BRAIN HEALTH & AGING WELL
A FOCUS ON DIET

Carol Johnston, PhD, RD
Professor and Associate Dean
Nutrition Program
College of Health Solutions
Arizona State University

OUTLINE

1. **Diet recommendations** for 'Healthy Minds'

2. The facts: **Nutritional Status** of Americans – deficiencies that impact brain health

3. Additional **'Food for Thought'**

1. HEALTHY DIETS

American Heart Association®

•Eat a variety of fruit and vegetable servings every day.
•Eat a variety of grain products every day
•Eat fish at least 2 times each week
•Stay at a healthy weight by balancing the amount of calories you eat with the activity you do every day
•Eat **foods** low in saturated fat and trans fat
•Read food labels and limit the amount of trans fat you eat
•Limit sodium
•Limit alcohol intake to 1-2 drinks a day
•Limit drinks and foods with added sugar

NIH National Institute of Diabetes and Digestive and Kidney Diseases
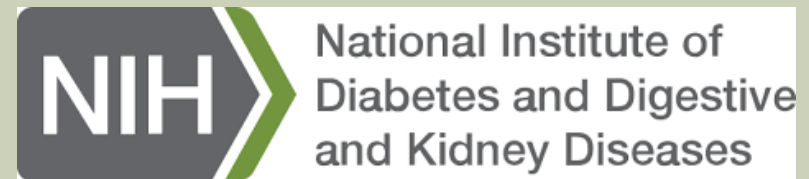
The 'Diabetic Diet':
• Limiting foods that are high in sugar
• Eating smaller portions
• Being careful about when and how many carbohydrates you eat
• Eating a variety of whole-grain foods, fruits and vegetables every day
• Eating less fat
• Limiting your use of alcohol
• Using less salt

HEALTHY DIETS REDUCE CHRONIC DISEASE RISK

- Help to keep blood glucose level, blood pressure, and cholesterol in target ranges
- Help to lose weight or stay at a healthy weight
- Prevent or delay diabetes problems
- Prevent or delay coronary artery disease, heart failure
- Promote feeling good and energy levels

- ## Promote healthy brain
  - Reduced blood glucose, reduced blood pressure, good blood flow, reduced inflammation

DIET SIMPLIFIED

Key points:

- Eat minimally processed foods (≤3 ingredients; particularly no added fat, sugar and sodium)
- Eat <u>whole</u> fruit, vegetables, and grains
- Eat lean/low-fat animal products; include fish weekly
- Eat smaller portions
- Avoid sugary drinks
- Limit alcohol to 1-2 servings/day

Eat a variety of foods

Meat **2** **2** Dairy

Grains **4** **4** Fruit and Vegetables

or more
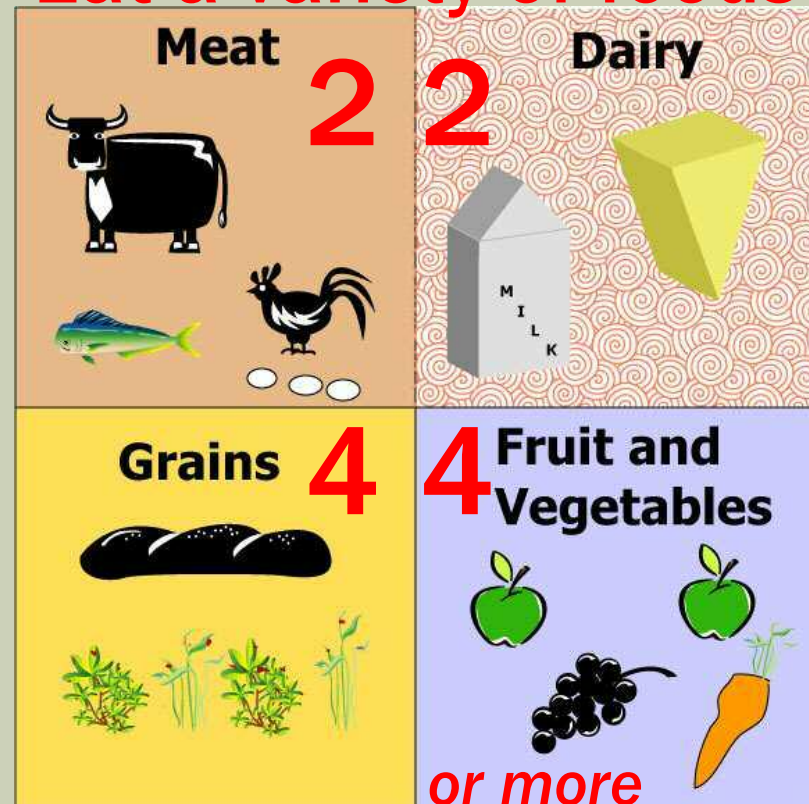
DIET SIMPLIFIED
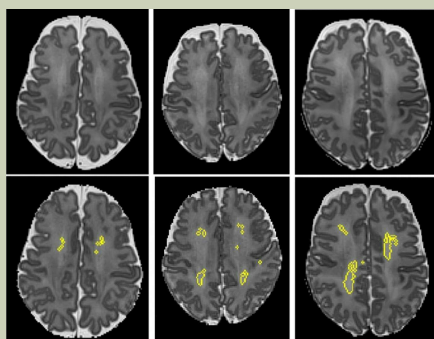
Recent 'Brain Imaging' Evidence:

- Foods strongly associated with greater brain integrity:

fruit, vegetables, legumes, olive and seed oils, fish, lean red meat, poultry

- Foods not strongly linked to brain integrity:

milk and dairy products, cream, butter, processed meat and offal

DIET SIMPLIFIED

Additional 'Imaging' Evidence:

Foods strongly associated with protection from Alzheimer's Disease:

higher intake of fresh fruit and vegetables, whole grains, fish and low-fat dairies

lower intake of sweets, fried potatoes, high-fat dairies, processed meat and butter

This study identified nutrient patterns associated with major brain AD biomarkers (via MRI and PET scans) in a cohort of clinically and cognitively normal individuals at risk for AD (n=52; age, 55+; location, NYC).

