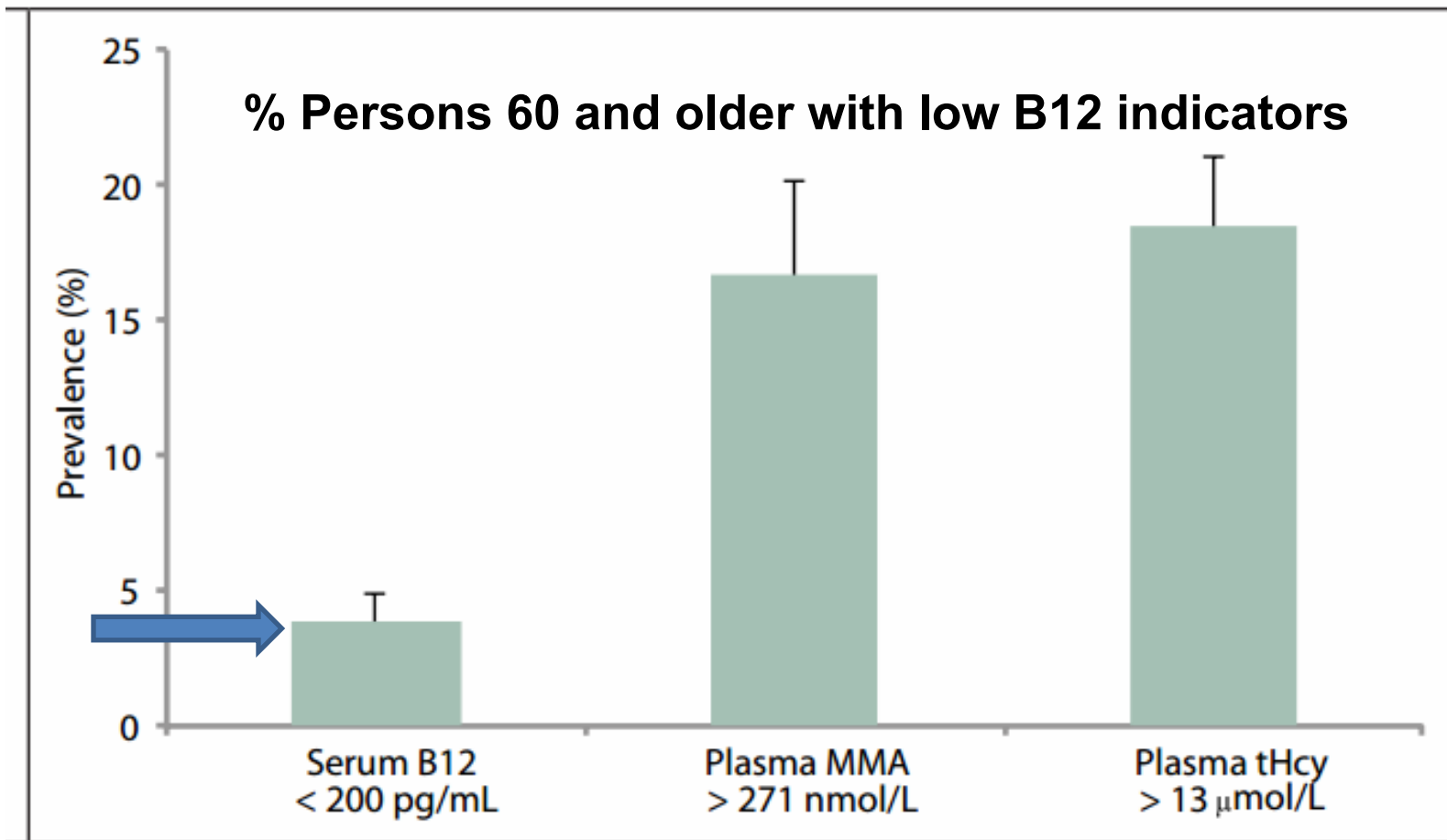
## Table 1.5.c. Serum vitamin B12: Prevalence

Prevalence (in percent) of low serum vitamin B12 concentration (< 200 pg/mL) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 2003–2006.

	Sample size	Prevalence (95% conf. interval)	Estimated total number of persons
<b>Total, 1 year and older</b>	16,316	2.0 (1.6 – 2.4)	5,563,000
<b>Age group</b>			
1–5 years	1,678	§	§
6–11 years	1,747	§	§
12–19 years	4,013	0.6 (0.4 – 1.0)	210,000
20–39 years	3,214	1.5 (1.2 – 2.0)	1,211,000
40–59 years	2,629	2.6 (1.8 – 3.7)	2,057,000
60 years and older	3,035	3.9 (3.1 – 4.9)	1,815,000
<b>Gender</b>			
Males	7,999	1.6 (1.3 – 2.0)	2,165,000
Females	8,317	2.3 (1.9 – 2.9)	3,402,000
<b>Race/ethnicity</b>			
Mexican Americans	4,205	1.0 (0.7 – 1.5)	265,000
Non-Hispanic Blacks	4,285	1.2 (0.8 – 1.8)	398,000
Non-Hispanic Whites	6,571	2.2 (1.8 – 2.7)	4,289,000

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate.





**Figure H.1.d.** Prevalence estimates of low serum vitamin B12 (B12), high plasma methylmalonic acid (MMA), and high plasma total homocysteine (tHcy) concentrations in U.S. persons 60 years and older, National Health and Nutrition Examination Survey, 2003–2006.

Data shown for plasma MMA are from NHANES 2003–2004 only. Error bars represent 95% confidence intervals.

