Sanford Medical Center
Aunt Cathy‟s Guide:

My Current Top Five Easy Ways to Improve Your Family's Nutrition

(subject to change at any moment!)

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This is a quick summary of some things in the nutrition news that can make a big difference in people‟s health. Although references are not provided in this brief version, all the suggestions are based on reports in the legitimate scientific literature and the references are available on my more thorough papers that are also on the sanfordhealth.org website.

The recommendations are not based on goofy things on the internet. When "researching" a topic on the internet, it is important to consider the reliability of the source. After all, there is no law against fiction in America! People can pretty much print anything. For example, websites that end in **.**edu (colleges and universities) tend to be more reliable than sites designed primarily to sell you something. And of course, none of the following suggestions are intended to take the place of the advice of your health care provider.

1. **Eat lots of brightly colored fruits and vegetables.** There are many beneficial phytochemicals (plant chemicals) that have been found to have a potentially protective role against a variety of common health problems such as cancer, heart disease, diabetes, MS, birth defects, and macular degeneration (a form of blindness.) Some of them act as protective "antioxidants," but they have many other benefits as well.

Some of the beneficial substances are actually the pigments that give the plants their color. Some examples are: lutein in green leafy vegetables, lycopene in tomatoes and watermelon, beta-carotene in peaches and carrots, anthocyanin in blueberries and beets and zeaxanthin in corn. It turns out that white is a color too, in terms of phytochemicals. Apples for example, have quercetin, a flavonol phytochemical with a number of potentially beneficial effects.

An example of other beneficial substances in fruits and vegetables is sulforaphane in broccoli, which decreases risk of colon cancer especially. Compared with meats, and high fat dairy foods, they are much lower in fat and calories. We tend to eat way too little of these terrific foods, and it hurts us. To get the best of all of them, eat a wide variety of fruits and vegetables of many colors, and aim for 9 servings a day (an amount that has been shown to be beneficial in some studies.) Some expert groups suggest even more. My official recommendation is: **"Eat all the brightly colored vegetables and fruits that you can get your hands on!"**

Nine servings seems like a lot to most folks, since many people eat very few. In fact, the french fry is the most commonly eaten vegetable in America. Hmmmm. Not an ideal pattern. Start by adding a couple servings and working up. Throw some chopped green pepper and dried tomatoes on the pizza. Keep those ready-to-eat baby carrots on hand. Make it EASY for us to grab the healthier snack as we run out the door.

Canned, frozen or fresh fruits and vegetables all count because the brightly colored antioxidants are not destroyed by heat! If you use canned veggies, watch out for the salt they often can them with. Choose low sodium versions, or at least rinse them off. This is not an issue with fruits, or with frozen veggies except if they are packed in some kind of sauce. Remember that color is a big deal, so choosing only iceberg lettuce won"t provide the dark green lutein found more generously in romaine or spinach. Color variety is key.

Check out "Aunt Cathy"s Ideas for Trying to Eat More of Those Terrific Antioxidant Phytochemicals . . . and Liking It" for ideas for adding them to our diet. This and many other nutrition topics are available at sanfordhealth.org, including any mentioned throughout this paper as having more information on a topic.

The dark leafy veggies are also terrific sources of vitamin K, a nutrient just now being recognized as critical to decrease risk of osteoporosis, diabetes, cardiovascular disease, kidney calcification, arthritis and liver and colon cancer.

It is also a nutrient found to be low in the diets of many Americans, and it has only recently been recognized that we are much more dependent on an oral intake of vitamin K than we thought. It used to be thought that intestinal bacteria provided significant vitamin K, but apparently that is a much less reliable source than we thought … and even less helpful for anyone taking chronic antibiotics.

It appears that the elderly need more than the current RDA of 90-120 mcg/day to maintain an adequate level in their blood. Other age groups have not yet been evaluated in this way, but for several reasons it is very likely NOT just the older folks for whom the recommended intake levels are not optimal. This information is so new that vitamin K is not even included in many multivitamins currently on the market, and many health professionals will not yet have heard about these new issues. If you are interested in learning more, I have put a „Vitamin K" handout on line at sanfordhealth.org that includes all the scientific references and detail on this topic.

Historically many people thought that vitamin K was potentially quite toxic because of being a fat-soluble vitamin. However, it is now well documented that vitamin K is a very safe substance and the fact that it will dissolve in fat has nothing to do with toxicity. In fact, no "Upper End of Safety" has ever been identified for vitamin K because no one ever overdosed on it. So go ahead and eat all the broccoli, spinach, kale, asparagus and romaine lettuce you can. **The only cautionary note is for people using a particular medication described in the box below. If you are NOT taking this medication, vitamin K is very safe and it is critical to assure an adequate intake.**

If you <u>are</u> taking medications to prevent blood clots, be sure to show this information to your doctor before adding a lot of vegetables to your diet. New research on the relationship between vitamin K and these drugs will result in changes in how we do things. But because the information in support of these changes is very new, it will also be new to many healthcare providers, so I also have a special „Vitamin K" handout that includes all the scientific references and detail for people using Coumadin/warfarin anticoagulant drugs that your doctor will want to see before making any changes in diet or medication.

Besides the benefits of avoiding complications from use of this drug that can develop due to vitamin K deficiency (like osteoporosis), **daily supplementation with RDA-ish levels of vitamin K also seems to make these drugs safer to use by minimizing extreme volatility in blood coagulation**. Other anticoagulant drugs do not work by interfering with vitamin K so it is <u>only</u> an issue with the specific drug Coumadin/warfarin. Your doctor can also contact me for the most recent reports on this topic.

2. When you eat grains, try to use whole grain whenever possible.

The "germ" (the part that becomes the baby plant) and the bran (the fibrous coating) of grains are removed in processing when grains are "refined." These are the parts that would have contributed the most magnesium, chromium, vitamin E, fiber and many other nutrients. Magnesium and chromium have important roles in using the rest of the grain (the starchy part) for energy and for avoiding diabetes.

Large national studies (such as NHANES by the National Center for Disease Control in Atlanta) have shown that the majority of Americans have a diet too low in these minerals. This inadequacy contributes to weight problems, diabetes, heart disease and some neurologic problems that are too common in our society.

"Enriched" grain products have only a few nutrients replaced (vitamins B1, B2, B3, and iron) out of all the nutrients that are removed when refining grain. This label can be confusing because the word "enriched" <u>sounds like</u> something was made to be even better. Instead, it means "not as nutritious as whole grain."

I always tell people to read the word "enriched" as "**<u>UN</u>-riched**," because it is not nearly as nutritious because whole grain includes the "germ." The germ is the part of the grain that will turn into the "**baby plant**," so that's where a whole lot of vitamins and minerals and essential oils are found. Most of the rest of the grain is just fuel for the baby plant to use until it can poke its nose out of the soil and do photosynthesis.

So eating just the fuel part without all the tools you need to use it efficiently (like magnesium and chromium in the germ) can contribute to our current problems with weight gain and diabetes. If you don't like whole grain bread and pasta, you can still add back the

nutrients and fiber they contain by adding wheat germ and bran to other foods. Check out "Aunt Cathy"s Industrial Strength „Instant" Oatmeal Recipe" for some ideas. And the next section talks about some other important foods to explore that have many of the same terrific nutrients found in the germ of whole grains.

3. Nuts, seeds, peanuts and dried beans/peas are terrific nutrient-rich foods because like the germ of grains, they are essentially the germ of new plants.

For example, in one study from Harvard, eating an ounce of nuts or peanuts four times a week or more was shown to be related to 25% less likelihood of developing diabetes. This appears to be associated with the generous magnesium in these foods. They also have more "satiety value" – you feel like you actually ATE something" -- and they are terrific nutritious snacks including for people who are watching their weight or who have diabetes.

Although all fats have about 9 calories per gram, the forms of fat in nuts and peanuts (mostly "monounsaturated" and "omega-3" fats) are less contributory to heart disease than many other forms of fat. Also they are rich in nutrient content so they are not an "empty calorie" food. So, although they do have calories, I think of these forms of fat as potentially "Dangerous to your butt, but not to your heart!" Additionally, dried beans and peas are also very low in fat and high in fiber. It looks like that means chili beans, lima beans, split peas, chick peas, navy beans, lentils, pinto beans, etc., are "health foods!"

These foods, and assuring adequacy of magnesium (and chromium, another key mineral in the same foods) in general, are especially beneficial for people who appear to be genetically (or for whatever reason) at greater risk of developing diabetes. This includes people who have family members with diabetes, people who are overweight, and some ethnic groups who appear to be disproportionately at risk.

For example, serious health problems related to diabetes have been found to be causing much more injury to Native Americans and African Americans than to some other groups of folks. **There are many contributing factors, of course, but assuring adequacy of magnesium and chromium (another key mineral in the same foods) is one factor that can be easily corrected if people just hear about it.** Adequate chromium intake is also associated with some other heart disease risk factors like helping prevent having high triglycerides (a particular form of fat) in the blood. [Vitamin D is another, as discussed later.]

4. Another important form of fat to include in our diet is called "omega-3" fat.

A lot of research shows that it is associated with a decreased risk of cancer, heart disease, inflammatory disease, depression, pregnancy problems, and much more. We Americans tend to eat too much of another family of fat called omega-6 fat, such as that found in corn oil. To improve the balance in the American diet, **flax, canola and walnuts** are great plant sources of omega-3 fat.

Additionally, there is a huge amount of research showing that the special forms of omega-3 fats found in **fish and fish-oil and krill supplements (EPA and DHA)** have certain very important advantages for many people. EPA decreases inflammation in a wide range of inflammatory diseases like MS, cardiovascular disease and arthritis. I think of **EPA** (whose real name is **e**icosa**p**entaenoic **a**cid) should be thought of as "**E**nvironmental **P**rotection **A**gency" instead, because it seems to be very protective against a number of health problems.

DHA in particular appears to be very important for the development of the brain and the retina of the eye, so it is critical during pregnancy and infancy. It has also been shown to be helpful in the continued good operation of the brain (e.g. in possibly helping to ward off age-related problems like alzheimers and other forms of dementia,) and for decreased risk of, or progression of, depression, blindness due to macular degeneration, attention deficit disorder and Parkinson"s disease.

More research is ALWAYS needed, of course, but the cumulative results of a great many studies have been in the same direction. Assuring an adequate intake of these fats looks like a VERY good idea. **Additionally, it is now recognized that for some people it is difficult to efficiently convert the plant omega-3 oils (like those in canola, flax and walnuts) into the important EPA and DHA oils that are found ready-made in the fish or krill oil.** This appears to be a factor in a broad range of inflammatory conditions and critical in pregnancy.