DIET SIMPLIFIED

Blood Marker Evidence:

Food group relativeranking for each individual primary and secondary outcome and summary ranking across outcomes[1]

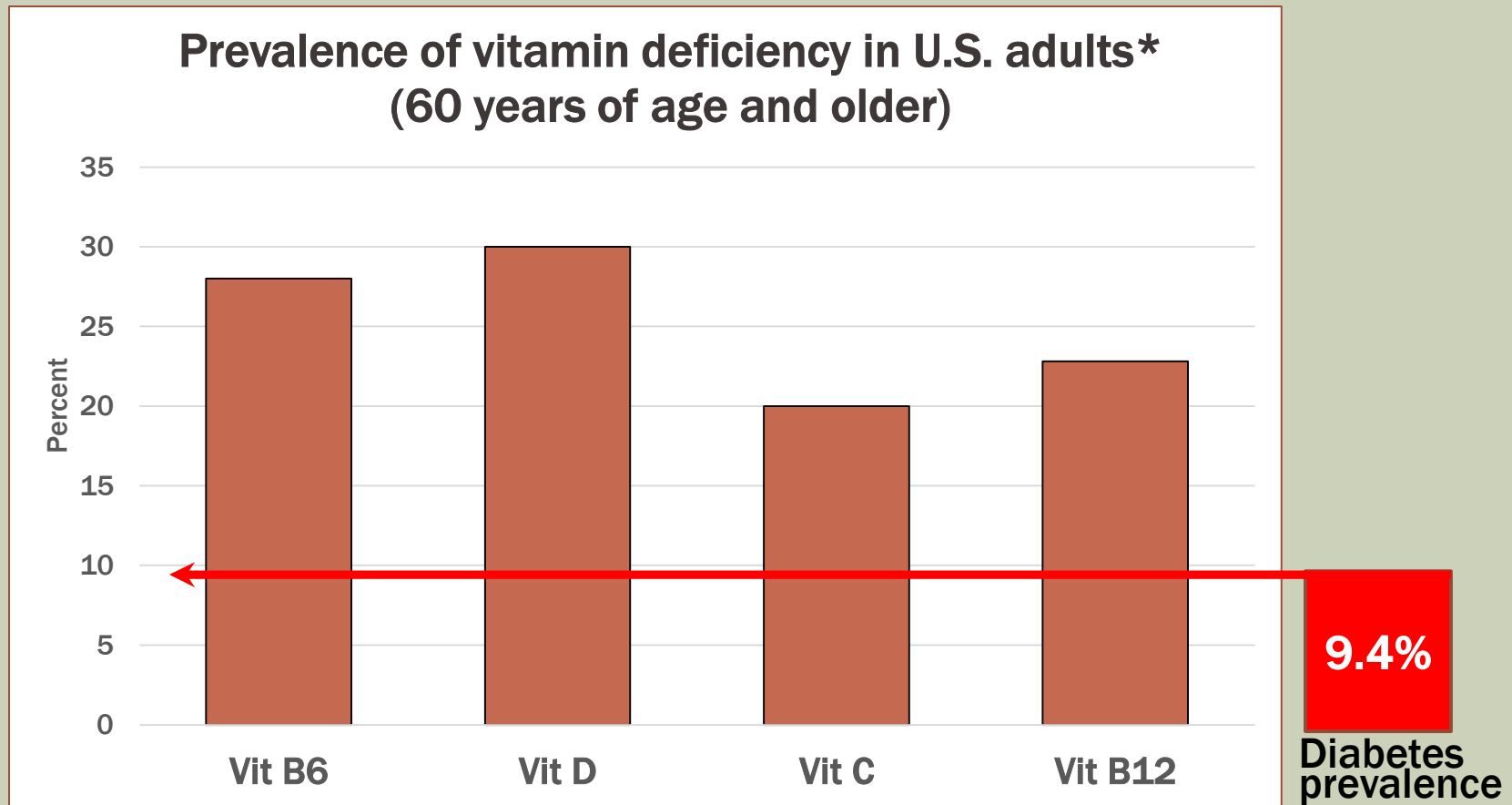| Food group	Primary outcomes		Secondary outcomes								Summary ranking
	LDL-C	TG	TC	HDL-C	FG	HbA1c	HOMA-IR	SBP	DBP	CRP	All outcomes combined
Nuts	93	78	92	62	84	37	67	32	42	76	66
Legumes	85	58	91	12	51	61	76	69	70	45	62
Whole grains	70	53	71	44	57	76	86	44	57	61	62
Refined grains	42	25	42	49	74	70	56	14	30	36	44
Fruits and vegetables	63	35	58	49	20	52	43	91	54	26	49
Eggs	40	16	30	58	NA	NA	6	41	41	80	39
Dairy	33	44	33	49	32	NA	21	NA	NA	48	37
Fish	23	97	23	91	NA	NA	47	62	33	32	51
Red meat	20	72	28	57	24	5	NA	48	74	46	42
SSBs	30	23	32	30	28	NA	NA	NA	NA	NA	29

Am J Clin Nutr. 2018 Sep 1;108(3):576-586.
Study summarized the effects of food groups on disease markers across 86 randomized intervention trials published between 1979 and 2018 (total n=3595 participants)

FOODS FOR HEALTHY MINDS

2. FOUR KEY NUTRIENT CONCERNS OF OLDER AMERICANS

Prevalence of vitamin deficiency in U.S. adults*
(60 years of age and older)

Percent

| Vit B6 | Vit D | Vit C | Vit B12 |

9.4%

Diabetes prevalence

*Nutrition status using biochemical indicators in blood

HEALTHY DIETS MAY BE LOW IN CERTAIN VITAMINS

Vitamin B12: *widely distributed in animal products (but older adults have low absorption capacity)*

	RDA=2.4 mcg/d
Salmon, sockeye, cooked, 3 ounces	4.8
Trout, rainbow, farmed, cooked, 3 ounces	3.5
Tuna fish, light, canned in water, 3 ounces	2.5
Burger, double patty and bun, 1 sandwich	2.1
Haddock, cooked, 3 ounces	1.8
Breakfast cereals, fortified with B12, 1 serving	1.5
Beef, top sirloin, broiled, 3 ounces	1.4

HEALTHY DIETS MAY BE LOW IN CERTAIN VITAMINS

Vitamin B6: *destroyed by heating/freezing; removed by milling; not available from many fruits, vegetables, and legumes*