TABLE 1

Bailey et al. *Am J Clin Nutr.* 2011;94

Prevalence of low serum vitamin B-12 and high methylmalonic acid (MMA) concentrations by several cutoffs and elevated total homocysteine (tHcy) in the US adult population ( $\geq 19$  y of age) by age, race-ethnicity, and sex (1999-2004)<sup>1</sup>

	No. of subjects	Serum vitamin B-12 <148 pmol/L	Serum vitamin B-12 <200 pmol/L	Serum vitamin B-12 <258 pmol/L	MMA >376 nmol/L	MMA >271 nmol/L	tHcy >13 $\mu$ mol/L
		%	%	%	%	%	%
Total sample	12,612	2.9 $\pm$ 0.2 <sup>2</sup>	10.6 $\pm$ 0.4	25.7 $\pm$ 0.6	2.3 $\pm$ 0.2	5.8 $\pm$ 0.3	6.1 $\pm$ 0.3
Age							
19-39 y	4538	2.0 $\pm$ 0.2 <sup>a</sup>	9.9 $\pm$ 0.4 <sup>a</sup>	26.1 $\pm$ 0.7 <sup>a</sup>	1.2 $\pm$ 0.2 <sup>a</sup>	3.9 $\pm$ 0.4 <sup>a</sup>	2.6 $\pm$ 0.4 <sup>a</sup>
40-59 y	5793	3.1 $\pm$ 0.3 <sup>b</sup>	10.9 $\pm$ 0.6 <sup>a,b</sup>	25.3 $\pm$ 0.8 <sup>a</sup>	2.0 $\pm$ 0.3 <sup>b</sup>	5.2 $\pm$ 0.4 <sup>b</sup>	6.6 $\pm$ 0.6 <sup>b</sup>
$\geq 60$ y	2281	5.0 $\pm$ 0.7 <sup>c</sup>	11.4 $\pm$ 1.0 <sup>b</sup>	25.8 $\pm$ 0.9 <sup>a</sup>	7.7 $\pm$ 0.7 <sup>c</sup>	15.9 $\pm$ 1.0 <sup>c</sup>	18.1 $\pm$ 1.0 <sup>c</sup>

# Vitamin B<sub>12</sub> - deficiency markers

- Lack of consensus about best marker and threshold
  - Serum B12 level                      **B12 < 148-200 pmol/L**
  - Plasma methylmalonic acid        **MMA > 271 nmol/L**
  - Plasma total homocysteine        **tHcy > 13 µmol/L**
  - Individuals differ in test responses due to genetics, hormones, B12/folate metabolism
- Limitations
  - **Serum B12 does not reflect tissue levels**
  - MMA – less than ½ with low serum B12 have elevated MMA
  - Homocysteine – affected by folic acid status – less than 1/3 will have low tHcy

Bailey et al. *Am J Clin Nutr.* 2011;94

# Vitamin B<sub>12</sub> – Folic acid interaction

- **High folic acid intake (>800 mcg/d) associated with increased risk (3-fold) for peripheral neuropathy**
  - Observed in **older adults (60+)** who have a common genetic variant (estimated at 1 in 6 of individuals)
  - linked to **reduced cellular vitamin B12 availability**
- “Due to the prevalence of the *TCN2* variant, and because the average daily folate intake for U.S. adults over 50 is already **more than twice the RDA**, we believe that our findings highlight a potential concern for a large proportion of older Americans,” said senior study author Ligi Paul, Ph.D., scientist in the Vitamin Metabolism Laboratory at the USDA HNRCA. “Our data suggest **that older adults should keep folate intake close to the recommended amounts, and try to get nutrients from a balanced diet rather than depending on supplements.**”

# Vitamin B<sub>12</sub> - Cognition

- Proper functioning of the brain
  - Synthesis and integrity of DNA
  - Methylation of DNA in the brain
  - Homocysteine can rise with B12 deficiency, damaging neurons
  - Cognitive dysfunction associated with B12 deficiency **improved with supplementation within the first year of onset**

**Ames B. *Proc Natl Acad Sci USA*. 2006;103.**

# B<sub>12</sub> – Marginal Status is Serious

- Below **400 pmol/L** is marginal
- Often due to use of acid-reducing meds
- Leads to **neurodegeneration of brain cells and myelin sheath**
  - MMA abnormally incorporated into neuronal lipids
  - Increase in inflammatory cytokines
  - Reduced synthesis of choline, precursor to neurotransmitter acetylcholine

previous observations of a leveling off of incidence

with nearly one in eleven (9.1 percent) for men.

