



UNC
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FOLATE IN HUMAN HEALTH & DISEASES: DID YOU KNOW?

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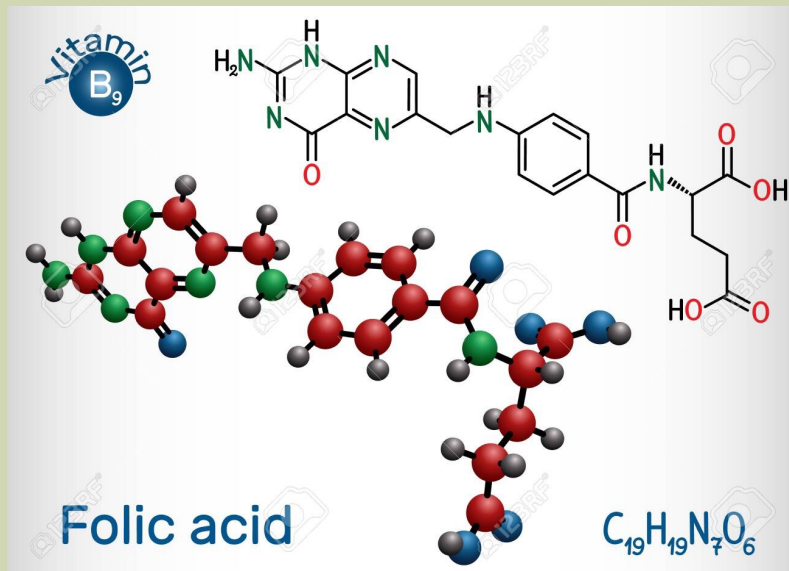
Denver

NC

India

What is folate and how it came into picture?

- In 1931, Lucy Wills reported that an unusual form of anemia, macrocytic anemia, could be cured by yeast extracts, suggesting that the disease is a nutritional deficiency.
- Soon thereafter, many groups identified the active nutrient, later named folic acid or folate.
- Independent groups used activated charcoal to adsorb and concentrate folic acid.



Hutchings et al., 1941; Mitchell et al., 1941; Stokstad and Jukes, 1949

Folic acid	Folate
Synthetic (man-made)	Naturally occurring
More readily used by the body	Cannot be used by the body unless activated
Found in fortified flour/cereals and supplements	Found in vegetables (leafy, broccoli etc.), legumes, and animal products



Food Sources of Folate



MUSTARD GREENS, RAW
2 cups chopped
210 mcg FOLATE



CHICKEN LIVER
1 ounce
165 mcg FOLATE



ASPARAGUS, BOILED
1, 1/2 cup chopped
134 mcg FOLATE



OKRA, BOILED
1/2 cup sliced
134 mcg FOLATE



ROMAINE LETTUCE
2 cups shredded
128 mcg FOLATE



COLLARD GREENS
2 cups chopped
120 mcg FOLATE



SPINACH, RAW
2 cups
116 mcg FOLATE



BROCCOLI, BOILED
1/2 cup florets
84 mcg FOLATE



BEEF LIVER
1 ounce
81 mcg FOLATE



KALE, RAW
2 cups chopped
39 mcg FOLATE



EGG YOLK
1 large
25 mcg FOLATE

mcg = micrograms

THE PALEO MOM



GOOD SOURCES

Legumes

beans • peas • lentils
• Lentils (cooked),
1/2 cup, 179 µg DFE



Green Leafy Vegetables

kale • spinach
• Spinach (cooked),
1/2 cup, 131 µg DFE



Fortified Food & Supplements

• Sliced Bread (enriched),
1 slice, 84 µg DFE



µg = micrograms; DFE = Dietary Folate Equivalents

To reduce the risk of NTD, all pregnant women shall consume above dose in addition to folate obtained in diet

World Health organization



Symptoms of Folate deficiency

- fatigue
- mouth sores
- gray hair
- swollen tongue
- poor growth (also among the chief symptoms of malnutrition)

Once anemia occurs, you might experience the following:

- fatigue
- dizziness
- feeling cold
- irritability
- headache
- difficulty breathing
- pale skin
- diarrhea
- weight loss
- loss of appetite
- difficulty concentrating

Your doctor may also order blood test to check your folic acid levels. This is called a red blood cell folate level test.