The American Heart Association recommends 1000 mg of fish oil for most people with risk of heart disease. People at risk include those who smoke, who have disturbed blood lipids (too much LDL cholesterol or triglycerides, or too little HDL cholesterol,) who are overweight or sedentary (not physically active,) or who have high blood pressure, diabetes, or a family history of heart disease. Other factors contribute to heart disease risk as well. Additionally, some people who have "high triglycerides" specifically may benefit from 2000-4000 mg/day.

[Omega-3 fatty acids and coronary heart disease risk: Clinical and mechanistic perspectives. Atherosclerosis. 2007 Dec 24 n-3 Fatty Acids: Recommendations for Therapeutics and Prevention. Proceedings of a symposium, New York, New York, USA, May 21, 2005. Am J Clin Nutr. 2006 Jun;83(6 Suppl):1451S-1538S.]

Saturated fats have long been on our list of "foods to eat less of." They include lard/ meat fat / dairy fat, and "hydrogenated" (solidified) or "partially hydrogenated oils" (shortening / margarine. None is a good source of omega-3 fat. Eating less of them and choosing foods that are more generous in their omega-3 fat content is a very good idea.

Some shortenings and margarines accidentally contain **"trans" fat**, another "good-to avoid" form of fat that must be shown on the nutrition labels of foods if there is more than ½ gram per serving. It is usually in food because the oil was "partially hydrogenated" to make it solid at room temperature like margarine or shortening. It is gradually being removed from our food supply because it is quite unhealthy. The biggest source at present is in baked goods made with shortening. Some margarines and shortenings are now made that have no trans fat in them, and they usually note this on the label because it is such a good thing.

5. Increase your regular intake of vitamin D to assure an intake that averages at least 2000 iu per day (for some folks more than 2000) and take a multivitamin with minerals daily <u>in addition to</u> "eating right."

This is a markedly different recommendation because new research shows that older recommendations of 200-400 – 600 iu of vitamin D were simply **<u>too low to assure adequacy</u>**. Some researchers have found that even 2000 iu may be too little for some people in terms of optimizing health and minimizing disease risks, especially among people with dark skin or who live up north. **In the northern third of the country vitamin D deficiency is now being described as "an unrecognized epidemic."**

It is now known that <u>inadequate vitamin D status is very common</u>, and that it is associated with increased risk of diabetes, lupus, scleroderma, fibromyalgia, multiple sclerosis, cancer of the breast, colon, prostate, endometrium and pancreas, congestive heart failure coronary artery disease, muscle pain, osteoporosis, rheumatoid arthritis, osteoarthritis, obesity, muscle weakness and falls, and possibly preserving cognitive function in older adults.

Other associations of inadequate vitamin D are now beginning to be explored such as increased risk of parkinsons disease, autism, asthma, impairment of the immune system, pre-eclampsia and cancer of the lung. This is not surprising because it has now been recognized that vitamin D actually functions as a key steroid hormone -- one that your body would make as needed … if you just give it enough of the material to do the job.

Over 200 different body tissues have been identified so far that have receptors for the vitamin D hormone, and they need it in order to work properly. "Vitamin D is a unique vitamin. Its metabolic product, calcitriol, is a profound secosteroid hormone that has **impact on over 1000 genes** in the human body."

Modern concepts in the diagnosis and treatment of vitamin D deficiency and its clinical consequences.

J Environ Pathol Toxicol Oncol. 2009;28(1):1-4.

[Vitamin D and aging. J Steroid Biochem Mol Biol. 2009 Mar;114(1-2):78-84. Vitamin D and type 2 diabetes Is there a link? Prim Care Diabetes. 2009 Apr 21. Behavioural and physical characteristics associated with vitamin D status in women. Bone. 2009 Jun;44(6):1085-91 Hypovitaminosis D is Associated with Greater Body Mass Index and Disease Activity in Pediatric Systemic Lupus Erythematosus. J Pediatr. 2009 May 14. Association between 25-hydroxyvitamin D levels and cognitive performance in middle-aged and older European men. J Neurol Neurosurg Psychiatry. 2009 Jul;80(7):722-9. Sex-specific association of serum vitamin D levels with physical function in older adults.Osteoporos Int. 2009 May;20(5):751-60. Vitamin D status and muscle function in post-menarchal adolescent girls. J Clin Endocrinol Metab. 2009 Feb;94(2):559-63. 25. Vitamin D Supplementation and Reduced Risk of Preeclampsia in Nulliparous Women. Epidemiology. 2009 May 15. Association of 25-Hydroxyvitamin D With Blood Pressure in Predominantly 25-

Hydroxyvitamin D Deficient Hispanic and African Americans. Am J Hypertens. 2009 May 14. Effect of vitamin D supplementation in the institutionalized elderly. J Bone Miner Metab. 2009 May 15. Association between serum 25-hydroxyvitamin D level and upper respiratory tract infection in the Third National Health and Nutrition Examination Survey. Arch Intern Med. 2009 Feb 23;169(4):384 90. Nutrition and health: guidelines for dental practitioners.Oral Dis. 2009 May 15. Hypovitaminosis D in obese children and adolescents: relationship with adiposity, insulin sensitivity, ethnicity, and season. Metabolism. 2008 Feb;57(2):183-91. 25-Hydroxyvitamin D and Risk of Myocardial Infarction in Men A Prospective Study *Arch Intern Med.* 2008;168(11):1174-1180. Diagnosis and treatment of vitamin D deficiency. Expert Opin Pharmacother. 2008 Jan;9(1):107-118. Vitamin D in Health and Disease. Clin J Am Soc Nephrol. 2008 Jun 4. Monthly ambient sunlight, infections and relapse rates in multiple sclerosis. Neuroepidemiology. 2008;31(4):271-9]

Another emerging area of research mentioned above is the role of vitamin D inadequacy as a factor in heart disease. Cardiovascular disease is the most common cause of death in the US, so this is a very important issue. In a "meta-analysis" (looking at data of many studies at once) published recently the risk for mortality (death) from all causes was found to be significantly less among people taking an ordinary dose of a vitamin D supplement compared with those who did not. Another prospective study concluded that a **low vitamin D level in the blood was associated with a higher risk of death from all causes, and specifically with heart attack as well**.

[Circulating calcitriol concentrations and total mortality. Clin Chem. 2009 Jun;55(6):1163-70. Vitamin D and cardiovascular disease. Pharmacotherapy. 2009 Jun;29(6):691-708.Serum vitamin D, parathyroid hormone levels, and carotid atherosclerosis. Atherosclerosis. 2009 Jun 6. Prospective Study of Serum 25-Hydroxyvitamin D Level, Cardiovascular Disease Mortality, and All-Cause Mortality in Older U.S. Adults. J Am Geriatr Soc. 2009 Jun 22 Increased Levels of 25 Hydroxyvitamin D and 1,25-Dihydroxyvitamin D After Rosuvastatin Treatment: A Novel Pleiotropic Effect of Statins? [Crestor] Cardiovasc Drugs Ther. 2009 Jun 20. Independent association of low serum 25-hydroxyvitamin D and 1,25-dihydroxyvitamin D levels with all-cause and cardiovascular mortality. Arch Intern Med. 2008:168(12):1340-1349. Vitamin D and cardiovascular disease risk. Curr Opin Clin Nutr Metab Care. 2008 Jan;11(1):7-12. Macro-and micronutrients in patients with congestive heart failure, particularly African-Americans. Vasc Health Risk Manag. 2007;3(5):743-7. Vitamin D supplementation & total mortality: a meta-analysis of randomized controlled trials. Arch Intern Med. 2007 10;167:1730-7]

Can we make adequate vitamin D in our skin?

Vitamin D is made by sunlight on our skin. That's why it is called the "Sunshine Vitamin." But it is now apparent that many different factors can interfere with this process so that many people actually make too little vitamin D to meet their needs:

Who are the people at risk of being unable to make enough vitamin D to meet their needs?

1. People who live in the northern half of the US are unable to make vitamin D for some or many months out of the year. This is the area north of 37^{o} N latitude [or 37^{o} S latitude in the Southern Hemisphere.] The number of months in which the rays of the sun are not strong enough to produce vitamin D in the skin ranges from about 2 months at the 40^{th} parallel (around Denver) to 4 month at the 42^{nd} parallel (around Chicago.)

   When you live way up north where I do, there are MANY months that the sun's rays are too weak. If you do the math, you will see that we lose about 1 month for each degree of latitude above the 37^{th} parallel. The upper border of much of the

US is the 49th parallel, so it is not surprising that the northern third of the country was called the "rickets belt" because that vitamin D deficiency disease was so very common up here. The map is shown at the end of this paper.

2. People who do live where the angle of the sun is more directly overhead (i.e. not up north in the USA) may still fail to produce adequate vitamin D in their skin because their skin is darkly pigmented or because of the effects of aging. For example, really dark skin produces less vitamin D than light skin for the same sun exposure. Similarly, older people (including me) produce less vitamin D in their skin that a younger person would produce.

3. People who are severely overweight appear to have higher vitamin D requirements.

4. People who take any kind of anti-seizure medications (epilepsy drugs) need more vitamin D because the drugs cause the vitamin D to turn over more rapidly.

5. People with conditions that interfere with absorption at the intestinal level will also fail to absorb vitamin D from foods or supplements, so they are much more dependent on the vitamin D produced in the skin than other people. This can include people with inflammatory bowel disease (like Crohn"s Disease,) Cystic Fibrosis, and unrecognized Celiac Disease.

6. People who are covered up with clothes or sunscreen most of the time also make much less vitamin D regardless of where they live. Similarly, staying in the air-conditioned indoors will diminish the amount of actual sun exposure, and many of us do not choose to be out in hot weather if we can avoid it. For example, people with MS often do not tolerate hot weather. People who work nights also need to think about this.

   Light that comes through windows does not do the job. This is now being demonstrated to be a big public health issue all over the world even in hot and sunny climates. Even at the equator there are many reports of people being found to have serious vitamin D deficiency simply because they are covered up much of the time. Some are covered up for religious reasons, some to prevent skin cancer (melanoma) and some of us are just covered up as a public service! ☺

We all need to be sure to get adequate vitamin D some other way.

It is estimated that about 50% of the earth's population is

at risk of vitamin D deficiency.

Vitamin D deficiency is being recognized more and more in southern places where the assumption has been that there is no risk in all that sunshine … but a whole bunch of us just don‟t go out in the sun much. One reason we are seeing more and more evidence of the epidemic nature of vitamin D deficiency is because many more doctors are checking their patients‟ blood levels. **In fact, a vitamin D blood measurement (called a "25hydroxycholecalciferol level") is now the most frequently lab test ordered by physicians in the US. .**

> [Sunlight, UV-radiation, vitamin D and skin cancer: how much sunlight do we need? Adv Exp Med Biol. 2008;624:1-15. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S.]