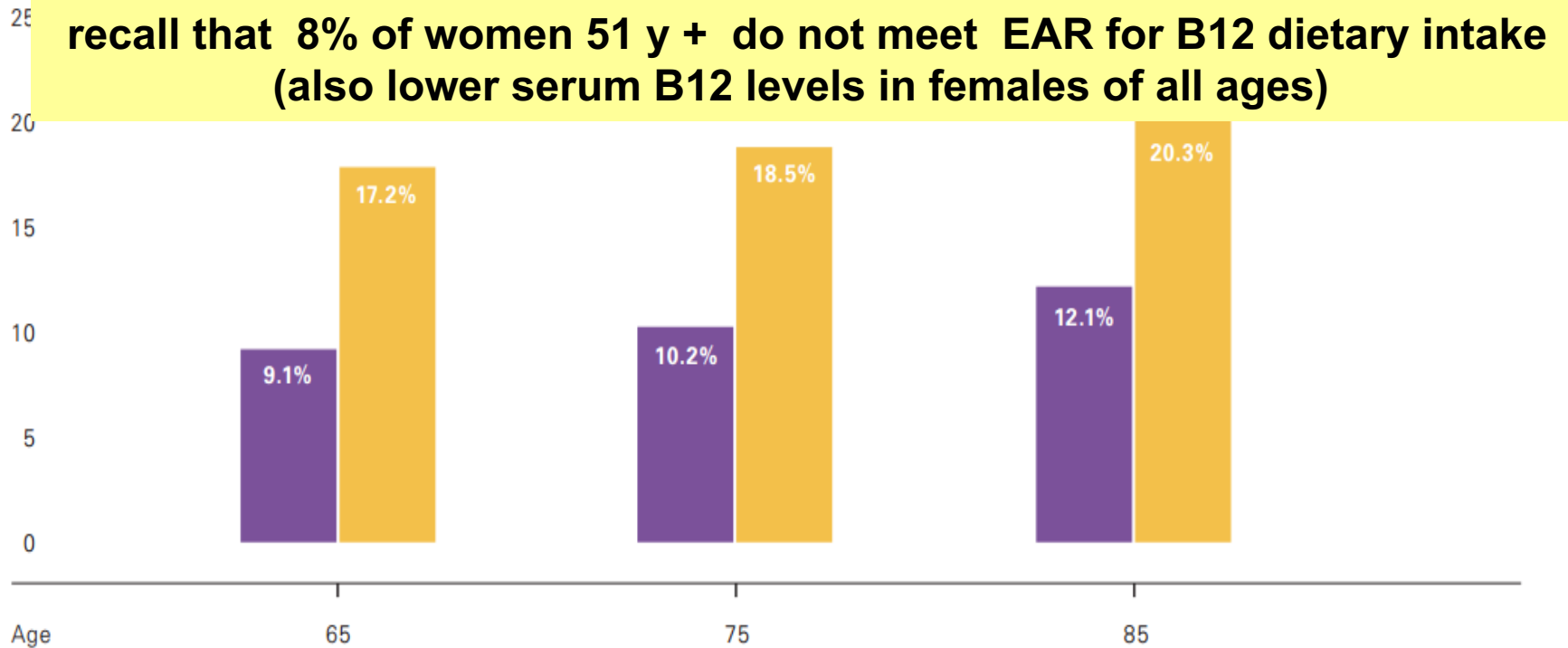
figure 3

Estimated Lifetime Risks for Alzheimer's, by Age and Sex, from the Framingham Study

Percentage

Men

Women



Created from data from Seshadri et al. (142)

Alzheimer's Association, 2014 Alzheimer's Dementia, Volume 10, Issue 2.

# B<sub>12</sub> – Marginal Status in Women

100 women 50-80 y with MCI, in therapy for memory impairment

If B12 between 150 and 300 vs.  $\geq 300$  pmol/L

- Able to learn 5 out of 75 fewer words,
- Remember 1 out of 15 fewer words,
- Recognize 3 out of 15 fewer words
- Microstructure of the hippocampus was worse in the **low-normal group** (150-299)

Köbe T et al. *Am J Clin Nutr.* 2016



# Vitamin B<sub>12</sub> – Brain

“Undiagnosed metabolic B12 deficiency may be an important missed opportunity for prevention of dementia and stroke.”

**Spence JD. *Nutr Res.* 2016;36.**

# Vitamin B<sub>12</sub> – Deficiency Signs

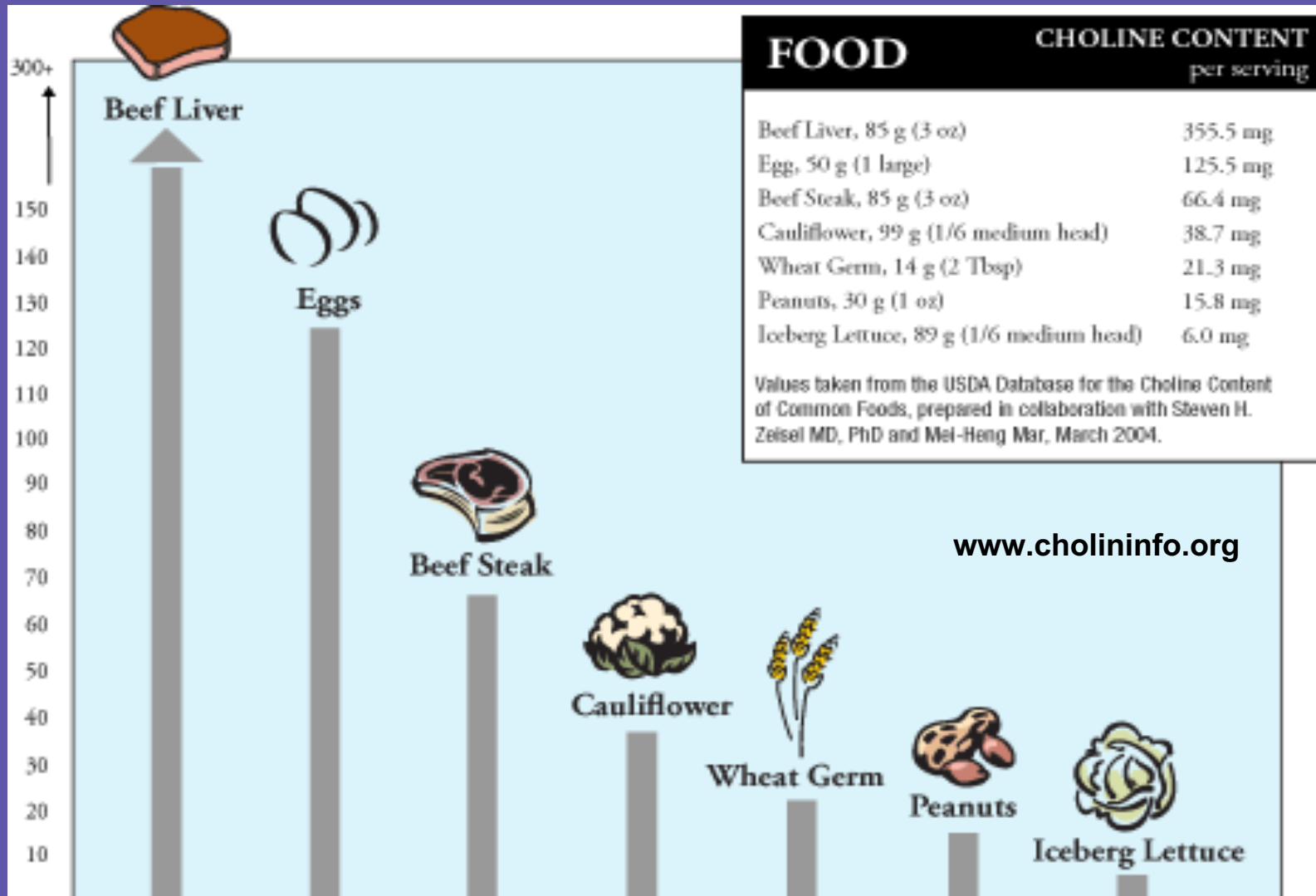
- Macrocytic Anemia
- Fatigue
- Peripheral Neuropathy (numbness hands/feet)
- Abnormalities of lipid metabolism
- Memory loss, depression, irritability
- Hearing Loss
- Supplementation: hydroxocobalmin or methylcobalamin preferred (IM if pernicious anemia) in senior due to poor absorption from foods