But how much **FOLATE????**

The Recommended Dietary Allowance (RDA) for infants, children, and teens

- Birth to 6 months: 65 mcg DFE
- Ages 7–12 months: 80 mcg DFE
- Ages 1–3: 150 mcg DFE
- Ages 4–8: 200 mcg DFE
- Ages 9–13: 300 mcg DFE
- Ages 14–18: 400 mcg DFE

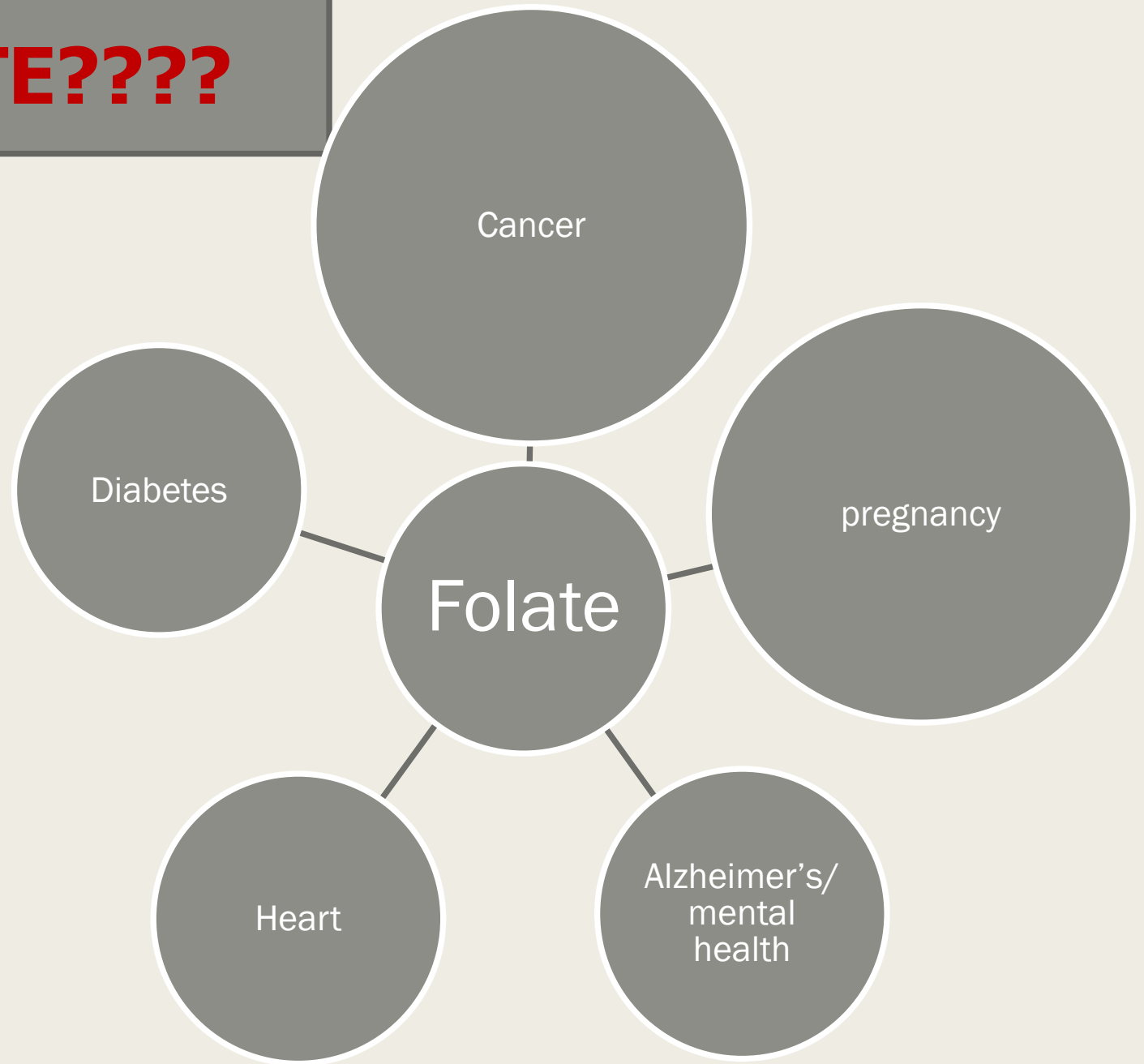
DAILY RECOMMENDATION

400
µg DFE

Adults

600
µg DFE

Pregnant
Women



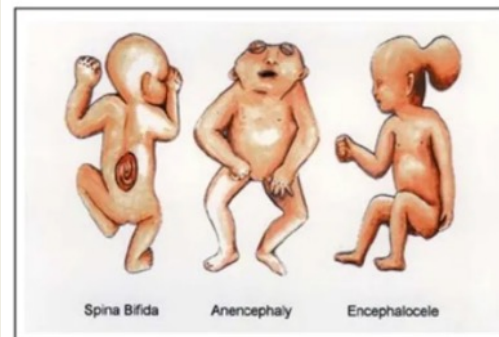
Folate and pregnancy

- The requirement for the B vitamin folic acid doubles during pregnancy, to 800 mcg per day from all sources.
- It is also essential for hematopoiesis and red blood cell production and expansion of the maternal blood volume
- Help prevent birth defects known as neural tube defects, such as spina bifida.