Did you know that the men at greatest risk of prostate cancer are older African-American men living in the north? African-American women living in the north also have a higher incidence of breast cancer, which appears to also be associated with low vitamin D status. Many researchers believe that we can lower the risk by correcting the inadequacy of vitamin D that is so common among people up north and among people of color.

For example, recently blood tests evaluating the ACTUAL vitamin D status of **African-American mothers and their newborns in Pittsburgh found that over half in each group was vitamin D deficient, even if prenatal vitamins were regularly used.** This has many very serious implications, but it could be remedied by more generous supplementation of this key vitamin. Attention to this is long overdue. **About a third of white mothers and babies in the same northern study were also found to be deficient.**

In another new report it was found that a daily intake of 2000 iu of vitamin D assured that dark-skinned northern women maintained a desirable blood level of greater than 50 ng/ml. Another study found that 2000 iu daily could raise the storage form of vitamin D in blood to 52 ng/ml, a level associated with reduction by 50% in incidence of breast cancer in observational studies. Ironically, 2000 iu daily had long been set as the presumed upper level of safety for vitamin D intake. **Many experts have expressed the opinion that the upper level of safety should be changed to a chronic intake of over 10,000 iu daily.**

What serum (blood) levels of vitamin D are associated with good health?

A recent report found evidence suggesting that higher vitamin D intakes beyond current recommendations may be associated with better health outcomes. They looked at a number of studies related to bone mineral density (BMD), lower extremity function, dental health, risk of falls, admission to nursing homes, fractures, cancer prevention and hypertension (high blood pressure.)

Their conclusion: "For all endpoints**, the most advantageous serum levels for 25(OH)D appeared to be at least 75 nmol/l (30 ng/ml) and for cancer prevention, desirable 25(OH)D levels are between 90-120 nmol/l (36-48 ng/ml). An intake of no**

less than 1000 IU (25 mcg) of vitamin D3 (cholecalciferol) per day for all adults may bring at least 50% of the population up to 75 nmol/l. Thus, higher doses of vitamin D are needed to bring most individuals into the desired range. While estimates suggest that 2000 IU vitamin D3 per day may successfully and safely achieve this goal, the implications of 2000 IU or higher doses for the total adult population need to be addressed in future studies."

[Optimal serum 25-hydroxyvitamin D levels for multiple health outcomes. Adv Exp Med Biol. 2008;624:55-71.]

[Diagnosis and treatment of vitamin D deficiency. Expert Opin Pharmacother. 2008 Jan;9(1):107-118. Prevalence of vitamin D deficiency among healthy infants and toddlers. Arch Pediatr Adolesc Med. 2008:162(6):505-512 Hypovitaminosis D among healthy children in the United States. .Arch Pediatr Adolesc Med. 2008:162(6):513-519. Neonatal vitamin D status at birth at latitude 32 degrees 72': evidence of deficiency. J Perinatol. 2007 Sep;27(9):568-71. Dose response to vitamin D supplementation among postmenopausal African American women. Am J Clin Nutr. 2007 Dec;86(6):1657-62. The urgent need to recommend an intake of vitamin D that is effective. Am J Clin Nutr. 2007 Mar;85(3):649-50. Vitamin D and prevention of breast cancer: pooled analysis. J Steroid Biochem Mol Biol. 2007;103(3-5):708-11]

Clearly a lot more research is needed … it is ALWAYS needed …but these new reports are a great illustration of the emerging broad importance of this issue. **The 2000 iu level is safe in general and above the 2000 iu level is safe (and may be necessary) in some cases . . . what is clearly NOT safe is allowing a person to have a low vitamin D level.**

[Vitamin D Status: Measurement, Interpretation, and Clinical Application. Ann Epidemiol. 2008 Mar 8. Sunlight, UV-radiation, vitamin D and skin cancer: how much sunlight do we need? Adv Exp Med Biol. 2008;624:1-15. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S.]

Taking in this amount of vitamin D will require using a supplement. The primary supplemented food in our diet is fortified milk with 100 iu/cup, but 20 cups of milk is not reasonable, and it is also not good nutrition. One would have no room left for other foods.

Start with a regular multivitamin with minerals. That usually provides 400 iu. If you drink a lot of milk, that combination may be adequate. Otherwise, you can easily add a tiny, easy-to-swallow inexpensive 400 –2000 iu vitamin D capsule, or a calcium supplement with a similar amount of vitamin D. There are even tiny 1000 iu "gummi"-type and liquid type vitamin D products available.

Vitamin D can be stored well in the body and it is generally very well absorbed into the bloodstream from the intestines, so some people prefer taking more at once but less often … for example, taking a week's worth of extra vitamin D all on one day each week. **Vitamin D is generally "best" absorbed if taken with the largest daily meal, but the differences are usually not very important, especially if the total amount is generous and not skimpy**.

There are many ways to obtain an adequate amount even if it is not done in the most ideal manner. For example, I have some memory problems and I simply would not remember to take things throughout the day for "optimal absorption." so I just take everything all at once and just let „em fight it out in there. It doesn't have to be perfect … or expensive.

There are few foods naturally high in vitamin D – really just salmon, tuna, liver and cod-liver oil – which are problem foods for many people. We will begin to see more foods being supplemented now that the public is becoming aware of the problem. Some yogurt and cheese now have a little vitamin D added, and the calcium-fortified orange juices are now supplemented as well. However, the amount is still in the low level range used to fortify milk. Other foods will likely be fortified in the coming years. Note also that milk "straight from the cow or goat" does not contain any vitamin D, so some of our farm families get none and are quite unaware of it.

However, if you are in an at-risk group (that is, dark skin, living up north, covered up, using sunscreen, old, or not drinking 20 cups of milk a day --- in other words, pretty much everybody.) assuring vitamin D adequacy will likely require taking an additional vitamin D supplement even if you do drink a lot of milk and take a multivitamin.

Vitamin D Inadequacy in Pregnancy and Breastfeeding Alert

Interestingly, mother"s milk is an amazingly nutritious food and breastfeeding is certainly encouraged. However, at this time in history the milk does not contain much vitamin D. This is probably because when people were invented nobody lived in Fargo. Babies would have crawled around by the equator and made their own vitamin D in their skin. But up here in the North, we have had to make a number of adjustments to survive … many of us have bought a a furnace, a coat, really good mittens and we also need vitamin D. It is that simple.

Because of the finding of serious vitamin D deficiency in many breast-fed babies, in 2003 the American Academy of Pediatrics recommended that breastfed babies be given "at least 200 iu of vitamin D by two months of age." **In 2008 that recommendation was changed to 400 iu/day for <u>all infants</u> and they recommended starting it right away because <u>many babies were actually born with inadequate stores of vitamin D because their mothers were deficient during pregnancy</u> (in spite of taking prenatal vitamins.)**

This change brings US recommendations in line with those of their Canadian colleagues who have recommended 400 iu for babies, and at least 800 iu for everyone else up there for several years now. Here are some details of the kind of research that led to this change in recommendation:

A recent study in Boston of 380 healthy infants and toddlers who were seen for a routine health visit found that the prevalence of vitamin D deficiency ($\leq$20 ng/mL) was 12% (44 of 365 children), and 146 children **(40%) had levels below an accepted optimal threshold** (<30 ng/mL.*)

[Prevalence of Vitamin D Deficiency Among Healthy Infants and Toddlers *Arch Pediatr Adolesc Med.* 2008;162(6):505-512. Neonatal vitamin D status at birth at latitude 32 degrees 72': evidence of deficiency. J Perinatol. 2007 Sep;27(9):568-71.]

The same Boston authors studied the therapeutic amounts of vitamin D supplementation needed to correct the low vitamin D status of the children. They concluded that these two approaches were effective for bringing low vitamin D levels into the range of ≥30 ng/mL* within a 6 week treatment period: **Daily 2000 IU vitamin D2 or D3 or Weekly 50,000 IU vitamin D2**

[Treatment of Hypovitaminosis D in Infants and Toddlers. J Clin Endocrinol Metab. 2008 Apr 15.]

*However, note that a report described earlier suggested that the healthiest ranges of serum vitamin D may in fact be above this "optimal threshold" of ≥30 ng/mL, and that it might be in the range of 36-48 ng/mL. [Optimal serum 25- hydroxyvitamin D levels for multiple health outcomes. Adv Exp Med Biol. 2008;624:55-71.]

Take that multivitamin/ minerals for other important reasons as well.

Besides the welcome 400 iu of vitamin D, multivitamins provide **folic acid and vitamin B12 in forms that are easier to absorb and use** by people taking certain common medications, those who have certain genetic traits, and people who experience some age-related changes in the stomach.

For example, some people take "proton pump inhibitor" medications (strong blockers of stomach acid production for heartburn or "gastro-esophageal reflux.") They can be unable to obtain vitamin B12 from normal food sources because the process requires the presence of acid in the stomach. However, they CAN absorb the vitamin B12 in the vitamin pill form. Similarly, **a third of the elderly are found to be vitamin B12 deficient** when the most sensitive tests are used. That's a lot of people! Often it happens for the same reason … an age-related decreased production of stomach acid.

Both of these invisible vitamin B12 absorption situations can cause very serious health problems … and both are prevented by simply taking a regular multivitamin! So, without having to know if you are personally at risk or a family member is at risk, the simple use of the multivitamin will prevent a number of serious problems. The problems to be avoided in this way include nerve damage, cancer, depression, stroke, falls and birth defects.

However, some other causes of vitamin B12 deficiency will NOT be corrected just by the multivitamin (although people should still take one for other reasons, of course.) For example, the **diabetes medication Metformin (Glucophage) also can also have a negative effect on vitamin B12 status.** This is also true of a very serious vitamin B12 deficiency condition called **"pernicious anemia."** These are both caused by factors other than the changes in stomach acid. Vitamin B12 issues with Metformin or pernicious anemia will need to be monitored and corrected by your health care provider, as the simple multivitamin will not solve those problems. A shot or special form of vitamin B12 may be needed.

(For more information on vitamin B12 issues and monitoring vitamin B12 status, please see my vitamin B12 handouts.)

I do not sell anything. I just think that the evidence is quite clear that taking a multivitamin is a very good idea for everyone, and more and more professional health associations are of the same opinion. A low cost product is just fine, contrary to the claims of people who are trying to sell you a pricier "pyramid scheme" products.