	RDA=1.7 mg/d	
Chickpeas, canned, 1 cup	1.1	X
Beef liver, pan fried, 3 ounces	0.9	X
Tuna, yellowfin, fresh, cooked, 3 ounces	0.9	?
Salmon, sockeye, cooked, 3 ounces	0.6	X
Chicken breast, roasted, 3 ounces	0.5	X
Breakfast cereals, fortified with B6	0.5	☺
Potatoes, boiled, 1 cup	0.4	X
Turkey, meat only, roasted, 3 ounces	0.4	X
Banana, 1 medium	0.4	☺
Ground beef, patty, 85% lean, broiled, 3 ounces	0.3	X
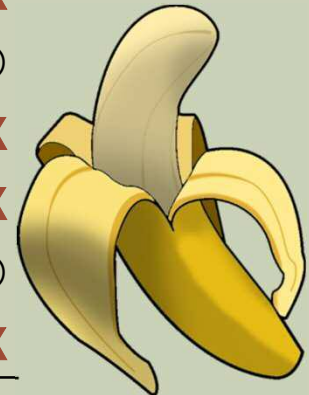
X = *unreliable source*

B VITAMINS AND THE BRAIN

Vitamin B12 deficiency **has been associated with various neuropsychiatric symptoms, and it has also been reported to be a reversible cause of dementia.**

Low-normal concentrations **of vitamin B-12 may be associated with worse cognition.**

MRI reveals brain atrophy in B12 deficiency
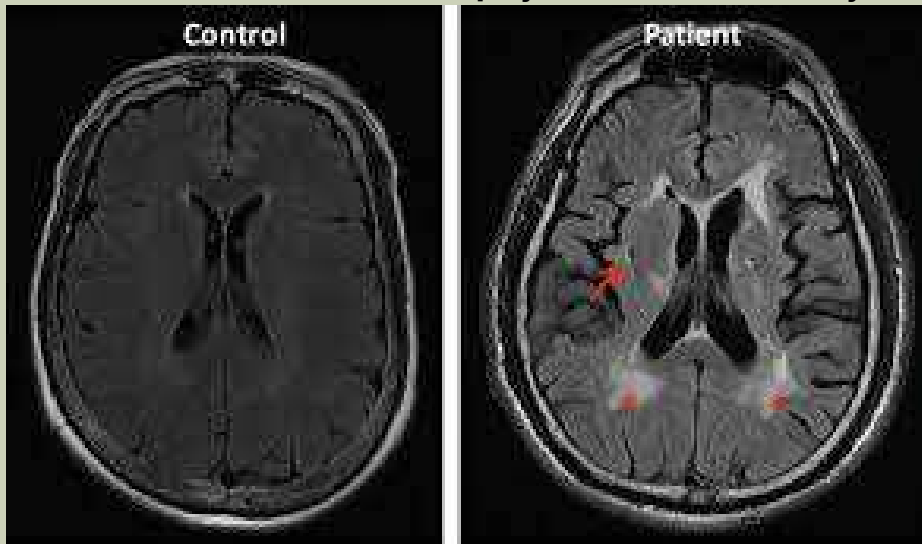
Handbook of Famine, Starvation, and Nutrient Deprivation
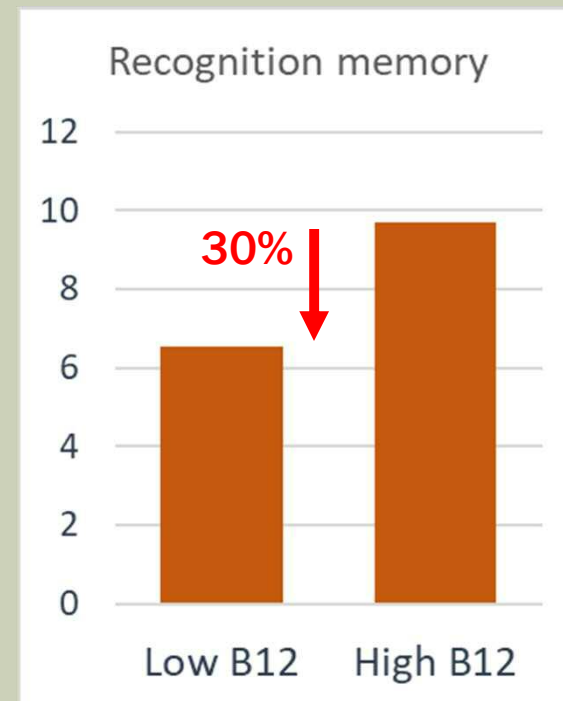
Am J Clin Nutr. 2016 Feb 24

B VITAMINS AND THE BRAIN

Adequate plasma levels of PLP (B6 coenzyme) or B12 were significantly associated with less depression after controlling for age, physical activity, stressful life event.

Risk for Depression and vitamin B status

40% reduction in depression

Psychother Psychosom. 2004;73(6):340-3.
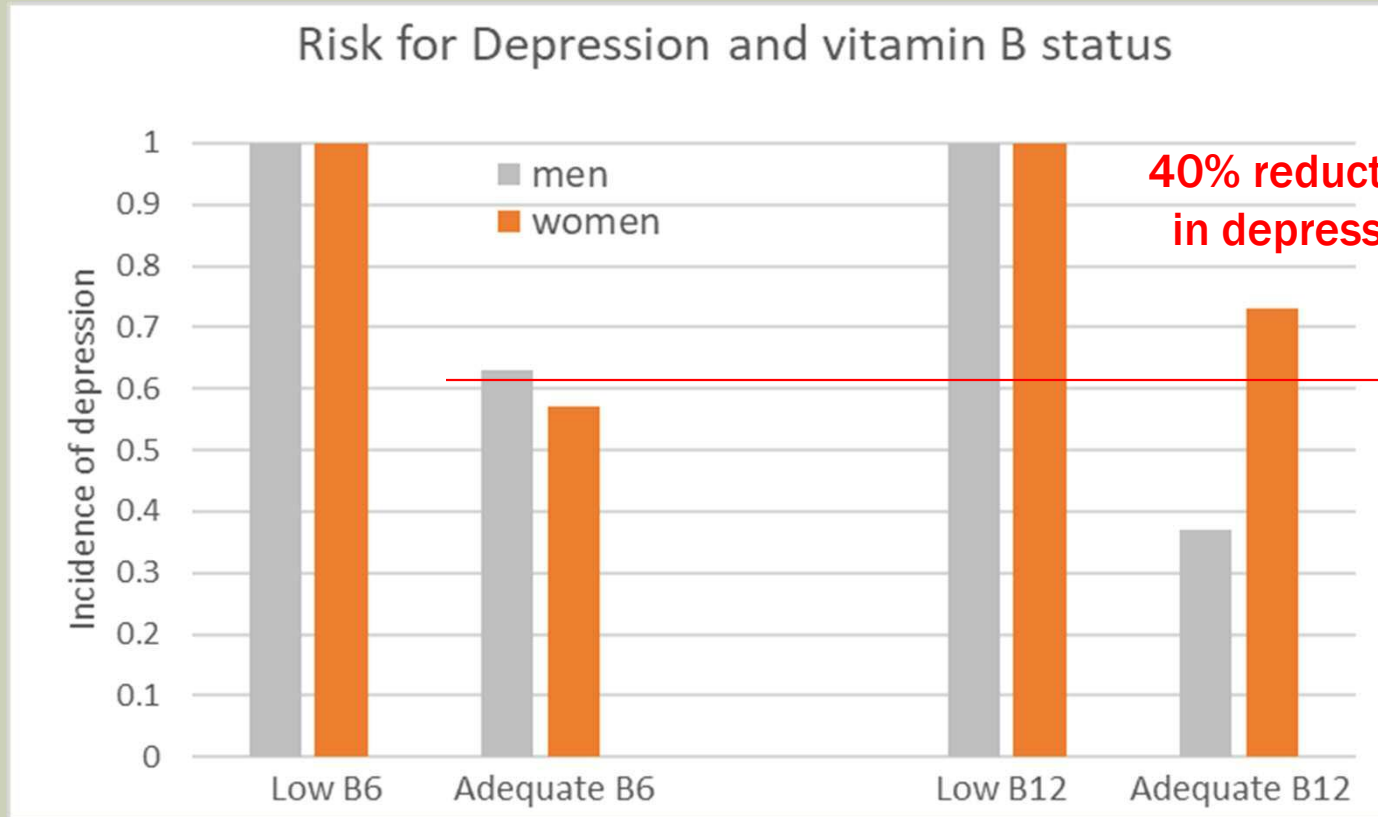
B VITAMINS AND THE BRAIN