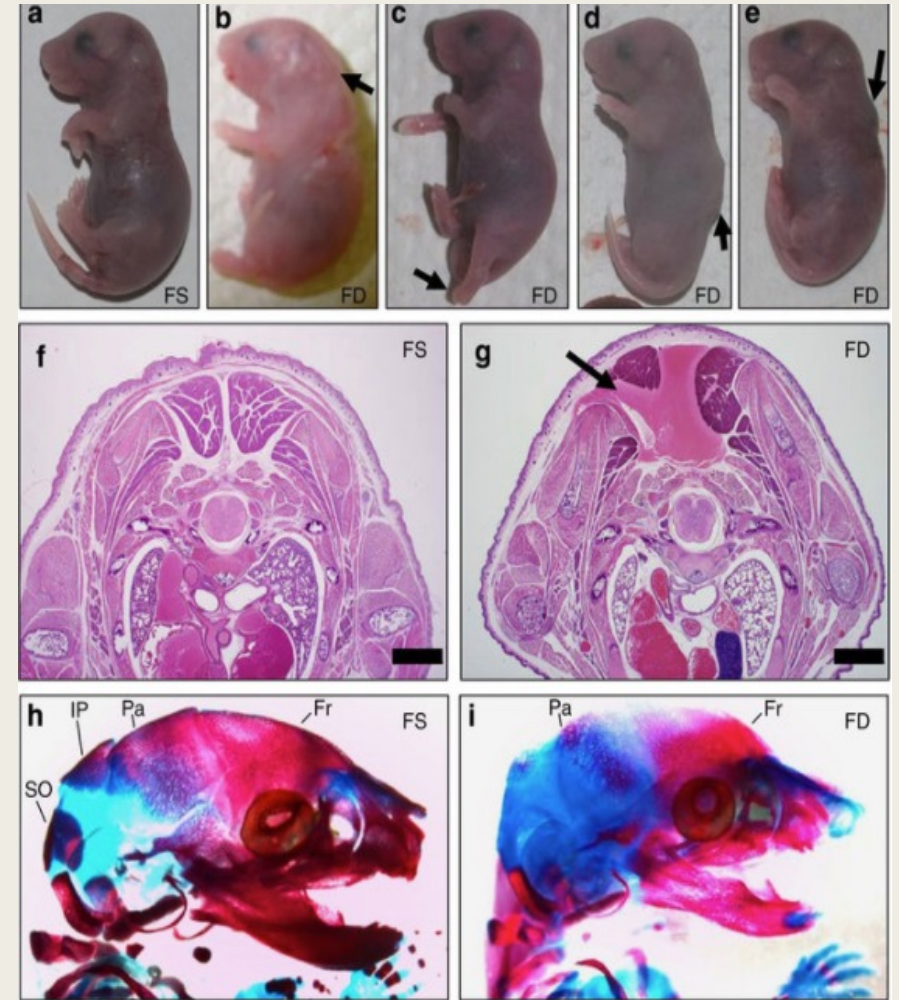
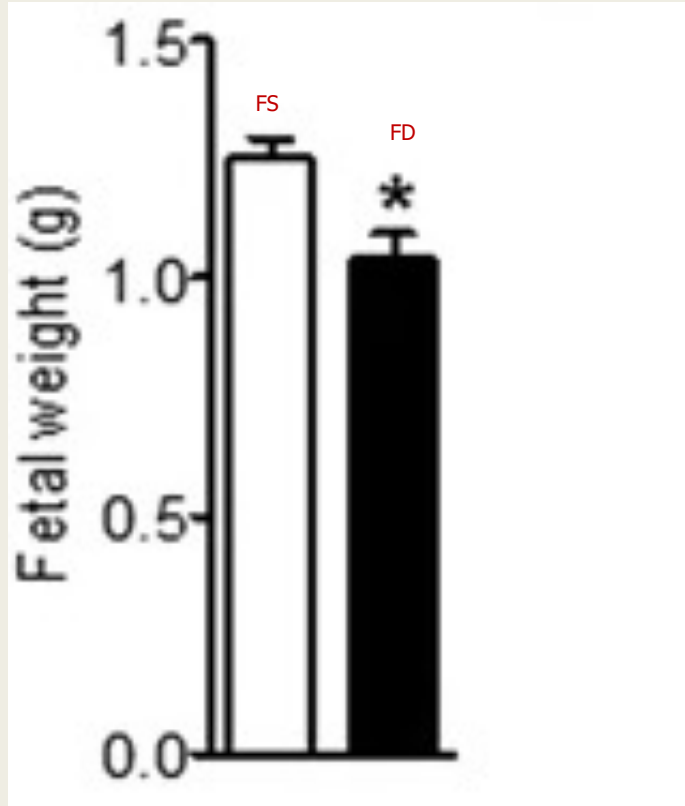
Among women who take periconceptional folate, the incidence of NTDs was 0.9 per 1000 as opposed to the group who did not; the incidence was 3.5 per 1000.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3519088/>