# Vitamin B<sub>12</sub> – Deficiency Signs

- Clinical B12 deficiency
  - Fatigue
  - Numbness and tingling in hands and feet
  - Confusion and poor memory
  - Anemia – “masked” with folic acid supplementation
- Supplementation with B12 (hydroxocobalamin or methylcobalamin preferred) orally or (intramuscularly if pernicious anemia) in senior due to poor absorption from foods

**Ames B. *Proc Natl Acad Sci USA*. 2006;103**

# Choline



## Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States 2007-2010

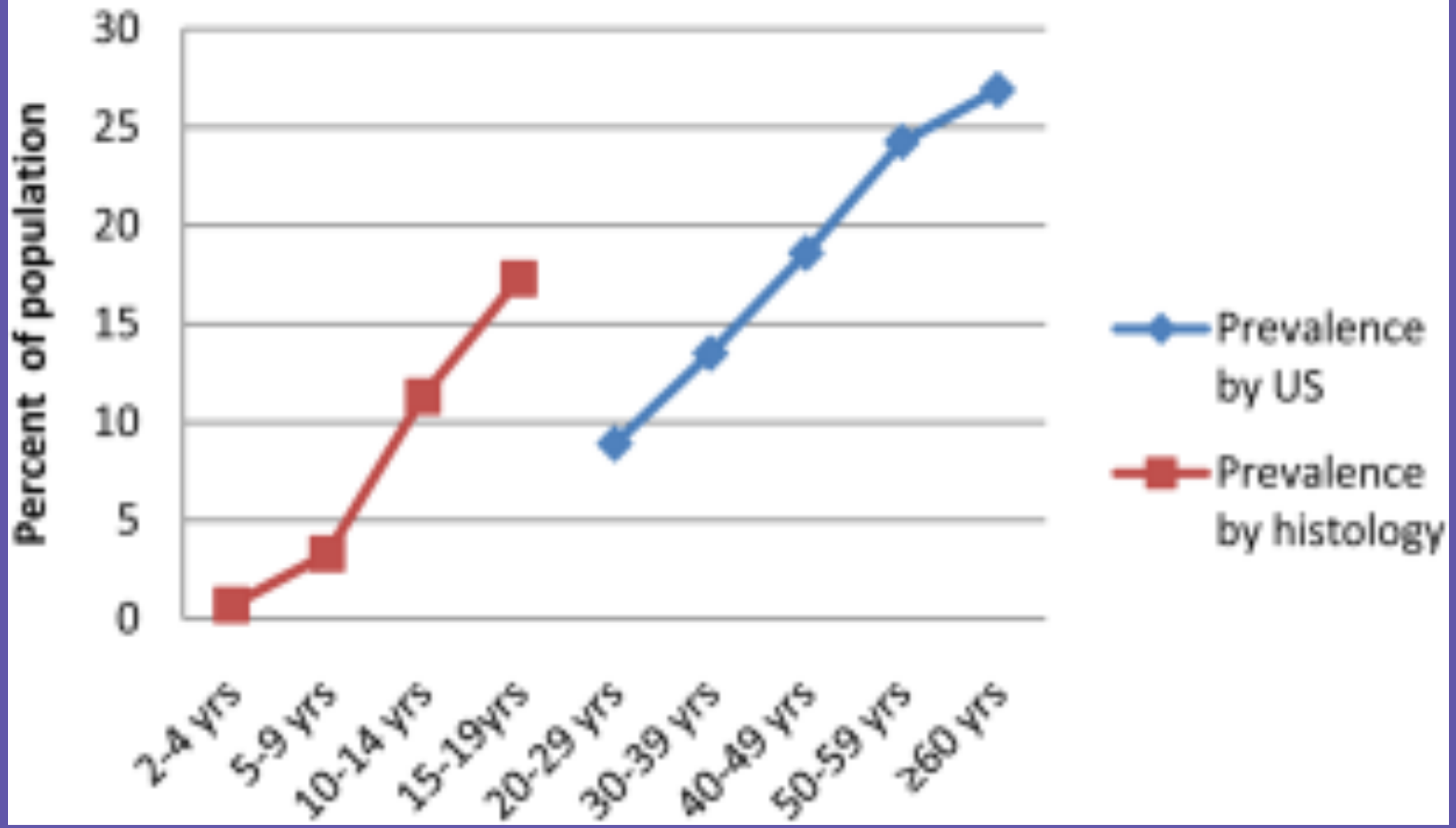
	Choline	mg/d	
	% above AI	AI	mean intake
<b>Males 51-70 y</b>	<b>10%</b>	550	<b>396</b>
<b>Males &gt; 71 y</b>	<b>&lt; 3%</b>	550	<b>326</b>
<b>Females 51-70 y</b>	<b>4%</b>	425	<b>274</b>
<b>Females &gt; 71 y</b>	<b>&lt; 3%</b>	425	<b>240</b>