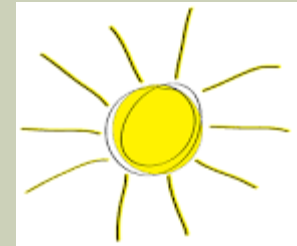Vitamin B12 is required for nerve cell integrity (e.g., formation of the MYELIN SHEATH)
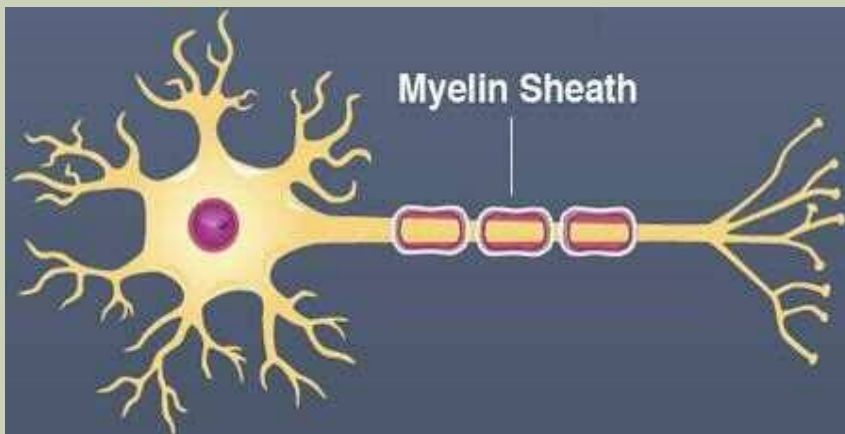
Vitamin B6 is required for the production of the neurotransmitter, SEROTONIN.

HEALTHY DIETS MAY BE LOW IN CERTAIN VITAMINS

Vitamin D: *only in oily fish; produced via sun exposure (but pathway minimal in older adults)*
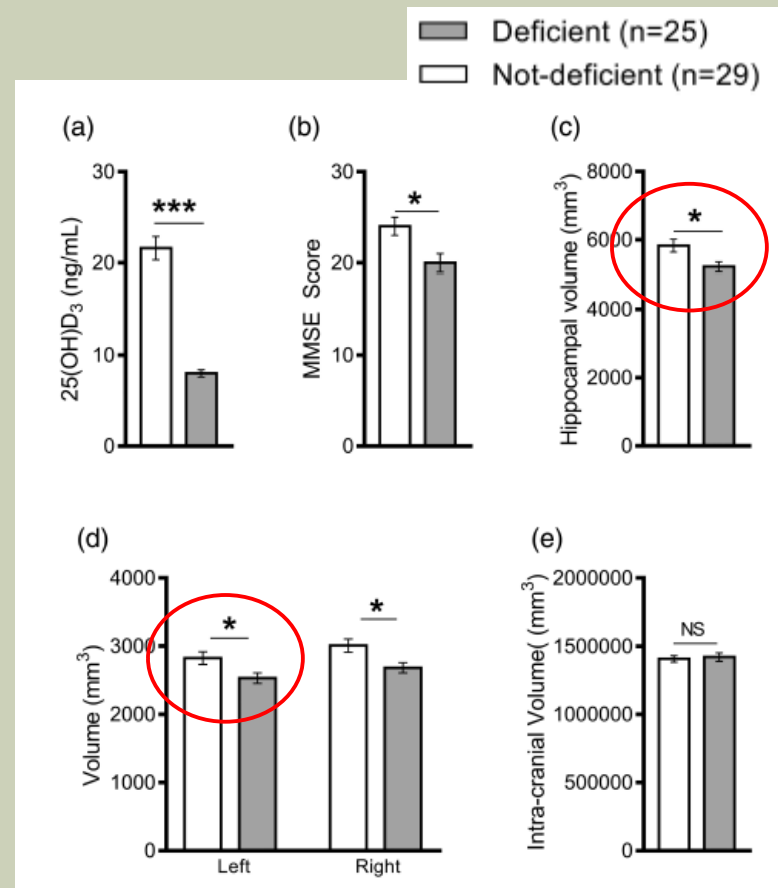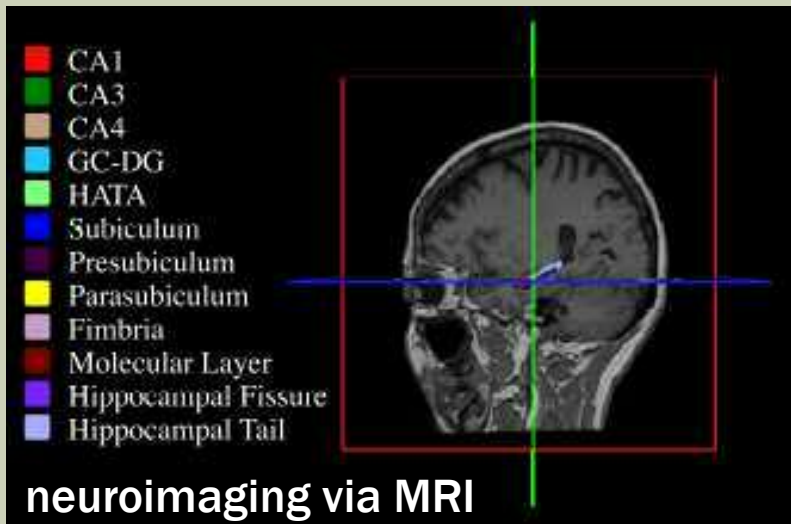
RDA=600-800 IU/d