Neural Tube Defects



Preclinical studies

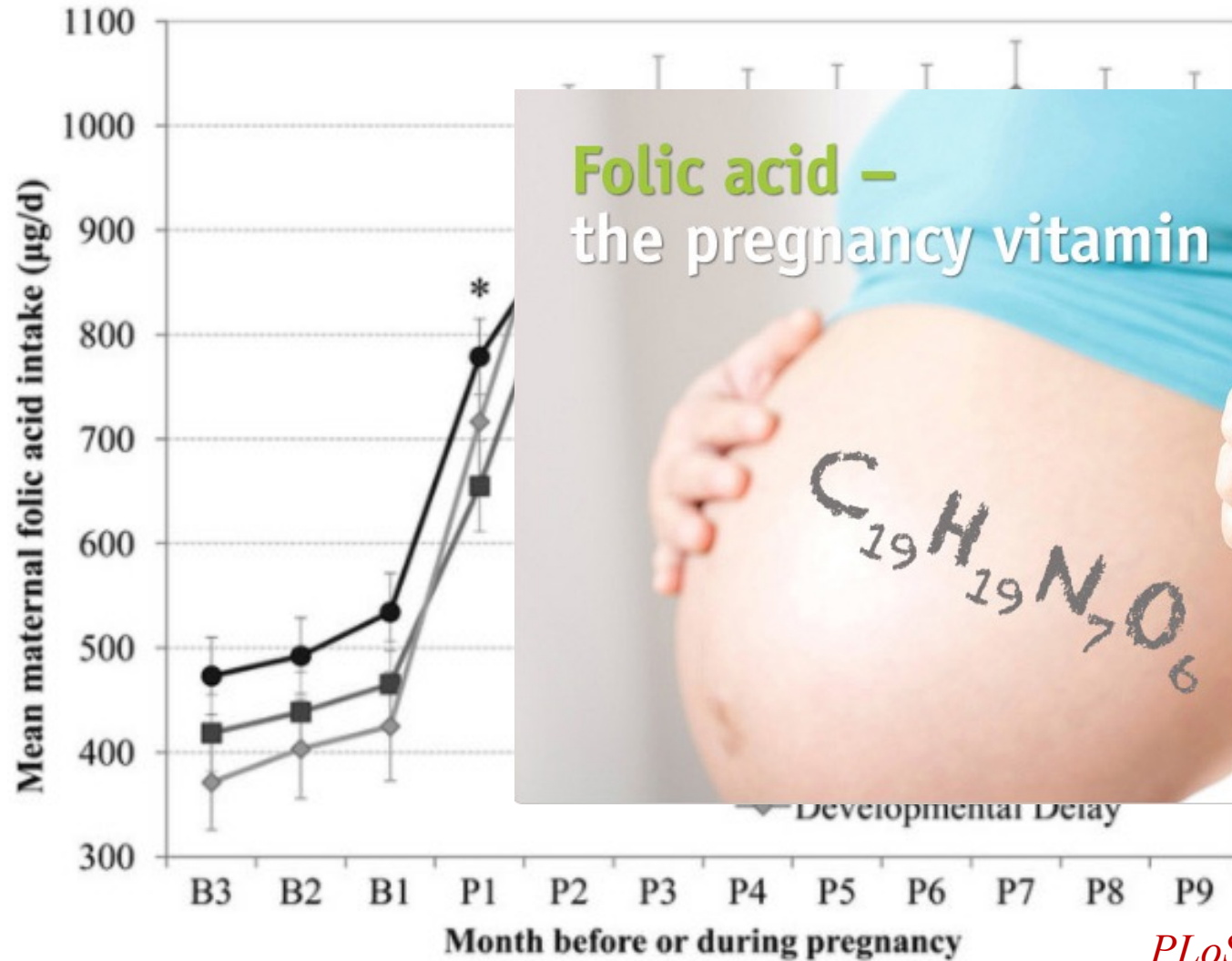


Low paternal dietary folate alters mouse sperm epigenome & is associated with negative pregnancy outcomes

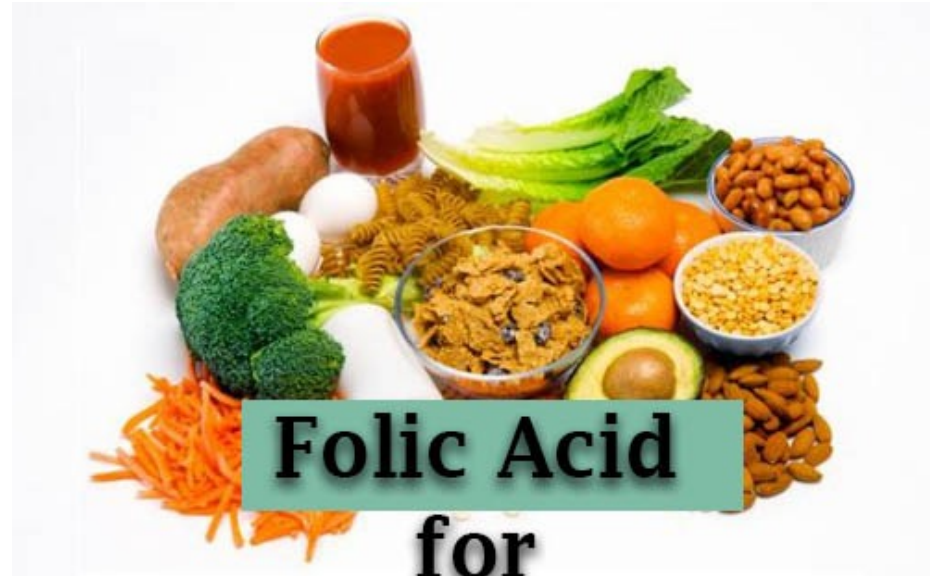
<https://doi.org/10.1038/s41598-017-03888-2>