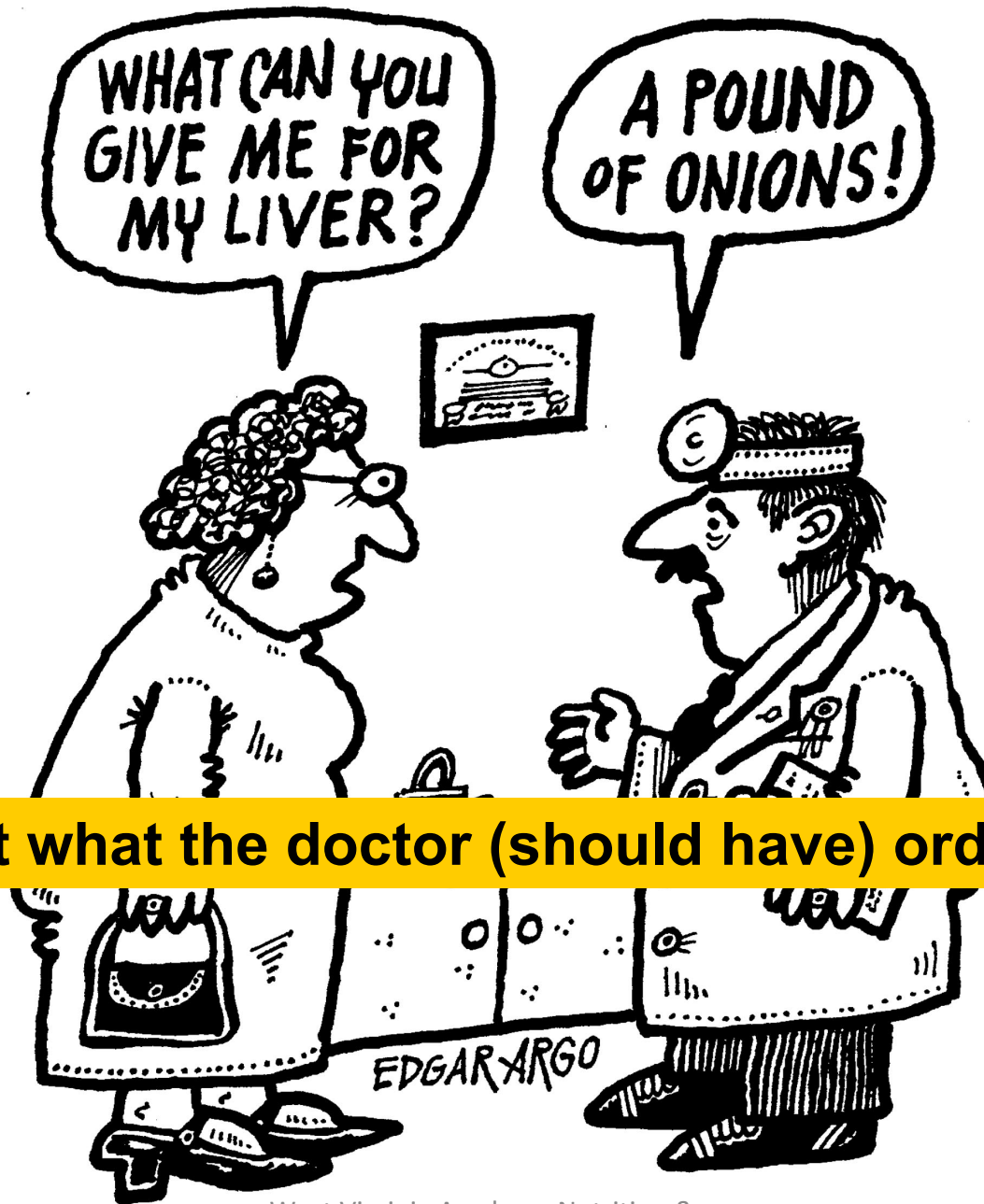
# Choline – roles and deficiency

- Neurotransmitter synthesis (acetyl choline), structure and dynamics of cell membranes, lipoprotein synthesis, and methyl-group metabolism including DNA repair
- **Deficiency symptoms**
  - **Fatty liver**
    - **Fat cannot be transported out of liver**
    - **Altered cholesterol homeostasis**
  - **Muscle weakness**
- Common gene polymorphisms affecting endogenous biosynthesis substantially increase deficiency effects
- **10% subjects developed fatty liver, muscle damage, or both even with AI of choline.** Damage reversed with high-choline diet.