Salmon , cooked, 3 ounces	447
Milk, vitamin D-fortified, 1 cup	120

Also rich source of omega-3 fat

VITAMIN D AND THE BRAIN

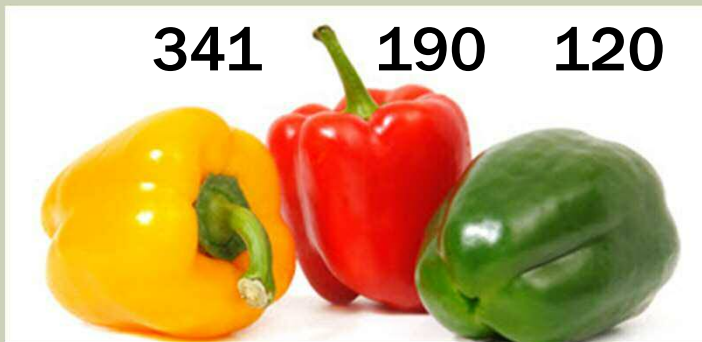**A low plasma level of vitamin D** was significantly associated with reduced brain volume
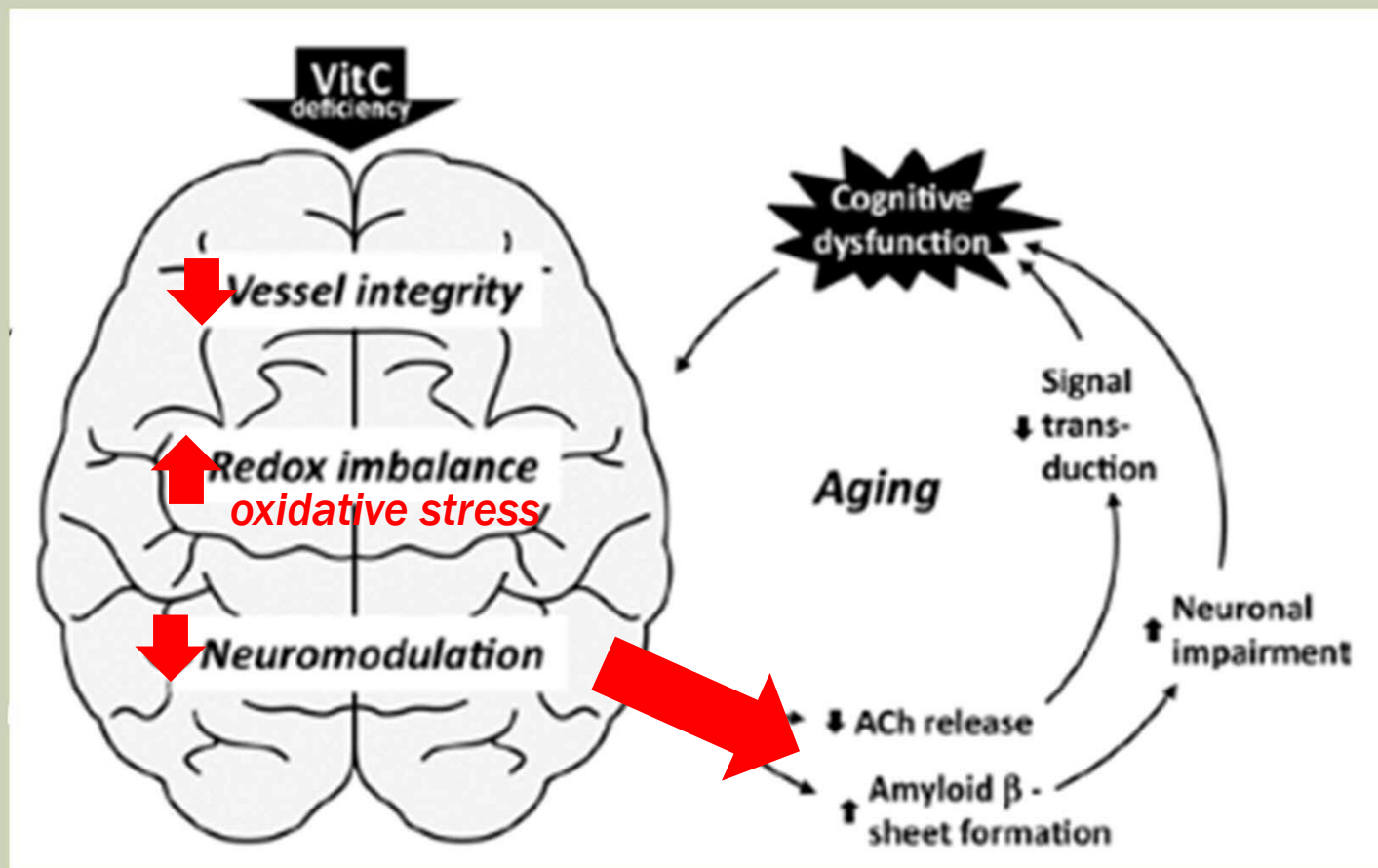

neuroimaging via MRI

HEALTHY DIETS MAY BE LOW IN CERTAIN VITAMINS

Vitamin C: *limited fruits and vegetables are rich sources; easily destroyed when exposed to oxygen, light, heat*

RDA = 90 mg

341   190   120

~~90~~
50

20   6

0

Vitamin C is involved in the physiology of the nervous system (roles in collagen synthesis and antioxidant protection)


Nutrients.2014 Sep 19;6(9):3818-46.

FOR THE 'PROBLEM' NUTRIENTS, SUPPLEMENTATION CONSIDERED PRUDENT

SUGGESTED USE: Adults: Take one (1) tablet daily with food. Not formulated for use in children. Do not exceed suggested use.