December 2013 Nature Communications 4(1):2889

Effect of Folic acid ingestion on brain development in fetus



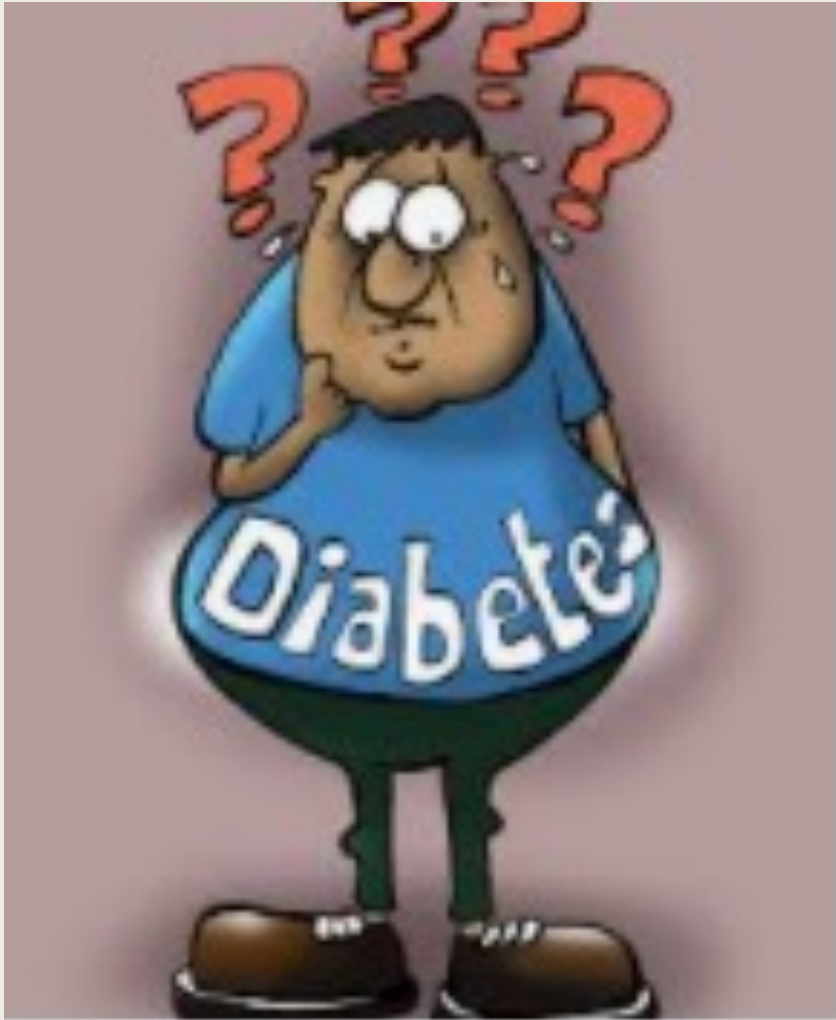
PLoS Med. 2009;6:e1000061



Folic Acid for Diabetes



Folate and diabetes



- Supplementing with folic acid has been associated with the :
Improve blood sugar, reduce insulin resistance, and enhance cardiovascular function in Type 2 diabetes and helps in reducing diabetic complications, including neuropathy.



Folate and mental health

- People with [depression](#) have been shown to have lower blood levels of folate than people without depression
- Folic acid and methyl-folate, are associated with significantly greater reductions in depressive symptoms, compared with antidepressant medication treatment alone