**Zeisel & da Costa. *Nutr Rev.*2009;67**

# Schematic of NAFLD Prevalence by Age Group





**Just what the doctor (should have) ordered!**



# Choline – Emerging Roles

- Component of intestinal mucous that
  - facilitates nutrient absorption
  - Part of protective barrier against GI contents including microbes and toxins
- Animal model: phosphatidylcholine prevents experimentally induced colitis
  - Role in IBD?

Sun et al. *Nutrients*.2016;8

# Choline – Nutrient synergy for AD

- Uridine and **choline** are precursors for phosphatides in synaptic membranes, **therefore crucial to synaptic function; variety of evidence points to a role for uridine and choline in cognitive enhancement.**
- In **animal** models of **AD**, dietary enrichment with a combination of several precursors and cofactors (UMP, v-3 PUFAs, **choline**, folate, vitamin **B12**, vitamin B6, phospholipids, antioxidants) **increased neuronal membrane phosphatidylcholine synthesis.**

**Engelborghs et al. *Acta Clinica Belgica*. 2014;69**

# ZINC

## LAST BUT NOT LEAST!

## Mean intake and percentiles of usual intake from food and beverages by Dietary Reference Intake age-gender groups in the United States 2007-2010

	<b>Zinc</b>	mg/d	
	<b>% below EAR</b>	EAR	RDA
<b>Males 51-70 y</b>	<b>17</b>	9.4	11
<b>Males &gt; 71 y</b>	<b>30</b>	9.4	11
<b>Females 51-70</b>	<b>14</b>	6.8	8
<b>Females &gt; 71</b>	<b>23</b>	6.8	8

**No clinical biomarker with sensitivity to detect marginal zinc deficiency**

# Zinc roles

- Structure of proteins and cell membranes
  - **Loss from membranes increases oxidative damage** and impairs function
  - Copper-zinc superoxide dismutase – antioxidant
- Cell signaling: hormone release & nerve impulses
- Gene expression

**Linus Pauling Micronutrient Information Center, Oregon State Univ.**

# Zinc roles, cont.

- Over 300 enzymes need zinc
- Role in **apoptosis**
- Vitamin A
  - Zinc needed for transport in blood
  - Zinc deficiency leads to decreased release of vitamin A from liver

Linus Pauling Micronutrient Information Center, OSU

# Zinc & Immune function

- Integrity of immune system
- Development and function of cells mediate:
  - **Innate immunity** (neutrophils, macrophages, NK cells)
  - **Adaptive immunity** (B-cells & T-cells)
- Deficiency
  - Decreased cytokine production
  - Decreased activity of thymulin, for T-cell function
  - Increased susceptibility to infectious agents

Linus Pauling Micronutrient Information Center, OSU

# Zinc & Pneumonia

- **“Zinc may be a new risk factor for pneumonia in the elderly.”**
  - One of the most common causes of hospitalization & decreased ADL
  - Incidence and mortality rates rising in elderly
  - Hospitalization rates in NH residents 30X independent living
    - Death rates among NH residents as high as 57%
    - For seniors, **hospitalization for pneumonia has greater risk of death compared to other top 10 reasons for admission**

American Thoracic Society , Top 20 Pneumonia Facts-2015  
Barnett, Hamer, Meydani. *Nutr Rev.* 2010;68  
Meyabndi et al. *Am J Clin Nutr.* 2007:86



# Zinc & Pneumonia

- 30% NH residents > 65 years have low serum zinc despite supplementation with 7 mg/d for one year
  - Lower incidence of pneumonia if zinc adequate
  - All-cause mortality 27-39% lower if serum zinc  $\geq 70 \mu\text{g/dL}$