Children"s chewable vitamins are very similar to adult products, and they can be very useful for people with trouble taking pills or who have concerns about the vitamin"s ability to dissolve and be well absorbed in the intestine. Most product labels say for ages under four give ½ tablet daily, and for ages four-through-adult, take a whole one daily. Read the label.

Note that many children's and adult vitamins are not very complete. Some very popular products like some "gummi" vitamin products are actually quite incomplete and therefore not the best choice for a multivitamin. It is a good idea to pick a product that says "Complete" on the label (even though NONE of the vitamins on the market are actually complete.) The labels show that some products clearly provide nutrients that other products (including others by the same manufacturer) have left out. Some products will advertise some special feature to make them stand out in the crowd, and it is often an unimportant distinction. For the most part, just a complete-type generic is just fine, and much less costly.

Another nutrient problem has recently been found to need more attention here and around the world: IODINE DEFICIENCY.

In many parts of the world (including the US --- see map at the end of the paper) iodine deficiency is common, and the traditional international approach to solving it has been to add iodine to salt. However, it appears that **the amount obtained from iodized salt is actually not sufficient, especially during pregnancy, and that even in areas thought to have corrected iodine deficiency many women obtain too little.**

Iodine deficiency is the number one cause of preventable mental retardation in the world. Iodine deficiency can also result in deafness and a serious lack of energy in anyone affected because it impairs the function of the thyroid gland. The World Health Organization is now increasing the recommendation for iodine intake, especially in pregnancy.

Back home in America, many people are unaware that they should select "iodized salt" …the packaging is often very similar and they are side-by-side on the shelf at the store.

Most specialty salts that are popular now, like **sea salt or exotic salts, are also not iodized.** Additionally, we frequently are advised to cut back on salt for other health reasons, which can further limit iodine intake. The choice of salt as the way to supplement iodine was made well before ideas of sodium restriction were common for health reasons.

Actually, most of our sodium intake is not from salting foods at the table, but from the high sodium content of many processed foods. However**, the sodium used in food processing is not iodized**. Another new factor contributing to our decreased iodine intake is the movement toward **buying and eating primarily locally grown foods**. It supports local farmers, results in fresher foods and decreases the cost and pollution of trucking things all over the US. However, this also removes one more source of dietary iodine if one happens to live in an area where the ground is low in iodine, so assuring iodine adequacy some other way is necessary.

Because it has long been assumed that the iodine deficiency problem was "solved" in the US, at present many vitamin pills contain no iodine at all, including many prenatal vitamins. So, this is one more nutrient that a person should check for when they select a multivitamin. Choose iodized salt if you use salt, and people who use little salt should be sure to find an iodine supplement especially if they live in the northern half of the country or other iodine-poor region.

The problem of iodine deficiency has simply not been in our radar for many years. This is a very newly recognized and extremely important health problem that needs attention. In some countries with naturally low iodine soil (like Australia, for example) this problem is now being addressed by a "Public Health" approach: mandating iodine fortification of bread. We may be looking into this kind of solution in the future.

[Iodine Content of prenatal multivitamins in the United States. NEJM. **2009**;360:939-940. Iodine deficiency in pregnancy and the effects of maternal iodine supplementation on the offspring: a review. Am J Clin Nutr. **2009** Feb;89(2):668S-72S. Iodine status of the U.S. population, National Health and Nutrition Examination Survey 20032004. Thyroid. **2008** Nov;18(11):1207-14.]

And finally:

Of course, taking a multivitamin does <u>not</u> take the place of eating healthy foods.

Do I even have to say this?

For example, the vitamin pills contain no protein, no omega-3 fats, and little or no beneficial phytochemicals, potassium, magnesium, selenium, chromium, calcium, phosphorus, etc. The people who design the pills assume that taking a multivitamin does not take the place of eating healthy foods. It is up to us to eat more of the really great nutritious foods as described in this paper.

For people who say that they "don't believe in" taking a vitamin, I usually try to point out that nutrition is not a religion, so belief is not really a central issue. It's a biological/biochemical science. At this time in history, the science indicates that it is advantageous to take a multivitamin, some fish oil, and for some folks additional vitamin D, vitamin K and iodine **IN ADDITION TO eating lots of healthy nutritious foods.**

Bottom line:

Eat lots of healthy foods including plenty of:

brightly colored fruits and vegetables

nuts, legumes, seeds and whole grains (baby plants)

un-processed or minimally-processed foods

Use mostly olive oil in food preparation in place of other fats.

Take a standard "complete-type" multivitamin with minerals.

For many people, for many reasons, eating fish or taking fish- or krill-oil supplements is advisable.

Many people will also need extra attention to assure adequacy of:

Vitamin B12 **Vitamin D**

Vitamin K **Iodine**

MAPS of INTEREST: VITAMIN D and IODINE

Cathy Breedon

VITAMIN D:

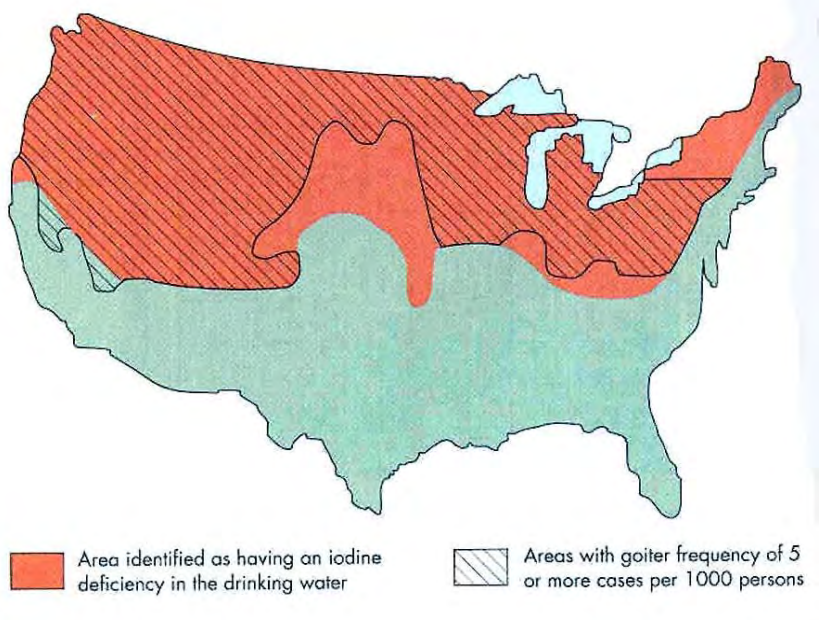
https://www.health.harvard.edu/newsweek/images/latitude-vitaminD.jpg

Except during the summer months, the skin makes little if any vitamin D from the sun at latitudes above 37 degrees north (in the United States, the shaded region in the map) or below 37 degrees south of the equator. People who live in these areas are at relatively greater risk for vitamin D deficiency.

(Actually, that's where **I** live … but you can see why it's a really big deal Up North!")

IODINE: **Map showing spatial correlation between the former "Goiter Belt*" in the northern U.S. and areas where the iodine content of drinking water is naturally low.**

www.uwsp.edu/gEo/faculty/ozsvath/images/goiter_belt.htm [*Goiter is an abnormal enlargement of the thyroid gland, often due to iodine deficiency.]



2011

Sanford Medical Center

Aunt Cathy's Guide to Nutrition:

New Attention to an Old Problem:

Iodine Deficiency in Pregnancy and Lactation

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Bibliography and some abstracts 2005- Jan. 2011

2011

Hypothyroxinemia and Pregnancy. Endocr Pract. 2011 Jan 17:1-24. Objective: To evaluate the peer-reviewed literature on iodine deficiency and hypothyroxinemia in pregnancy. … An adequate amount of iodine intake has to be recommended pre-conception or starting early in pregnancy.

Neonatal Age and Point of CareTSH Testing in the Monitoring of Iodine Deficiency Disorders: Findings from Western Uganda. Thyroid. 2011 Feb;21(2):183-8. Background: Iodine deficiency is a major public health problem throughout Africa. Although salt for human consumption is said to contain adequate amounts of iodine in Uganda, iodine intake may not be optimal. … **Based on the percentage of neonates with TSH values >5 mIU/L, presumptive iodine deficiency persists in western Uganda. This finding suggests that continued monitoring of iodine nutrition in the area surrounding the Rwenzori Mountains in Uganda and Congo is needed.** …

Iodine-induced neonatal hypothyroidism secondary to maternal seaweed consumption: A common practice in some Asian cultures to promote breast milk supply. J Paediatr Child Health. 2011 Jan 31. **Mild iodine deficiency is a recognised problem in Australia and New Zealand. However, iodine excess can cause hypothyroidism in some infants**. We highlight two cases which illustrate the risks of excess dietary iodine intake during pregnancy and breastfeeding. They also describe **a cultural practice of consuming seaweed soup to promote breast milk supply.** Although most attention recently has been on the inadequacy of iodine in Australian diets, the reverse situation should not be overlooked. Neither feast nor famine is desirable.

2010

Iodine deficiency in infancy - a risk for cognitive development. Dtsch Med Wochenschr. 2010 Aug;135(31-32):1551-6. Severe iodine deficiency during pregnancy seriously influences fetal brain development and in the worst case induces cretinism. **Recent studies have shown that even a mild iodine deficiency during pregnancy and during the first years of life adversely affects brain development. The World Health**

Organisation (WHO) considers iodine deficiency as the most common preventable cause of early childhood mental deficiency. In this context, the insufficient production of the four iodine atoms containing thyroxine seems to play a causal role, i. e., due to the iodine substrate deficiency the neuronally particularly relevant free-thyroxine level falls. **Due to the very limited iodine storage capacity, the infantile thyroid is eminently dependent on an adequate and steady iodine supply. In the first month of life, when milk is the only energy- and nutrient provider, infants fed a commercial formula regularly have a sufficient iodine supply. However, breastfed infants, who depend on maternal iodine status, frequently show an inadequate iodine intake. Furthermore, iodine intake is critical when complementary food (CF) is introduced. Especially homemade CF is poor in iodine, but also commercial CFs are only partly fortified.** A simultaneous inadequate iodine supply of the breastfeeding mother and the preferential use of mostly iodine-poor organic milk cannot ensure an adequate iodine supply of the infant. **In terms of an improvement of nutrient supply, especially concerning an unhindered brain development, the corresponding German reference value for iodine intake of infants until age 4 month should be raised from currently 40 microg/d to at least 60 microg/d (WHO-reference: 90 microg/d).**