Reduced dietary intake of folate



Serum levels of folate decreases



Homocysteine increases



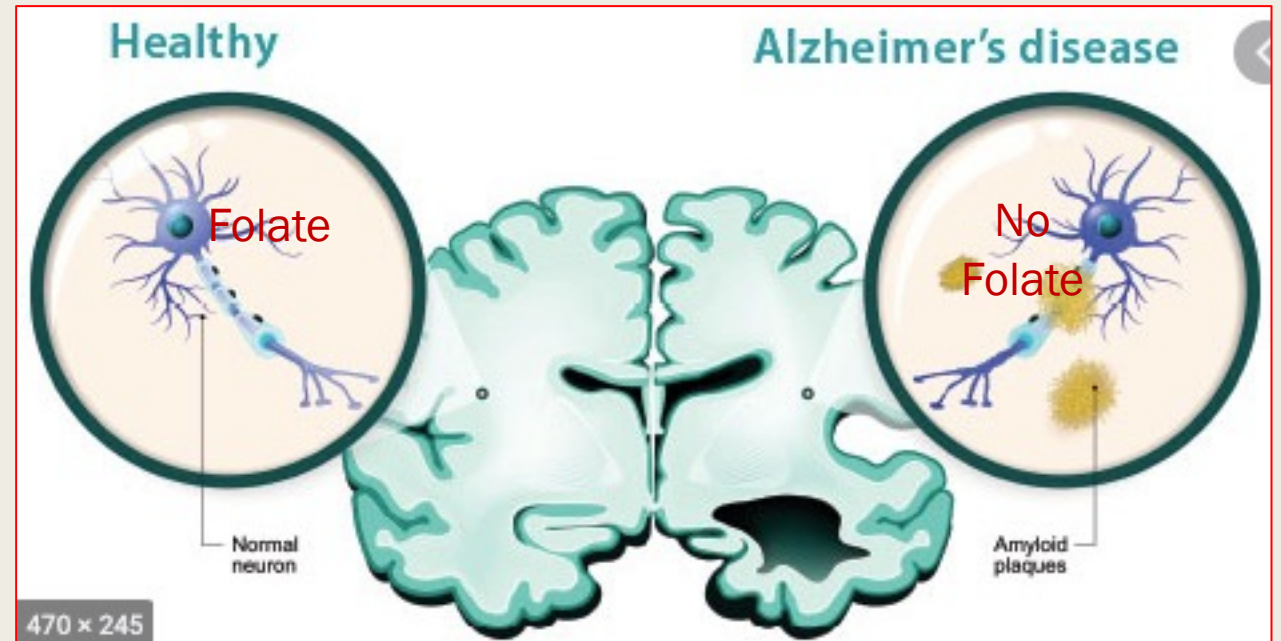
DNA- methylation, DNA damage,
lipid peroxidation increase



Cognitive decline and impairment

Folate and mental health continue....

- Human trials reveal that low folate status increased the risk of cognitive decline and dementia in older adults



lifeextension.com//2018/9/folate-improves-brain-function

Thus, folate metabolism plays a crucial role in the brain

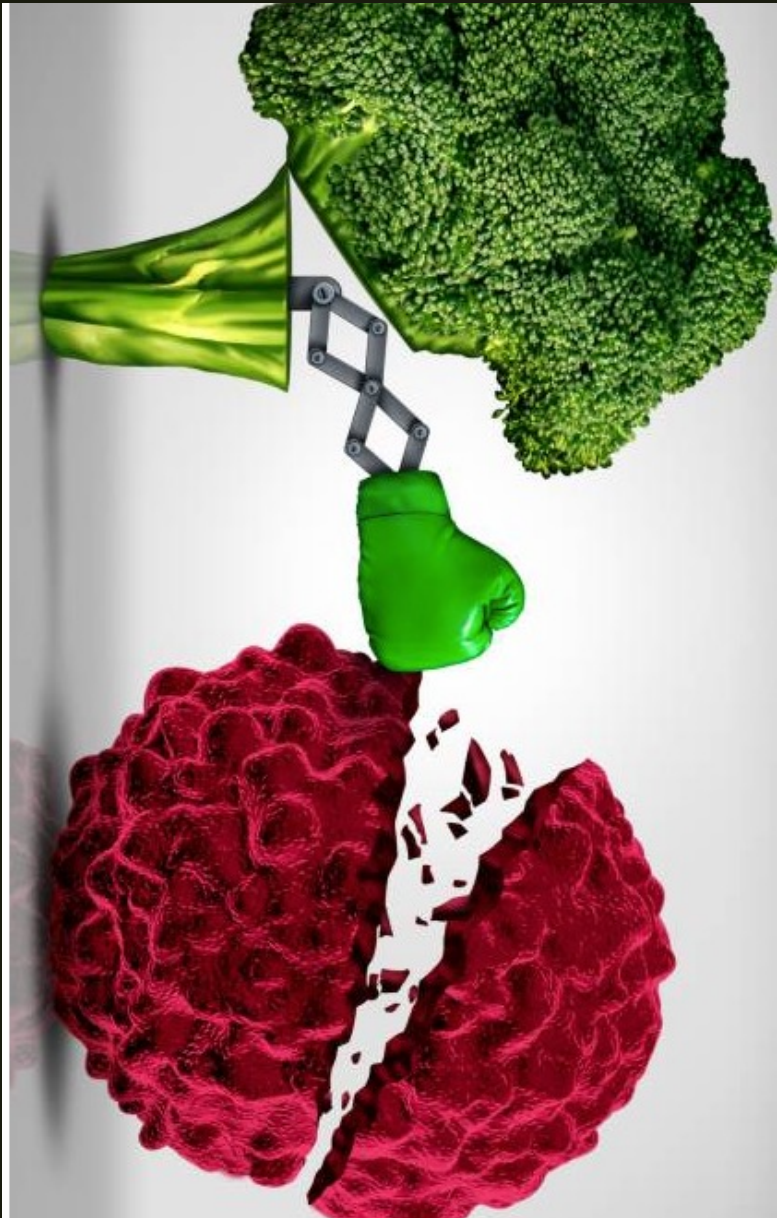
Folate and reduction of heart diseases risk factors