Supplement Facts

Serving Size 1 Tablet

Amount Per Serving	% Daily Value
Vitamin A 1,050 mcg (29% as Beta-Carotene)	117%
Vitamin C 100 mg	111%
Vitamin D₃ 25 mcg (1,000 IU)	125%
Vitamin E 15.8 m	105%
Vitamin K 50 mcg	42%
Thiamin 1.1 mg	
Riboflavin 1.1 mg	85%
Niacin 14 mg	88%
Vitamin B₆ 5 mg	294%
Folate 667 mcg D	167%
Vitamin B₁₂ 50 mc	2,083%
Biotin 30 mcg	100%
Pantothenic Acid	100%
Calcium 300 mg	23%
Iron 8 mg	44%
Phosphorus 20 m	2%
Iodine 150 mcg	100%
Magnesium 100 m	24%
Zinc 15 mg	136%
Selenium 22 mcg	40%
Copper 0.5 mg	56%
Manganese 2.3 mg	100%
Chromium 52 mcg	149%
Molybdenum 50 mcg	111%
Chloride 72 mg	3%
Potassium 80 mg	2%
Lutein 300 mcg	*

* Daily Value not established.
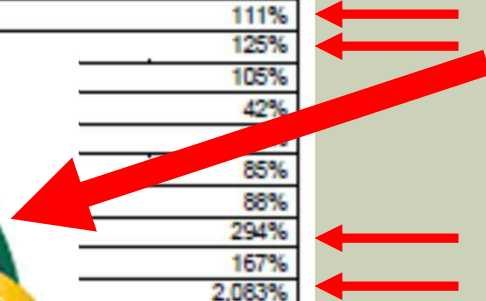
# VITAMIN SUPPLEMENTATION IMPROVED COGNITIVE PERFORMANCE (8 weeks; n=60; 21-59y)

TABLE 2 | Paired *t*-tests post intervention by supplementation group.

Measure/Function	Multivitamin		Vitamin D		Vitamin C	
	Time 1 mean (SD)	Time 2 mean (SD)	Time 1 mean (SD)	Time 2 mean (SD)	Time 1 mean (SD)	Time 2 mean (SD)
IQ:						
WASI-II FSIQ-4	110.40 (12.07)	114.05 (10.42)	113.15 (10.41)	116.50 (11.11)		
Memory:						
WMS Verbal Mem. Immediate	10.80 (2.59)	12.50 (2.59)	11.60 (2.28)	12.95 (2.56)	11.75 (2.53)	13.65 (1.84)
WMS Verbal Mem. Delayed	11.00 (2.63)	13.30 (2.43)	11.35 (3.13)	13.20 (3.19)	11.45 (2.61)	14.20 (2.26)
WMS Visual Repro. Delayed	10.95 (2.35)	14.30 (2.43)	11.55 (3.65)	14.35 (2.98)	13.05 (3.25)	15.45 (2.81)
WMS Symbol Span	11.80 (3.58)	13.65 (3.13)				
Doors and People Overall	12.05 (2.63)	13.70 (2.56)	13.35 (3.27)	13.80 (2.57)	12.65 (2.34)	14.45 (2.16)
Executive Function:						
DKEFS Trail Making Number/Letter Switch (visuo-motor switching)					12.40 (1.31)	12.95 (1.23)
DKEFS Design Fluency Total (Visual strategy generation)	7.90 (1.55)	9.45 (2.31)			8.35 (1.39)	9.35 (1.57)
DKEFS Tower Mean 1st Move Time (motor planning)	10.95 (2.37)	11.95 (1.50)				
WAIS-III Symbol Search Correct (visuo-motor processing speed)	12.05 (2.67)	13.40 (2.37)	12.75 (3.52)	13.95 (3.14)	13.60 (2.04)	14.95 (2.32)

Front Behav Neurosci. 2019 May 28;13:115.   200 mg vitamin C, 10 µg vitamin D or A-Z multivitamin/mineral supplement

3. 'FOOD FOR THOUGHT'

Proper hydration is important for optimal cognitive functioning
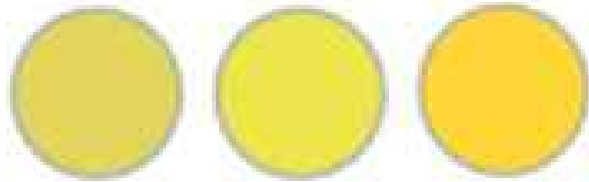
Hydration status predicted 20% of cognitive function

psychomotor processing speed
and
memory performance
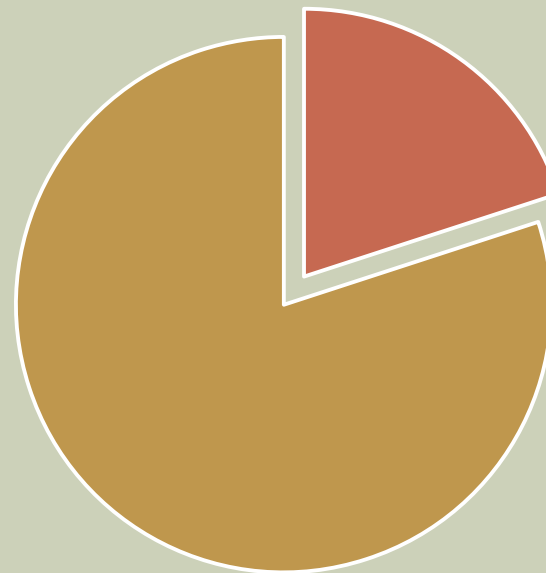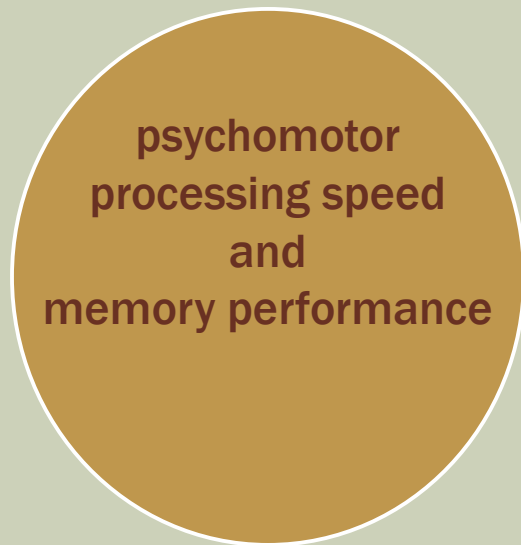
Participants (n=28) were aged 50-82 years and college educated

Int J Psychophysiol. 2004 Jul;53(2):121-5.

CHECK YOUR URINE!