Some subgroups of reproductive age women in the United States may be at risk for iodine deficiency. J Nutr. 2010 Aug;140(8):1489-94. Consuming an adequate amount of iodine during pregnancy is critical for fetal neurologic development. Even a mild deficiency can impair cognitive ability. Important sources of iodine in the United States include dairy products and iodized salt. **Although the U.S. population has traditionally been considered iodine sufficient, median urinary iodine concentrations (UIC) have decreased 50% since the 1970s.** We analyzed 2001-2006 NHANES data from urine iodine spot tests for pregnant (n = 326), lactating (n = 53), and nonpregnant, nonlactating (n = 1437) women of reproductive age (15-44 y). **We used WHO criteria to define iodine sufficiency** (median UIC: 150-249 microg/L among pregnant women; >or=100 microg/L among lactating women; and 100-199 microg/L among nonpregnant, nonlactating women). **The iodine status of pregnant women was borderline sufficient** (median UIC = 153 microg/L; 95% CI = 105-196), **while lactating** (115 microg/L; 95% CI = 62-162) **and nonpregnant, nonlactating** (130 microg/L; 95% CI = 117-140) **women were iodine sufficient.** … **Iodine levels among U.S. women should be monitored, particularly among subgroups at risk for iodine deficiency.**

Serum thyroid hormone levels in preterm infants born before 33 weeks of gestation and association of transient hypothyroxinemia with postnatal characteristics. J Pediatr Endocrinol Metab. 2010 Sep;23(9):899-912.: Fetal thyroid function and the hypothalamopituitary-thyroid axis continue to mature throughout pregnancy. Therefore, thyroid hormone levels of premature infants differ from those of mature ones. Our primary objective was to evaluate the reference values of serum thyroid hormones in preterm infants born before 33 wk gestation. The second objective was to define a cut-off value for transient hypothyroxinemia of prematurity (THOP) according to gestational age and association of THOP with postnatal characteristics in these infants…. CONCLUSIONS: In preterm infants below 30 wk, thyroid hormones were lower and urinary iodine values were higher compared to infants with older gestational age. THOP at the first wk of life may convey important prognostic information about neonatal morbidity and length of hospitalization stay.

Iodine status of pregnant women from central Poland ten years after introduction of iodine prophylaxis programme. (Pol J Endocrinol 2010; 61 (6): 646-651).2010 Nov-Dec;61(6):646-51. Introduction: Until 1997, Poland was one of the European countries suffering from mild/moderate iodine deficiency. In 1997, a national iodine prophylaxis programme was implemented based on mandatory iodisation of household salt with 30 ± 10 mg KI/kg salt, obligatory iodisation of neonatal formula with 10 µg KI/100 mL and voluntary supplementation of pregnant and breast-feeding women with additional 100-150 µg of iodine. Our aim in this study was to evaluate the iodine status of pregnant women ten years after iodine prophylaxis was introduced. … **Conclusion: Iodine supplements with 150 µg of iodine should be prescribed for each healthy pregnant woman according to the assumptions of Polish iodine prophylaxis programme to obtain adequate iodine supply.**

Patterns of iodine intake and urinary iodine concentrations during pregnancy and blood thyroid-stimulating hormone concentrations in the newborn progeny. Thyroid. 2010 Nov;20(11):1295-9. Background: Appropriate maternal intake of iodine during pregnancy is essential for maternal thyroxine production and thyroid status of the fetus. It should be possible to enhance iodine intake during pregnancy by using iodine fortified salt or taking iodine supplements. In the present report we determined the status of iodine nutrition in pregnant women who were stratified on the basis of their history of taking or not taking iodized salt or iodine supplements. The study was performed in Toledo (Spain), a region in which prior studies have noted borderline iodine sufficiency. Iodine nutrition was assessed by measuring urinary iodine concentration (UIC) and neonatal thyrotropin (TSH).… **Conclusions: In a region with a history of borderline iodine deficiency the UICs were below 150 µg/L in a substantial percentage of pregnant women who did not take iodine supplements, regardless of whether or not they took iodized salt. Our results support the use of iodine supplements from the start of the pregnancy, or even before pregnancy in women who live in regions with a history of even small degrees of iodine deficiency.** In addition, neonate TSH screening is not the best tool to assess whether the iodine status in populations is ideal.

Iodine-induced neonatal hypothyroidism secondary to maternal seaweed consumption: A common practice in some Asian cultures to promote breast milk supply. J Paediatr Child Health. 2011 Jan 31. Mild iodine deficiency is a recognised problem in Australia and New Zealand. However, iodine excess can cause hypothyroidism in some infants. We highlight two cases which illustrate the risks of excess dietary iodine intake during pregnancy and breastfeeding. They also describe **a cultural practice of consuming seaweed soup to promote breast milk supply.** Although most attention recently has been on the inadequacy of iodine in Australian diets, the reverse situation should not be overlooked. Neither feast nor famine is desirable.

Hypothyroxinemia and Pregnancy. Endocr Pract. 2011 Jan 17:1-24. Objective: To evaluate the peer-reviewed literature on iodine deficiency and hypothyroxinemia in pregnancy. … **An adequate amount of iodine intake has to be recommended pre-conception or starting early in pregnancy.**

Neonatal Age and Point of CareTSH Testing in the Monitoring of Iodine Deficiency Disorders: Findings from Western Uganda. Thyroid. 2011 Feb;21(2):183-8. Background: Iodine deficiency is a major public health problem throughout Africa. Although salt for human consumption is said to contain adequate amounts of iodine in Uganda, iodine intake may not be optimal. … **Based on the percentage of neonates with TSH values >5 mIU/L, presumptive iodine deficiency persists in western Uganda. This finding suggests that continued monitoring of iodine nutrition in the area surrounding the Rwenzori Mountains in Uganda and Congo is needed.**

Iodine intake in Portuguese pregnant women: results of a countrywide study. Eur J Endocrinol. 2010 Oct;163(4):631-5. Iodine is the key element for thyroid hormone synthesis, and its deficiency, even moderate, is harmful in pregnancy, when needs are increased, because of its potential deleterious effects on fetal brain development. In Portugal, no recent data on iodine intake exists. The objective of this countrywide study was to analyze iodine status in pregnant Portuguese women in order to propose adequate measures to the health authorities…. women assisted in most Portuguese maternity hospitals. **Considering the potential deleterious effects of inadequate iodine supply in pregnancy, iodine supplementation is strongly recommended in this period of life.**

Poor iodine status and knowledge related to iodine on the eve of mandatory iodine fortification in Australia. Asia Pac J Clin Nutr. 2010;19(2):250-5. **Background: Mandatory fortification of bread with iodised salt is proposed to address the re-emergence of iodine deficiency in Australia and New Zealand.** … **These data add support to the need for a national approach to address iodine intake which includes an accompanying consumer education campaign.**

The Swiss iodized salt program provides adequate iodine for school children and pregnant women, but weaning infants not receiving iodine-containing complementary foods as well as their mothers are iodine deficient. J Clin Endocrinol Metab. 2010 Dec;95(12):5217-24. BACKGROUND**:** If children and pregnant women in the population are iodine sufficient, it is generally assumed infants are also sufficient. But weaning infants may be at risk of iodine deficiency because iodized salt contributes little dietary iodine during this period. To fill this gap, iodine fortification of infant formula milk (IFM) and complementary foods (CF) is likely important. OBJECTIVES: The objective of the study was to first confirm that Swiss school children and pregnant women remain iodine sufficient and then to assess iodine status in infancy and the relative contribution of breast milk and IFM/CF to their iodine intakes. … RESULTS: Median (m) UICs in pregnant women (162 μg/liter) and school children (120 μg/liter) were sufficient, and 80% of the household salt was adequately iodized (≥15 ppm). However, mUICs in infants not receiving IFM/CF were not sufficient: 1) mUIC in breast-fed infants (82 μg/liter) was lower than in non-breast-fed infants (105 μg/liter) ($P<0.001$) and 2) mUIC in breast-fed weaning infants not receiving IFM/CF (70 μg/liter) was lower than infants receiving IFM (109 μg/liter) ($P<0.01$). mUIC was low in lactating mothers (67 μg/liter) and median breast milk iodine concentration was 49 μg/kg **CONCLUSIONS**: **In countries in which iodized salt programs supply sufficient iodine to older children and pregnant women, weaning infants, particularly those not receiving iodine-containing IFM, may be at risk of inadequate iodine intakes.**

Effect of iodine deficiency and hypothyroidism on the protein expressions of CaMK II in the hippocampus of pups. Wei Sheng Yan Jiu. 2010 Mar;39(2):180-3. Objective: To observe the effect of iodine deficiency and hypothyroidism on the protein expressions of CaMK II in the hippocampus of pups. … **Conclusion:** Iodine deficiency and hypothyroidism may decrease the protein expression of CaMK II.

Dietary iodine: why are so many mothers not getting enough? Environ Health Perspect. 2010 Oct;118(10):A438-42.

Iodine deficiency in Australia: is iodine supplementation for pregnant and lactating women warranted? Med J Aust. 2010 Apr 19;192(8):461-3. Recent research has confirmed that Australian children and pregnant women are mildly iodine deficient. **A considerable proportion of the pregnant population is moderately to severely iodine deficient. Even subclinical hypothyroidism in the mother, occurring as a consequence of iodine deficiency, can cause irreversible brain damage in the fetus, making it essential to avoid iodine deficiency in pregnancy.** The proposal of Food Standards Australia and New Zealand (FSANZ) - Mandatory Iodine **Fortification for Australia (P1003) - has been implemented. FSANZ openly admits P1003 is inadequate for covering the needs of pregnant women.** Therefore, health professionals and the public must be properly informed about the limitations of this proposal. Views differ about the most effective measures to prevent iodine deficiency in Australia. **We propose that women planning a pregnancy, and pregnant and lactating women should be advised to take an iodine supplement.** Women with pre-existing thyroid disease should exercise caution and seek medical advice before taking a supplement.

Micronutrients and women of reproductive potential: required dietary intake and consequences of dietary deficienty or excess. Part II - Vitamin D, Vitamin A, Iron, Zinc, Iodine, Essential Fatty Acids. J Matern Fetal Neonatal Med. 2010 Apr 14. Part II of this review considers additional micronutrients. … **To assure adequate iodine, food is fortified worldwide with iodated salt. If urinary iodine levels are low, supplementation is needed.** Essential fatty acids requirements can be met by one to two portions of fish per week.