- Having elevated levels of the amino acid homocysteine is associated with an increased risk of developing [heart disease](#).
- Folic acid supplements improve blood flow and improve cardiovascular function

Review including 30 studies and over 80,000 people demonstrated that supplementing with folic acid led to a 4% reduction in overall heart disease risk and a 10% reduction in stroke risk

Folate and Cancer



1. Mechanistic evidence provides support for an inverse association between folate intake and cancer risk.
2. Folate is necessary for *de novo* synthesis of thymine
3. Furthermore, folate deficiency has role in DNA methylation.

FOLATE AND CANCER



Mandatory fortification of wheat flour and enriched cereal grain products aimed at reducing the incidence of neural tube defects has raised questions regarding growth of nascent cancers.

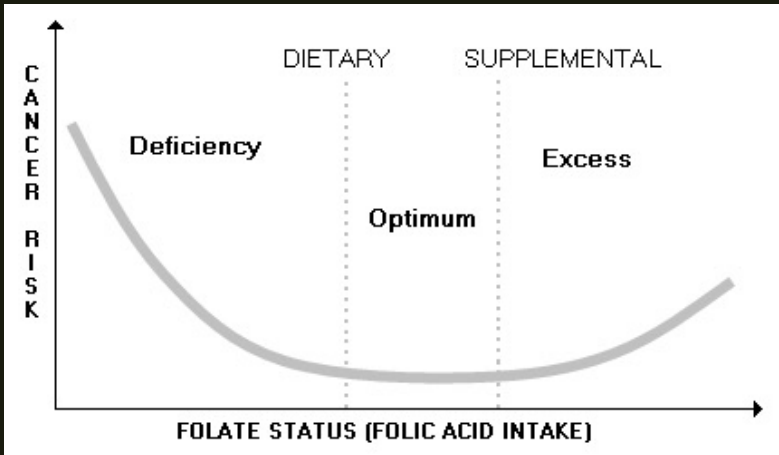
Mandatory fortification has been in effect in the USA since 1998, and at least 87 countries have regulations in different stages of implementation

In the USA, a 140 mcg/100 g product is added to fortified foods and in some countries more is added; for example, Chile adds 220 mcg/100 g product

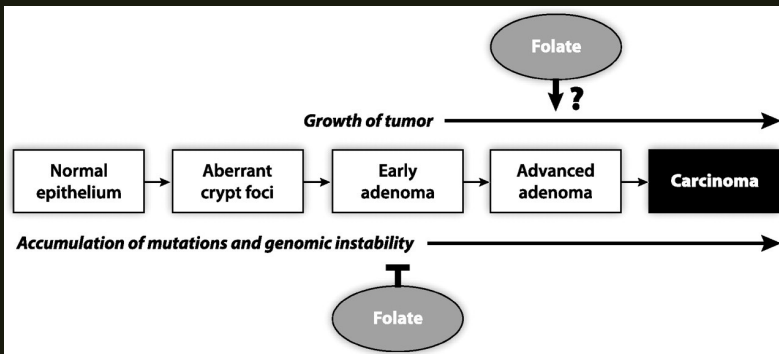
In addition, 35% of US adults may take a supplement containing 400 mcg folic acid, and in some countries, the frequency of people supplementing is even higher.

So, the average total folate intake of 813 mcg/day for men and 724 mcg/day for women has been reported in the USA, with only 15–17% of adults not meeting the daily recommended amount

Daily dose of internet.....



- Unlike the U.S., Norway does not fortify flour and grain food products with folic acid
- Because of this, Norwegians tend to have much lower [blood](#) folate levels than Americans, making the population a good one for studying the impact of folic acid supplementation on [cancer](#) risk
- A 10-y follow-up study of this trial showed that those who received folic acid supplementation had a significantly increased risk of prostate cancer

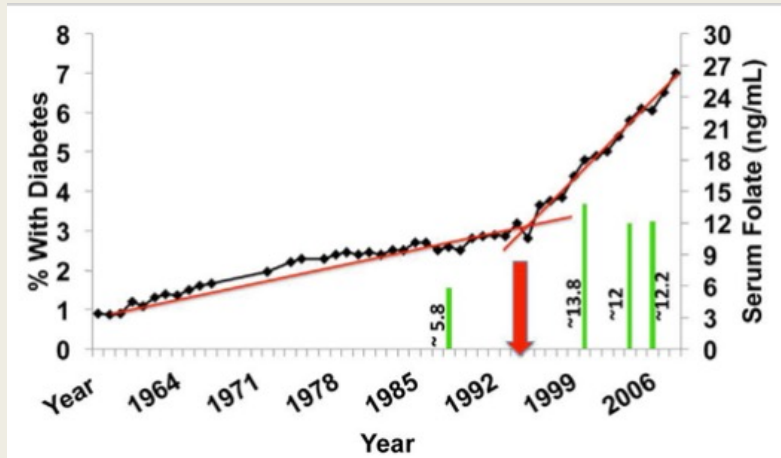


Folate – Friend or Foe

- People experiencing symptoms like weakness, fatigue, difficulty concentrating, and **shortness of breath** may benefit from getting their B12 levels checked. High intakes of folic acid may mask a **vitamin B12 deficiency**.
- Excess folic acid intake may speed age-related mental decline, particularly in people with low vitamin B12 levels.
- One study in healthy people [over the age of 60](#) linked high folate levels to mental decline in those with low vitamin B12 levels — but not in those with normal B12 levels