Adequately hydrated

Possibly dehydrated

Probably dehydrated

Neuroimage Clin. 2017 Sep 6;16:507-513.
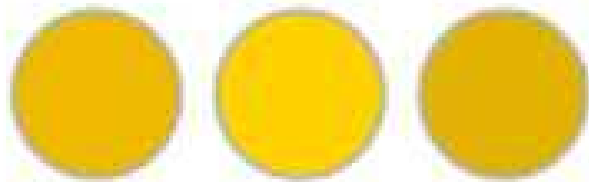
It is estimated that up to **40 percent** of community-dwelling elderly people in the U.S. may be chronically underhydrated

Dehydration decreases global brain volume (**-0.3 to -1.7%**). Compare to annual atrophy rates in older adults: -0.3 to -0.9%.

'FOOD FOR THOUGHT'

Metabolomics *a new way to look at blood metabolites; provides a global picture of individuals' biological status*

2019 study revealed baseline serum signature of several food metabolites associated with subsequent cognitive decline in 418 older French adults (≥65 y)

Less cognitive decline
Coffee
Fish
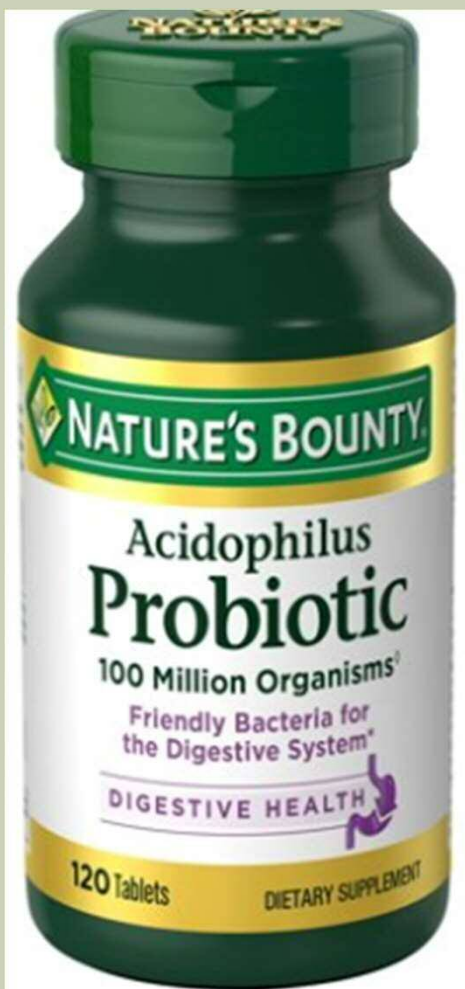**Chocolate**
Red wine

Greater cognitive decline
Juice
Caffeine
Glucose
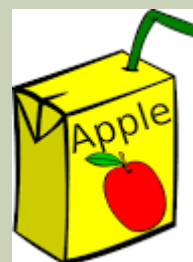
'FOOD FOR THOUGHT'

The GUT *relationship between gut microbiota and neurological diseases*
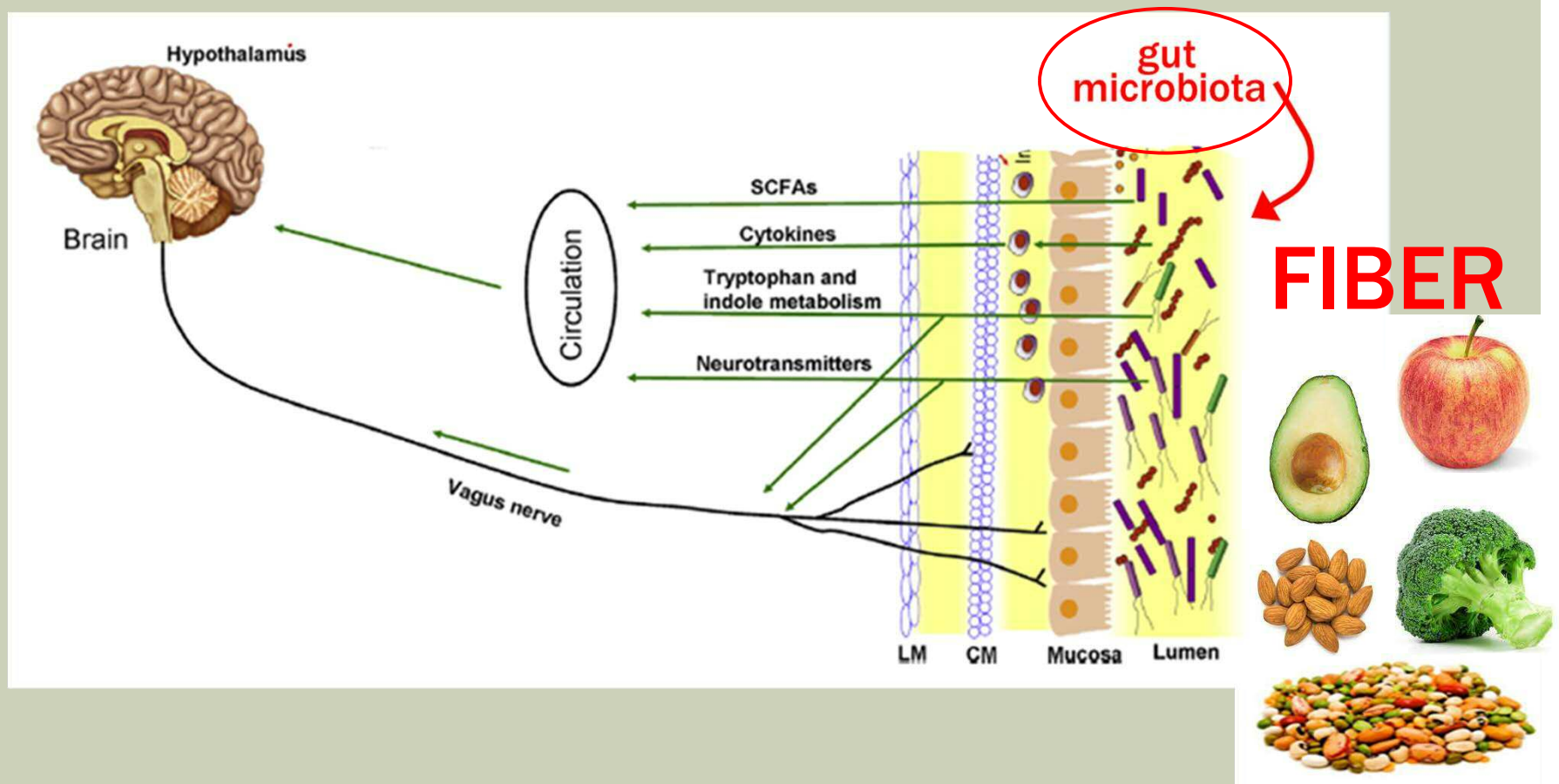
'FOOD FOR THOUGHT'