CB Note: The iodine-related section of the above report says that "To assure adequate iodine, food is fortified worldwide with iodated salt. If urinary iodine levels are low, supplementation is needed." It sounds a bit like things are OK because "food is fortified worldwide with iodated salt." As described elsewhere in this paper, many places that have low iodine in the soil still **do not have access to iodized salt.** Additionally, the newest evaluations are showing that **the amount added to salt is insufficient** for many women and especially for pregnant and lactating women. **And the likelihood is quite low that women around the world (and here) normally get their urinary iodine level evaluated in order to determine whether "supplementation is needed."**

Iodine intake in Portuguese pregnant women: results of a countrywide study. Eur J Endocrinol. 2010 Oct;163(4):631-5. …urine iodine concentration (UIC) was evaluated 3631 pregnant women followed in 17 maternity hospitals from hinterland and coastal areas in Continental Portugal and the Portuguese islands of Açores and Madeira. Results: Median UIC value was 84.9 μg/l (range 67.6-124.1) in Continental Portugal, 69.5 μg/l in Madeira, and 50.0 μg/l in Açores. The percentage of satisfactory values (>150 μg/l) was 16.8, ranging from 8.8 to 34.1 in the Continent, and being 8.2 in Madeira and 2.3 in Açores. The percentage of values below 50 μg/l was 23.7, ranging from 14.0 to 37.4 in the Continent, 33.7 in Madeira, and 50.0 in Açores**.** Conclusions: **Our results point to an inadequate iodine intake in pregnant women assisted in most Portuguese maternity hospitals. Considering the potential deleterious effects of inadequate iodine supply in pregnancy, iodine supplementation is strongly recommended in this period of life.**

Iodine intake and maternal thyroid function during pregnancy. Epidemiology. 2010 Jan;21(1):62-9. Background: An adequate iodine intake during pregnancy is essential for the synthesis of maternal thyroid hormones and normal brain development in the fetus. Scant evidence is available on the effects and safety of iodine supplementation during pregnancy in areas with adequate or mildly deficient iodine intake. We examined the association of maternal iodine intake and supplementation with thyroid function before 24 weeks of gestation in population-based samples from 3 different areas in Spain. Methods: A cross-sectional study of 1844 pregnant women (gestational age range 8-23 weeks) was carried out in 3 areas in Spain (Guipúzcoa, Sabadell, Valencia), during the period 2004-2008. We measured levels of free thyroxine and thyroid-stimulating hormone (TSH) in serum, iodine in a spot urine sample, and questionnaire estimates of iodine intake from diet, iodized salt and supplements. Adjusted associations were assessed by multiple linear regression and logistic regression analyses. **Results:** There was an increased risk of TSH above 3 muU/mL in women who consumed **200 microg or more of iodine supplements daily compared with those who consumed less than 100 microg/day** (adjusted odds ratio = 2.5 [95% confidence interval = 1.2 to 5.4]). **We observed no association between urinary iodine and TSH levels. Pregnant women from the area with the highest median urinary iodine (168 microg/L) and highest supplement coverage (93%) showed the lowest values of serum free thyroxine.** (geometric mean = 10.09 pmol/L [9.98 to 10.19]). **CONCLUSIONS: Iodine supplement intake in the first half of pregnancy may lead to maternal thyroid dysfunction in iodine-sufficient or mildly iodine-deficient populations.**

Thyroid disorders and pregnancy. Internist (Berl). 2010 May;51(5):620-4. Disorders of the thyroid in women are common during the reproductive years. Incorrect or delayed treatment during pregnancy can adversely affect the health of mother and child. Knowledge of the physiological changes during this time is essential. … [CB note: **This paper is looking at women who have medical conditions involving the thyroid gland, and not at public health iodine-in-pregnancy issues.]**.

Lifestyle factors in people seeking infertility treatment - A review. Aust N Z J Obstet Gynaecol. 2010 Feb;50(1):8-20. Background: Clinical infertility is a prevalent problem with significant financial and psychosocial costs. Modifiable lifestyle factors exist that may affect a person's time to conception and their chance of having a healthy, live birth. … **Results: A person's time to pregnancy and their chance of having a healthy, live birth may be affected by factors such as weight, vitamin and iodine intake** … Conclusion**:** Advice on modifiable lifestyle factors should be given to people presenting for infertility treatment to help them make positive changes that may improve their chances of pregnancy and delivering a healthy, live baby. Developing a guideline for this would be a prudent step towards helping clinicians to implement this aspect of preconception care.

The challenges of iodine supplementation: a public health programme perspective. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):89-99. An adequate iodine intake during pregnancy, lactation and early childhood is particularly critical for optimal brain development of the foetus and of children 7-24 months of age. **While the primary strategy for sustainable elimination of iodine deficiency remains universal salt iodisation, the World Health Organization and the United Nations Children's Fund recommend a complementary strategy of iodine supplements as a temporary measure when salt iodisation could not be implemented.** This article aims to review current evidence on efficacy and implications of implementing iodine supplementation as a public health measure to address iodine deficiency. Iodine supplementation seems unlikely to reach high coverage in a rapid,

equitable and sustained way. Implementing the programme requires political commitment, effective and efficient supply, distribution and targeting, continuous education and communication and a robust monitoring system. Thus, universal salt iodisation should remain the primary strategy to eliminate iodine deficiency.

Cretinism revisited. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):39-50. **Endemic cretinism includes two syndromes: a more common neurological disorder with brain damage, deaf mutism, squint and spastic paresis of the legs and a less common syndrome of severe hypothyroidism, growth retardation and less severe mental defect. Both conditions are due to dietary iodine deficiency and can be prevented by correction of iodine deficiency before pregnancy.** Endemic cretinism is now included in the spectrum of the effects of iodine deficiency in a population termed the 'iodine deficiency disorders (IDDs)', which also includes a wide range of lesser degrees of cognitive defect that can be prevented by the correction of iodine deficiency. **Iodine deficiency is now recognised by the World Health Organization (WHO) as the most common preventable cause of brain damage with in excess of 2 billion at risk from 130 countries. A global United Nations (UN) programme of prevention has achieved 68% household usage of iodised salt by the year 2000 compared with less than 20% prior to 1990.**

Iodine intake as a determinant of thyroid disorders in populations. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):13-27. Depending on the availability of iodine, the thyroid gland is able to enhance or limit the use of iodine for thyroid hormone production. When compensation fails, as in severely iodine-deficient populations, hypothyroidism and developmental brain damage will be the dominating disorders. This is, out of all comparison, the most serious association between disease and the level of iodine intake in a population. In less severe iodine deficiency, the normal thyroid gland is able to adapt and keep thyroid hormone production within the normal range. However, the prolonged thyroid hyperactivity associated with such adaptation leads to thyroid growth, and during follicular cell proliferation there is a tendency to mutations leading to multifocal autonomous growth and function. … Monitoring and adjusting of iodine intake in a population is an important part of preventive medicine.

Epidemiology of iodine deficiency: Salt iodisation and iodine status. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):1-11. Universal salt iodisation (USI) and iodine supplementation are highly effective strategies for preventing and controlling iodine deficiency. USI is now implemented in nearly all countries worldwide, and two-thirds of the world's population is covered by iodised salt. **The number of countries with iodine deficiency as a national public health problem has decreased from 110 in 1993 to 47 in 2007. Still one-third of households lack access to adequately iodised salt. Iodine deficiency remains a major threat to the health and development of populations around the world, particularly in children and pregnant women in low-income countries**. Data on iodine status are available from 130 countries and approximately one-third of the global population is estimated to have a low iodine intake based on urinary iodine (UI) concentrations. Insufficient control of iodine fortification levels has led to excessive iodine intakes in 34 countries. The challenges ahead lie in ensuring higher coverage of adequately iodised salt, strengthening regular monitoring of salt iodisation and iodine status in the population, together with targeted interventions for vulnerable population groups.

Iodine deficiency in the prenatal period may form learning ability deficiency in the postnatal period. Georgian Med News. 2010 Jan;(178):65-8. The present study analysis the changes in learning ability of the progeny of rats suffered from iodine deficiency. … **We can conclude that the diet with very low iodine content results in a low level of thyroxin in maternal serum and neurological deficiency in progeny manifested by learning disability during maze testing. Addition of the iodine to the diet prevents development of mentioned neurological deficiency.**

Suboptimal iodine status of Australian pregnant women reflects poor knowledge and practices related to iodine nutrition. Nutrition. 2010 Oct;26(10):963-8. OBJECTIVE: To assess the iodine status and knowledge and practices related to iodine nutrition of Australian women during pregnancy. …**CONCLUSION: Public health strategies, including nutritional education and supplementation, are urgently required to improve the iodine status of pregnant women. Currently, no readily accessible information on iodine is available to women attending antenatal clinics in Australia.**

The influence of dietary status on the cognitive performance of children. . Mol Nutr Food Res. 2010 Apr;54(4):457-70. **The rapid rate of growth of the brain during the last third of gestation and the early postnatal stage makes it vulnerable to an inadequate diet, although brain development continues into adulthood and micronutrient status can influence functioning beyond infancy. Certain dietary deficiencies during the first 2 years of life, for example iodine and iron, create problems that are not reversed by a later adequate diet**. …. In particular, attention has been directed to protein-calorie malnutrition and more **specifically the intake of iron, iodine and vitamin A** …

Iodine intake is still inadequate among pregnant women eight years after mandatory iodination of salt in Turkey. J Endocrinol Invest. 2010 Jul-Aug;33(7):461-4. … Conclusion: Our study revealed that **iodine deficiency still remains a serious problem for pregnant women**. Based on our results, antenatal follow-up protocols in the primary care setting in Turkey must include iodine supplementation.

Iodine deficiency in pregnancy, infancy and childhood and its consequences for brain development. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):29-38. Iodine deficiency during foetal development and early childhood is associated with cognitive impairment. Randomised clinical studies in school-aged children encountered in the literature indicate that cognitive performance can be improved by iodine supplementation, but most studies suffer from methodological constraints. Tests to assess cognitive performance in the domains that are potentially affected by iodine deficiency need to be refined. Maternal iodine supplementation in areas of mild-to-moderate iodine deficiency may improve cognitive performance of the offspring, but randomised controlled studies with long-term outcomes are lacking. Studies in infants or young children have not been conducted. The best indicators for iodine deficiency in children are thyroid-stimulating hormone (TSH) in newborns and thyroglobulin (Tg) in older children. Urinary iodine may also be useful but only at the population level. Adequate salt iodization will cover the requirements of infants and children as well as pregnant women. However, close monitoring remains essential.

[CB note: This particular discussion is about research design and the need for more research. Of course more research is always needed. However, as most of the people who read my materials are not epidemiologists (nor am I) some fine points of interpretation of this report may be helpful.