**American Thoracic Society , Top 20 Pneumonia Facts-2015**

**Barnett, Hamer, Meydani. *Nutr Rev.* 2010;68**

**Meyabndi et al. *Am J Clin Nutr.* 2007:86**

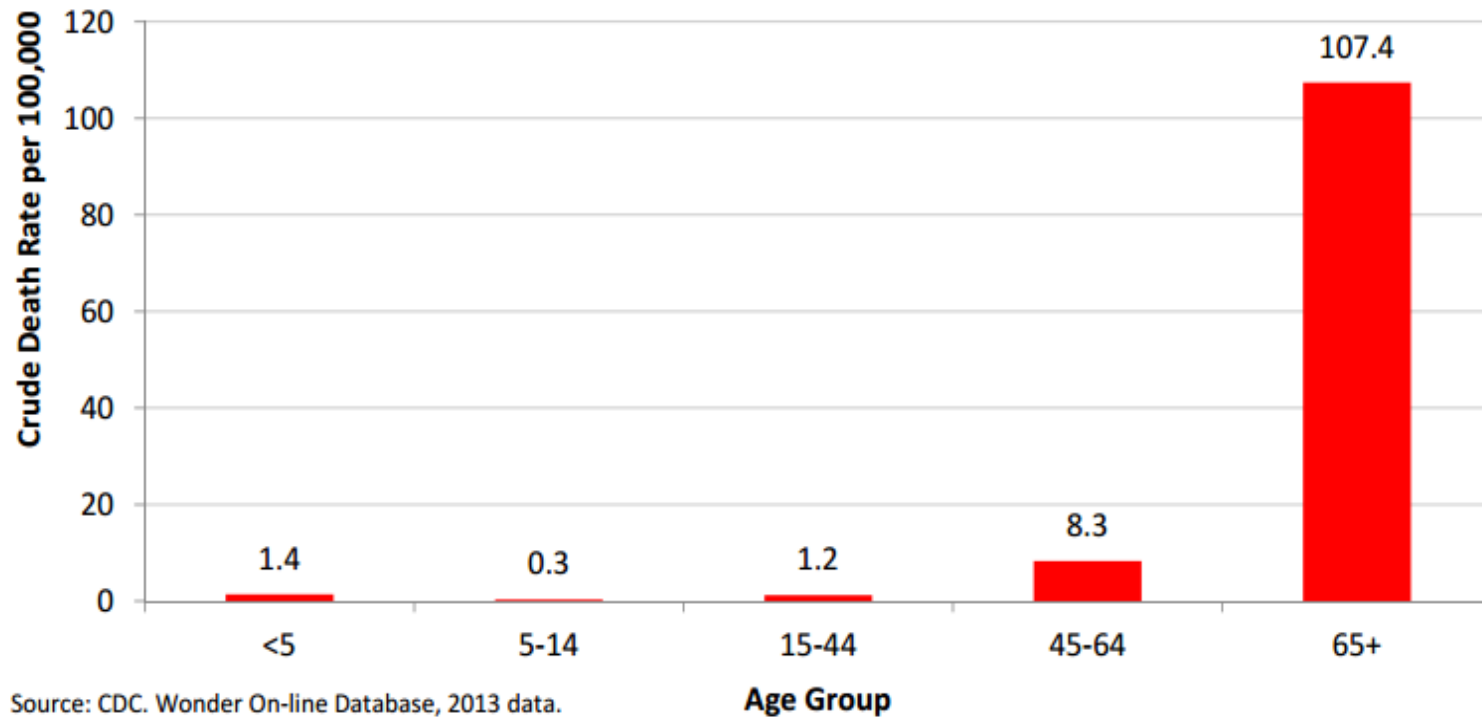
## Age

The pneumonia and influenza mortality rate is much higher for those aged 65 years and older compared to younger age groups.

About 85 percent of all pneumonia and influenza deaths occur in this age group, and it represents the seventh leading cause of death in this age group. (1)

Only about 3 percent of pneumonia and influenza deaths occurred in those under age 45.

### Pneumonia & Influenza – Death Rates by Age Group, 2013



Source: CDC. Wonder On-line Database, 2013 data.

# Zinc, other considerations

- Zinc deficiency can lead to slower turnover of taste buds and **reduction of taste sensitivity**
- **Serum Cu/Zn ratio is a useful diagnostic marker for taste disorders**
  - 1.1 or below is needed
- **Medications can alter levels:**
  - Lower: ACE inhibitors, Thiazide diuretics
  - Raise: Amiloride K<sup>+</sup> sparing diuretic
  - Zinc supplementation contraindicated w/some meds

Yangaqisawa et al. *J Trace Elem Med Biol.* 2016:36  
[UMM.edu/health/medical/altmed](http://UMM.edu/health/medical/altmed)

# HOW WE CAN ADDRESS MALNUTRITION IN SENIORS WITH NOURISHING FOOD

# Guidance from 1985

**“Physicians must keep in mind that whatever technique older patients used to reach their present age is probably better than what we can recommend.”**

**Freedman & Ahronheim, *Geriatrics*. 1985;40**

# Menu board from the 1950s Ward's Grill in Saluda, NC (since 1890!)

HAMBURGER  
CHEESEBURGER  
HOT DOGS  
HAM PLAIN

**SOUPS**  
ANY FLAVOR

**DRINKS**  
SMALL OR LARGE  
ANY FLAVOR

## *Sandwiches*

HAM SALAD • LET. & TOM.  
MINCED & SLICED BAR-B-Q  
HAM & EGG

CHEESE & EGG  
GOOSE LIVER  
FRIED EGG

## **SHORT ORDERS**

STEAKS • CHOPS  
HOT ROAST PORK  
HOT ROAST BEEF  
SHRIMP • OYSTERS  
EGGS • BACON & EGGS  
COLD PLATES

HAM & EGGS  
FRENCH FRIES  
POTATO SALAD  
TOSSED SALAD  
SOUPS  
OYSTER STEW

HAM & CHEESE  
GRILLED CHEESE  
BACON, LET. & TOM.  
CHICKEN SALAD

**SHAKES**  
REG. & THICK  
ANY FLAVOR

**SUNDAES**  
CHOC. • CHOC. NUT  
PINEAPPLE • PINEAPPLE SPLIT



# Convenient PICK UP - TAKE OUT Packages

## CHICKEN DINNER

3 Large Pieces Chicken

Potatoes, Cracklin'  
Gravy, Tangy Cole  
Slaw, Hot Rolls

**\$1.15**

## Luncheon Special

### SNACK BOX

2 pieces Chicken  
Potatoes, Cracklin'  
Gravy, Hot Roll

89c

## the THRIFT BOX

9 Large Pieces of  
CHICKEN

**\$2.25**

Chicken for 3-5 People

## JUMBO BOX

The Chicken Dinner  
with 5 Pieces Chicken . . . **\$1.65**

CHICKEN — Gizzard Dinner . . . \$1.00  
— Liver Dinner . . . \$1.25  
with Potatoes, Cracklin' Gravy,  
Cole Slaw, Hot Rolls

## the BARREL

feeds from 7-10 hungry  
people  
21 pieces of Chicken  
Great for parties,  
Picnics, large  
families

**\$4.95**



## FAMILY BUCKET

feeds from 5-7 hungry  
people  
15 pieces of Chicken  
Cracklin' Gravy  
Hot Rolls

**\$3.75**

FRIED LIVERS . . . . . \$1.00 Pt.  
FRIED GIZZARDS . . . . . \$ .60 Pt.