THE NEW F-WORD AND ITS DIABETES CONNECTION



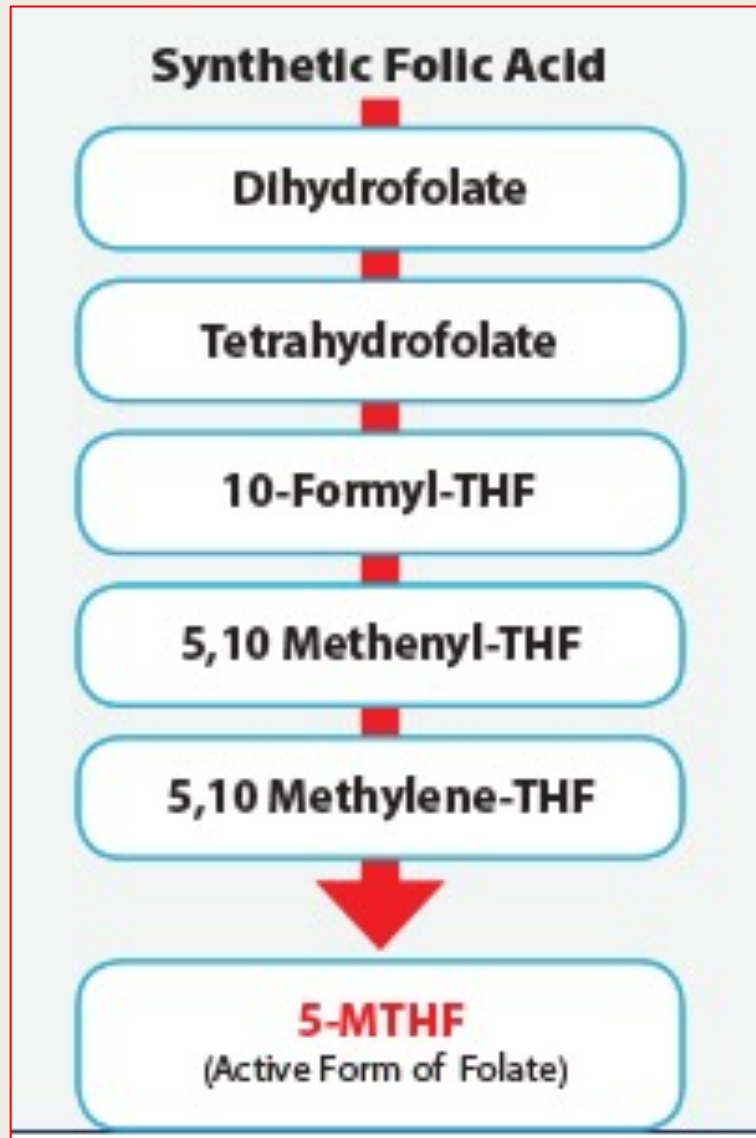
Diabetes Research Institute, 2008-2010

- In populations where folic acid is readily available along with vitamin supplements, additive might not be necessary and may be detrimental to people with genetic predispositions.
- Folic acid may result in adverse health conditions and can cause the onset of autoimmune conditions, like type 1 diabetes (T1D).



These observations call for more research to discover more about how the folic acid we consume as a modern society is affecting us, and what kind of lasting results overconsumption has on our bodies.

More usable form of folic acid- Methyl folate



Science is not
for the faint-
hearted. It can
be messy and all
too often, there
is no definite
answer...until
there is.

- Folate is needed in pregnancy
- Folate along with vitamin B12 is helpful in normal brain development
- Relationship between diabetes and folic acid supplementation is still controversial but some studies emphasize positive correlation
- Folate intervention reduce stroke risk in heart patients
- Folate consumption and cancer development varies depending upon genetic variability and type.



What to do....

- The first step is, as always, talk to your physician.
- You can ask for a blood test to determine the folate status and what if any MTHFR mutation

Overall, folate supplementation benefits and may help prevent several health conditions and diseases.

*The science is still out, but there are number of ongoing clinical trials, and as Trinity told Neo (The Matrix)
"The answer is out there..."*

ACKNOWLEDGEMENTS



PUMPKIN CARVING CONTEST



MENTORS
PRESENT AND PAST LAB MEMBERS
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