First, the type of research designs described here as "lacking" are "randomized controlled studies with long-term outcomes" including "studies in infants or young children." **Although desirable from a statistical confidence level sense, obtaining the results of this kind of study design with infants, children, or ANYBODY would most likely be unethical** and therefore not likely to ever become available. **(If we are pretty darn sure that iodine deficiency is not good for people, we can never do the kind of study where some folks are randomly assigned to not receive the supplemental amount presumed to provide adequacy … especially for "long-term" outcome measures**.)

I think it is important to realize that although we will likely never have this kind of definitive data, there is a ton of other kinds of research evidence that the problem of Iodine Deficiency Disorders (IDD) is huge and that correcting it to the best of our ability is worthwhile.

Second is a comment about the interpretation of the second to the last statement: "Adequate salt iodization will cover the requirements of infants and children as well as pregnant women." My reaction is, well, of course "ADEQUATE" salt iodization will cover everyone's requirements. That's like saying "taking in enough food prevents starvation." It sounds like there is no problem. Here's the problem:

1) **Many people who need additional iodine do not get it for many reasons even if local iodization levels in salt are "adequate."** The reasons for this are discussed in detail in several of my other papers.
2) It is apparent by the recent upward adjustment in the amount of iodine now recommended by the WHO that the previous (recent**) iodization level has in fact been "INadequate" for pregnant women in particular.**

3) **About 1/3 of the world's population still does not have access to iodized salt. "**Epidemiology of iodine deficiency: Salt iodisation and iodine status." Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):1-11.

Neonatal TSH screening: is it a sensitive and reliable tool for monitoring iodine status in populations? Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):63-75. Conclusion … these researchers do not think it is very useful and they explain why they think this.

Thyroid function at the third trimester of pregnancy in a Northern French population. Ann Endocrinol (Paris). 2010 Sep 29. … Conclusion: The hypothyroxinemia at the third trimester of pregnancy was more prominent in the Parisian population and insufficient iodine intake could be responsible for the deficient increase in TT4. **It is therefore concluded that the inability of the thyroid to establish the required equilibrium could be corrected by systematic iodine supplementation before pregnancy.** Finally, the strong correlation between FT4 and FTI suggests that the quality of FT4 test immunoassay is appropriate for estimating FT4 serum levels during pregnancy.

Inadequacy of nutrients intake among pregnant women in the Deep South of Thailand. BMC Public Health. 2010 Sep 24;10(1):572.

Universal screening detects two-times more thyroid disorders in early pregnancy than targeted high-risk case finding. Eur J Endocrinol. 2010 Oct;163(4):645-50. … CONCLUSIONS: Over half (55%) of pregnant women with abnormalities suggestive of autoimmune thyroiditis and/or hypothyroidism would be missed if only those with high-risk criteria were examined. A more extensive screening of thyroid autoimmunity and dysfunction seems warranted.

An approach to a sanitary and social problem: urinary iodine excretion in pregnant women from a iodine deficient region. Arch Latinoam Nutr. 2009 Dec;59(4):378-82. The urinary iodine excretion (UIE) assay is an effective method to detect reduced iodine intake. … 45% of pregnant women with UIE < 100 ug/l showed impaired thyroid function. …

Post-production losses in iodine concentration of salt hamper the control of iodine deficiency disorders: a case study in northern Ethiopia. J Health Popul Nutr. 2010 Jun;28(3):238-44.

Parameters of thyroid function throughout and after pregnancy in an iodine-deficient population. Thyroid. 2010 Sep;20(9):995-1001. Background: The thyroid hormone milieu is of crucial importance for the developing fetus. Pregnancy induces physiological changes in thyroid homeostasis that are influenced by the iodine status. However, longitudinal studies addressing thyroid function during pregnancy and after delivery are still lacking in mild-to-moderate iodine-deficient populations. Here we characterize the serum parameters of thyroid function throughout pregnancy, and until 1 year after delivery, in a population of pregnant women whom we have previously reported to be iodine deficient (median urinary iodine levels below 75 microg/L). … **Conclusion:** The pregnant women in this study had an absence of the usual free T(4) spike and a smaller than expected increment in total T(4), described during pregnancy in iodine-sufficient populations. A greater number of women had subclinical hypothyroidism compared with iodine-sufficient populations. **This hormonal profile, most likely due to iodine insufficiency, may result in inadequate thyroid hormone supply to the developing fetus. We conclude that care should be taken when reviewing the results of thyroid hormone tests in iodine-insufficient populations and when no gestation-specific reference values have been established. In addition, we recommend iodine supplementation in our population and populations with similar iodine status, particularly during pregnancy and lactation.**

Perinatal iron and copper deficiencies alter neonatal rat circulating and brain thyroid hormone concentrations. Endocrinology. 2010 Aug;151(8):4055-65. Copper (Cu), iron (Fe), and iodine/thyroid hormone (TH) deficiencies lead to similar defects in late brain development, suggesting that these micronutrient deficiencies share a common mechanism contributing to the observed derangements. … These results indicate that at least some of the brain defects associated with neonatal Fe and Cu deficiencies are mediated through reductions in circulating and brain TH levels.

Effect of selenium on hypothyroidism induced by methimazole (MMI) in lactating rats and their pups. Acta Biol Hung. 2010 Jun;61(2):145-57. The present study was undertaken to assess the effect of selenium (Se) on hypothyroidism induced by methimazole (MMI) in lactating rats and their pups. … In the MMI-treated group, thyroid iodine contents and plasma thyroid hormone levels significantly decreased, while plasma TSH levels increased in pups and their mothers. These biochemical modifications corresponded histologically to closed follicles, increased vascularity and a reduction in colloid volume. **Co-treatment with Se ameliorated these parameters. We concluded that the supplementation of Se in diet had beneficial effects on hypothyroidism during a critical period of life.**

CB Note: Both Selenium and iodine are required for production of thyroxine, and both are quite variable in foods depending on the content in the soil in which the foods are grown. In some areas of the world, particularly mountainous areas, selenium deficiency is common. Examples of areas that automatically supplement selenium include New Zealand and the Alpine region of Europe. It is likely that people with a combination of iodine AND selenium deficiency would experience much greater thyroid –related problems.

[Selenium status, thyroid volume and multiple nodule formation in an area with mild iodine deficiency. Eur J Endocrinol. 2011 Jan 17. Trace elements status in multinodular goiter. J Trace Elem Med Biol. 2010 Apr;24 (2):106-10. The impact of common micronutrient deficiencies on iodine and thyroid metabolism: the evidence from human studies. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):117-32. Selenium and thyroid. Best Pract Res Clin Endocrinol Metab. 2009 Dec;23(6):815-27. Selenium and the thyroid: a close-knit connection. J Clin Endocrinol Metab. 2010 Dec;95(12):5180-8. Fenvalerate exposure alters thyroid hormone status in selenium- and/or iodine-deficient rats. Biol Trace Elem Res. 2010 Jun;135(1-3):233-41.Selenium & iodine supplementation: effect on thyroid function of older New Zealanders. Am J Clin Nutr. 2009 Oct;90(4):1038-46. Role of iodine, selenium and other micronutrients in thyroid function and disorders. Endocr Metab Immune Disord Drug Targets. 2009 Sep;9(3):277-94. Selenium levels in first-degree relatives of diabetic patients. Biol Trace Elem Res. 2009 May;128(2):144-51. Effect of trace elements on thyroid structural and functional state (a review). Gig Sanit. 2008 Sep-Oct;(5):79-81.On the importance of selenium and iodine metabolism for thyroid hormone biosynthesis and human health. Mol Nutr Food Res. 2008 Nov;52(11):1235-46.Environmental factors and autoimmune thyroiditis. Nat Clin Pract Endocrinol Metab. 2008 Aug;4(8):454-60. Environmental triggers of autoimmune thyroiditis. J Autoimmun. 2009 Nov-Dec;33(3-4):183-9. Trace element levels in hashimoto thyroiditis patients with subclinical hypothyroidism. . Biol Trace Elem Res. 2008 Summer;123(1-3):1-7. Trace elements in growth: iodine and selenium status of Turkish children. . J Trace Elem Med Biol. 2007;21 Suppl 1:40-3.]

The impact of transient hypothyroidism on the increasing rate of congenital hypothyroidism in the United States. Pediatrics. 2010 May;125 Suppl 2:S54-63.

Therapeutic drug monitoring during pregnancy and lactation: thyroid function assessment in pregnancy-challenges and solutions. Ther Drug Monit. 2010 Jun;32(3):265-8.

Iodine intake in a population of pregnant women: INMA mother and child cohort study, Spain. J Epidemiol Community Health. 2010 Aug 15. Background Monitoring iodine status during pregnancy is essential to prevent iodine-related disorders. The objectives of this study are to estimate iodine intake and excretion, to assess their association and to evaluate the compliance of the recommendations in a multicentre cohort of pregnant women. …. Results 1522 women were included in the study. Median UIC was 134 (IQR 80-218) mug/l in Valencia, 168 (IQR 108-272) mug/l in Gipuzkoa and 94 (IQR 57-151) mug/l in Sabadell. 48.9% of Valencian women consumed iodine supplements, 93.3% in Gipuzkoa and 11.0% in Sabadell. Prevalence of iodised salt consumption was 50.5% in the whole sample. UIC was associated with intake of supplements, iodised salt, dietary iodine and water. UIC levels were lower than expected according to the estimated iodine intake. **Conclusion Median UIC reflected iodine deficiency according to WHO reference levels, except in Gipuzkoa where supplements are widely consumed. It is necessary to strengthen iodised salt consumption since it is already far from the objective proposed of coverage of 90% of households. More data would be valuable to assess the correspondence between iodine intake and excretion during pregnancy.**

Iodine intake and maternal thyroid function during pregnancy. Epidemiology. 2010 Jan;21(1):62-9. [Data from same study in Spain as above.]Background: An adequate iodine intake during pregnancy is essential for the synthesis of maternal thyroid hormones and normal brain development in the fetus. Scant evidence is available on the effects and safety of iodine supplementation during pregnancy in areas with adequate or mildly deficient iodine intake. We examined the association of maternal iodine intake and supplementation with thyroid function before 24

weeks of gestation in population-based samples from 3 different areas in Spain. Methods: A cross-sectional study of 1844 pregnant women (gestational age range 8-23 weeks) was carried out in 3 areas in Spain (Guipúzcoa, Sabadell, Valencia), during the period 2004-2008. We measured levels of free thyroxine and thyroid-stimulating hormone (TSH) in serum, iodine in a spot urine sample, and questionnaire estimates of iodine intake from diet, iodized salt and supplements. Adjusted associations were assessed by multiple linear regression and logistic regression analyses. **Results:** There was an increased risk of TSH above 3 muU/mL in women who consumed **200 microg or more of iodine supplements daily compared with those who consumed less than 100 microg/day** (adjusted odds ratio = 2.5 [95% confidence interval = 1.2 to 5.4]). **We observed no association between urinary iodine and TSH levels. Pregnant women from the area with the highest median urinary iodine (168 microg/L) and highest supplement coverage (93%) showed the lowest values of serum free thyroxine.** (geometric mean = 10.09 pmol/L [9.98 to 10.19]). **CONCLUSIONS: Iodine supplement intake in the first half of pregnancy may lead to maternal thyroid dysfunction in iodine-sufficient or mildly iodine-deficient populations.**