## Other Delicious Treats

— HOMEMADE SALADS —  
Potato - Cole Slaw and Macaroni Salad

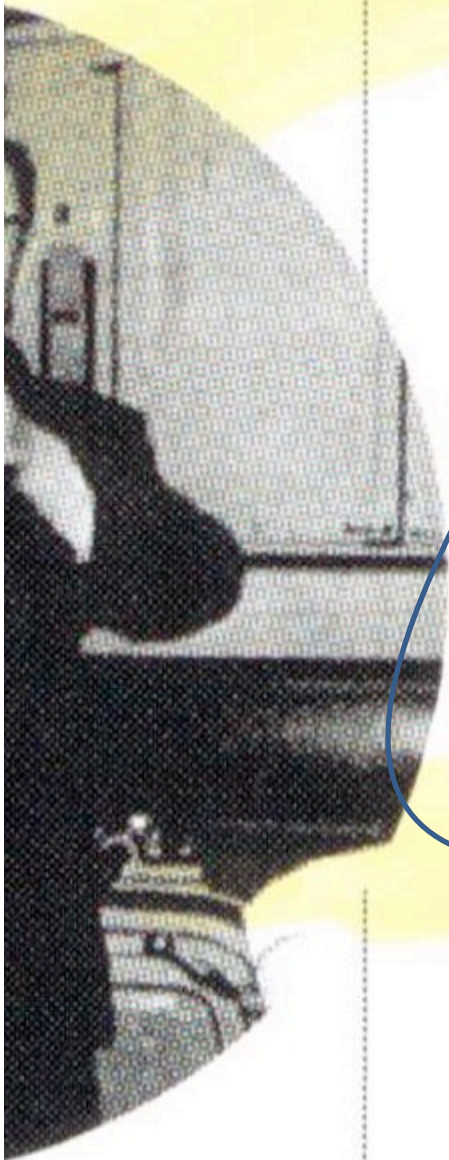
## Fried SHRIMP Dinner

LARGE SHRIMP - FRENCH FRIED POTATOES  
COLE SLAW - HOT ROLLS . . . . . **\$1.50**

JUMBO SHRIMP DINNER

# 1950

Dining halls serve two entrees per meal, such as fried chicken and liver. Taking food from dining halls after 7 p.m. closure nets one week of work in dish room, or adjudication before





# Small Changes in Diet – Big Impact



# Filling in the Gaps

FOOD, serving size frequency	Vit A/ serving	Vit A/ Day	Vit B12/ serving	Vit B12/ day	Choline/ serving	Choline/ day	Zinc/ serving	Zinc/ day
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**Historically, liver was fed as an effective therapy for pernicious anemia. (autoimmune B12 deficiency – used to be fatal.)**

Daily	mcg	mcg						
Beef, 3 oz Three times week		negligible	2.5 mcg	2.5 mcg	60 mg	9 mg	9 mg	1.3 mg
Oysters, 3 oz Once per week	76 mcg	1.1 mcg	14 mcg	2 mcg	70	10	35 mg	5 mg
<b>TOTAL (rounded)</b>		<b>1,060 mcg</b>		<b>15 mcg</b>		<b>340 mg</b>		<b>8 mg</b>
RDA (male-female)		<b>700 – 900 mcg RAE</b>		<b>2.4 mcg</b>				<b>8-11 mg</b>
AI for choline						<b>425 – 550 mg</b>		

# Make Your Own Livermush

By *Jed Portman*  
April 8, 2015



At *Garden & Gun*, we love livermush. Okay, not *all* of us. When we cooked a batch at the office a while back, some of the editors were less than enthusiastic about the name. But those who were brave enough to sample the North Carolina treat realized that it's actually a lot tastier than its unappetizing moniker implies. That's why we included livermush in our April/May issue, on our list of *fifty* reasons to love the South now.



Photograph by Lucy Cuneo



## Blog Categories

- A Southern Focus
- Belle Decor
- Below the Line
- Books
- Good Eats
- Southern in the City
- Southern Sounds
- The Sporting South

## What's New



HOME & GARDEN  
Homeplace: A Perfect Pairing

WEEKLY NEWSLETTER

Talk of the South

SIGN UP and get emails from *Garden & Gun*

# Old Fashioned Liver Loaf

- 1 pound sliced liver
- 3/4 cup boiling water
- 1 medium onion
- 1/2 pound pork sausage
- 1 cup dried bread crumbs
- 1 tablespoon Worcestershire sauce (or other such as fermented fish sauce)
- 1 tablespoon lemon juice
- 1 teaspoon salt
- 1/8 teaspoon pepper
- 2 eggs
- 4 slices of bacon

Pour the water over the liver and simmer 5 minutes. remove liver and grind with the onion, or process in food processor. Add the remaining ingredients except the bacon. Mix together. Place in a loaf pan. Top with bacon. Bake 45 min in 350 degree oven.

# Chopped Chicken Liver



# Thanks for Attending!

Contact Pam at

womenfamilynutrition@gmail

If you have any questions on today's presentation, or need further information.