prebiotic Contains oligosaccharides that promote the growth of lactobacilli and bifidobacteria
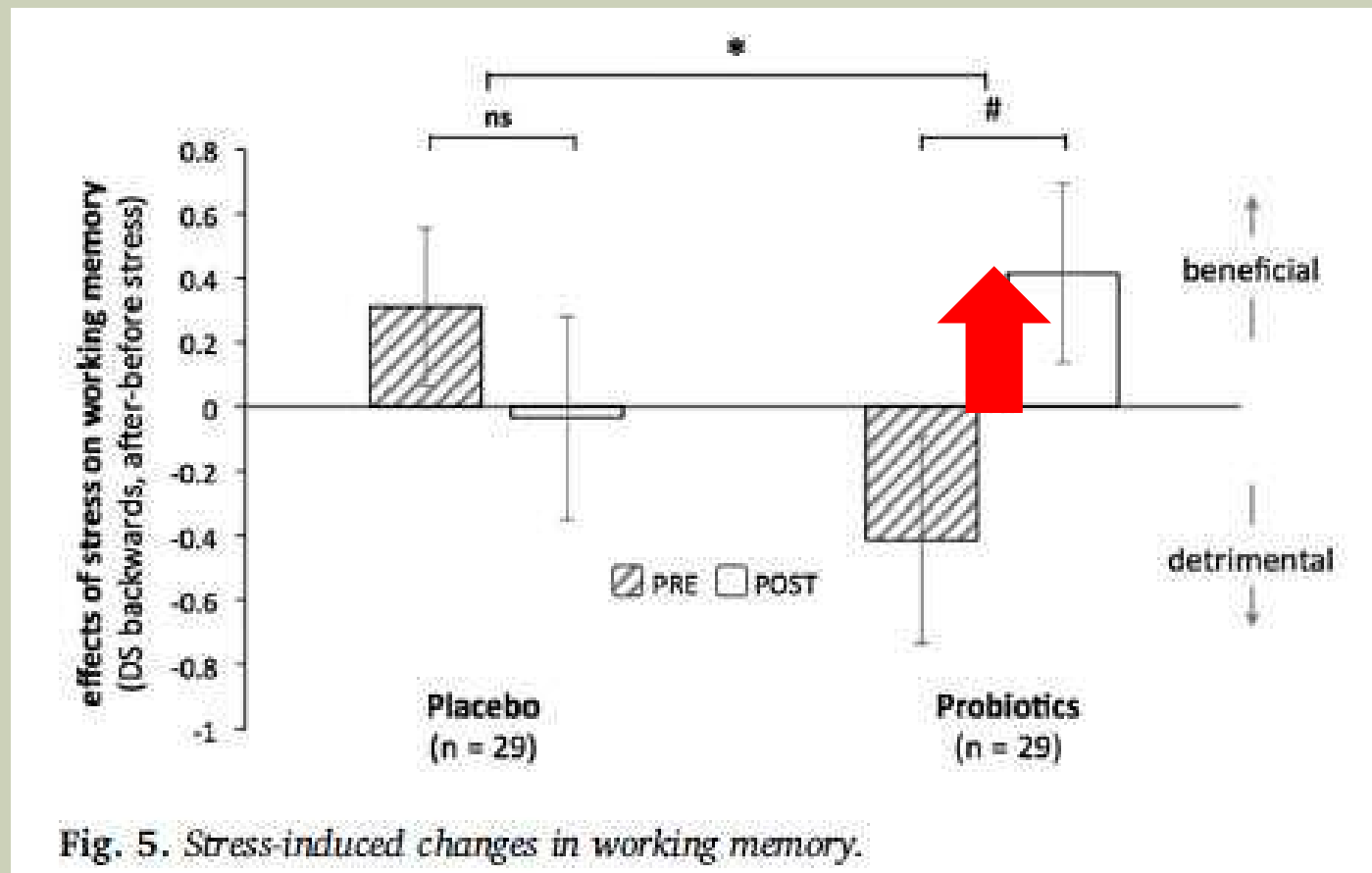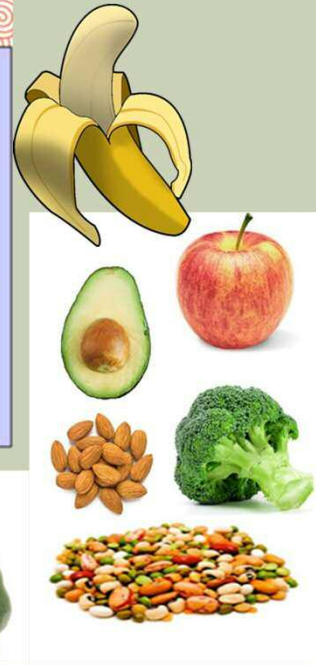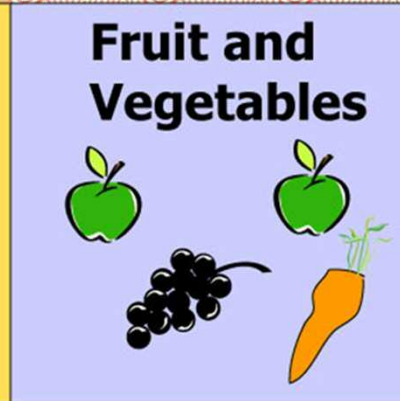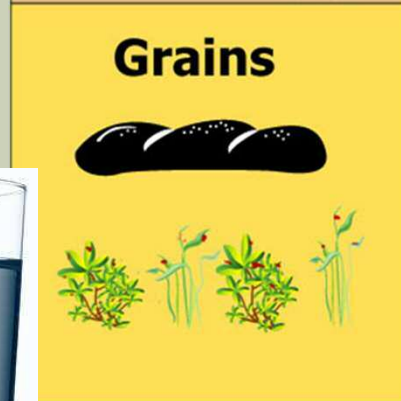
'FOOD FOR THOUGHT'

Probiotics *improve working memory*

Fig. 5. *Stress-induced changes in working memory.*

Participants (n=58 young adults; 28-day intervention) listened to a series of numbers and repeated each series

Meat

Dairy

Grains

Fruit and Vegetables

THANK YOU!