Plenary Lecture 3: Food and the planet: nutritional dilemmas of greenhouse gas emission reductions through reduced intakes of meat and dairy foods. Proc Nutr Soc. 2010 Feb;69(1):103-18. Legally-binding legislation is now in place to ensure major reductions in greenhouse gas emissions in the UK. Reductions in intakes of meat and dairy products, which account for approximately 40% of food-related emissions, are an inevitable policy option. The present paper assesses, as far as is possible, the risk to nutritional status of such a policy in the context of the part played by these foods in overall health and well-being and their contribution to nutritional status for the major nutrients that they supply. … However, overall protein intakes would probably fall, with the potential for intakes to be less than current requirements for the elderly. Whether it is detrimental to health is uncertain and controversial. Zn intakes are also likely to fall, raising questions about child growth that are currently unanswerable. Milk and dairy products, currently specifically recommended for young children and pregnant women, provide 30-40% of dietary Ca, **iodine**, vitamin B12 and riboflavin. Population groups with low milk intakes generally show low intakes and poor status for each of these nutrients. **Taken together it would appear that the reductions in meat and dairy foods, which are necessary to limit environmental damage, do pose serious nutritional challenges for some key nutrients. These challenges can be met, however, by improved public health advice on alternative dietary sources and by increasing food fortification.**

Symposium on 'Geographical and geological influences on nutrition': Iodine deficiency in industrialised countries. Proc Nutr Soc. 2010 Feb;69(1):133-43**. Iodine deficiency is not only a problem in developing regions; it also affects many industrialised countries. Globally, two billion individuals have an insufficient iodine intake, and approximately 50% of continental Europe remains mildly iodine deficient. Iodine intakes in other industrialised countries, including the USA and Australia, have fallen in recent years.** Iodine deficiency has reappeared in Australia, as a result of declining iodine residues in milk products because of decreased iodophor use by the dairy industry. In the USA, although the general population is iodine sufficient, it is uncertain whether iodine intakes are adequate in pregnancy, which has led to calls for iodine supplementation. The few available data suggest that pregnant women in the Republic of Ireland and the UK are now mildly iodine deficient, possibly as a result of reduced use of iodophors by the dairy industry, as observed in Australia. Representative data on iodine status in children and pregnant women in the UK are urgently needed to inform health policy. In most industrialised countries the best strategy to control iodine deficiency is carefully-monitored salt iodisation. **However, because approximately 90% of salt consumption in industrialised countries is from purchased processed foods, the iodisation of household salt only will not supply adequate iodine. Thus, in order to successfully control iodine deficiency in industrialised countries it is critical that the food industry use iodised salt. The current push to reduce salt consumption to prevent chronic diseases and the policy of salt iodisation to eliminate iodine deficiency do not conflict; iodisation methods can fortify salt to provide recommended iodine intakes even if per capita salt intakes are reduced to <5 g/d.**

The current salt iodization strategy in Kyrgyzstan ensures sufficient iodine nutrition among school-age children but not pregnant women. Public Health Nutr. 2010 May;13(5):623-30. Although goitre and cretinism were brought under control in Kyrgyzstan during the 1960s by centrally directed iodized salt supplies, iodine-deficiency disorders (IDD) had made a comeback when the USSR broke up in 1991. Upon independence, Kyrgyzstan started developing its own salt processing industry and by 2001 the Government enacted a law on IDD elimination, mandating

universal salt iodization (USI) at 25-55 mg/kg. The present study [in 2007] aimed to evaluate the effectiveness of the USI strategy on the iodine consumption, iodine status and burden of IDD in the population of Kyrgyzstan. …
CONCLUSIONS: The iodine nutrition status of the Kyrgyz population is highly responsive to household salt iodization. Although the results in children suggest adequate iodine nutrition, the iodine consumption among pregnant women did not assure their dietary requirements. In-depth analysis of the survey data suggest that excess iodine intake is not likely to become a public health concern in Kyrgyzstan when the salt supply meets agreed standards.

Iodine: it's important in patients that require parenteral nutrition. Gastroenterology. 2009 Nov;137(5 Suppl):S36-46. Iodine deficiency has multiple adverse effects on growth and development because of inadequate thyroid hormone production. Four methods are generally recommended for assessment of iodine nutrition: urinary iodine concentration, thyroid size, and blood concentrations of thyroid-stimulating hormone and thyroglobulin. Iodine intakes < or = 1 mg/d are well tolerated by most adults, because the thyroid is able to adjust to a wide range of intakes. **A daily dose of 1 microg iodine/kg body weight is recommended for infants and children receiving parenteral nutrition (PN), but this is far below their requirement**. **Daily iodine requirements in adults receiving enteral nutrition or PN are estimated to be 70-150 microg, but most PN formulations do not contain iodine.** Despite this, deficiency is unlikely because absorption from iodine-containing skin disinfectants and other adventitious sources can provide sufficient iodine**. However, if chlorhexidine replaces iodine-containing disinfectants for catheter care, iodine deficiency may occur during long-term PN, and periodic testing of thyroid functions may be prudent. Infants may be particularly vulnerable because of their small thyroidal iodine store, but available data do not yet support routine supplementation of preterm infants with iodine**. Adults may be less vulnerable because thyroidal iodine stores may be able to support thyroid hormone production for several months. More studies to clarify this issue would be valuable.

Fetal and neonatal thyroid function: review and summary of significant new findings. Curr Opin Endocrinol Diabetes Obes. 2010 Feb;17(1):1-7. The purpose of this review is to briefly summarize current knowledge of fetal and neonatal thyroid function, and then to summarize the most significant new findings over the last year that add to our knowledge of the cause, diagnosis, and management of fetal and neonatal thyroid disorders…. [CB note: This is about managing certain types of thyroid disorders in newborns, and not generally about iodine intake issues in pregnancy.]

Impact of pregnancy on prevalence of goitre and nodular thyroid disease in women living in a region of borderline sufficient iodine supply. Horm Metab Res. 2010 Feb;42(2):137-42. An interplay of genetic, epigenetic, and environmental factors contributes to thyroid disease. In a cross-sectional study, we aimed to determine the influence of parity in combination with other risk factors on the prevalence of goitre and nodular thyroid disease (NTD) in women living in a region of previous overt iodine deficiency, which experienced a continuous improvement in alimentary iodine supply in the last two decades. Thyroid ultrasonography (7.5 MHz; Merck Thyromobil) was performed by the same investigator in 736 women living in Thuringia and Saxony [Germany].. **Goitre prevalence was 19.1%.** Solitary thyroid nodules were detected in 21.5%, and multiple nodules in 23.8% of women. In a multivariate analysis, neither age nor parity was positively correlated with goitre prevalence and NTD. A significant correlation was detected between BMI and goitre and multinodular disease. **Goitre was found in 25.3% of women with a positive family history for thyroid disease, as opposed to 16.1% goitre in women with a negative family history. Neither goitre nor NTD were associated with a history of smoking in the whole study population. Thyroid nodules and/or goitre are present in up to 45% of women in an area of previous overt iodine deficiency**. Whereas BMI and family history are positively correlated with the presence of NTD and goitre, no such correlation could be detected for pregnancy and smoking after processing our data with multivariate analyses.

Clin Endocrinol (Oxf). 2010 Jan;72(1):81-6. **Iodine sources and iodine levels in pregnant women from an area without known iodine deficiency.** An adequate iodine intake during pregnancy is essential for normal development of the foetus. **The World Health Organization (WHO) recommends that the median urinary iodine concentration (UIC) in a population of pregnant women should range between 150 and 249 microg/l.** The aim of this study was to evaluate iodine status and to examine the main sources of iodine in pregnant women from an apparently iodine-sufficient area. Methods: Six hundred pregnant women in the third trimester completed a food

frequency questionnaire, and iodine was measured in urine samples. Urinary iodine concentrations were described in the whole population and in subgroups according to their frequency of intake of milk, fish, eggs, bread and iodized salt, as iodine supplements. Results: The median UIC was 104 microg/l (n = 600), however, the median was higher among women who had a high milk intake (117 microg/l), used iodized salt (117 microg/l) or who were supplemented with iodine (141 microg/l). Women receiving iodine supplementation who also consumed more than one cup of milk per day had median UIC higher than 150 microg/l. In multivariate models, women with moderate and high milk intake had lower risk of having UIC below 150 microg/l [OR (95% CI): 0.42 (0.22-0.82) and 0.29 (0.15-0.55) respectively], after adjustment for potential confounders. **Conclusions: On the basis of WHO criteria, the iodine status of pregnant women was inadequate in this area. Milk was the most important dietary source of iodine, and iodine supplementation was also an important source of iodine, although not enough to reach the current recommendations.**

2009

Prevalence of iodine deficiency in pregnant women in the health area of Palencia (Spain). Endocrinol Nutr. 2009 Dec;56(10):452-7. BACKGROUND: **Iodine deficiency in pregnant women may result in substantial and irreversible impairment in fetal brain development, even from the first few weeks of pregnancy.** OBJECTIVE: To assess the nutritional iodine status of pregnant women in our health area and its **relationship with dietary factors and thyroid function and to suggest treatment guidelines.** … CONCLUSIONS: **Seventy-eight percent of pregnant women in our health area were iodine deficient. Iodized salt intake is related to iodine sufficiency and to increased urinary iodine concentrations. Measures to increase intake of iodized salt among the population should be implemented. Iodized salt supplements should be systematically prescribed in women from the beginning of pregnancy.**

A framework to explore micronutrient deficiency in maternal and child health in Malawi, Southern Africa. Environ Health. 2009 Dec 21;8 Suppl 1:S13. Global food insecurity is associated with micronutrient deficiencies and it has been suggested that 4.5 billion people world-wide are affected by deficiencies in iron, vitamin A and iodine. Zinc has also been identified to be of increasing concern. The most vulnerable are young children and women of childbearing age. …

Perinatal goiter with increased iodine uptake and hypothyroidism due to excess maternal iodine ingestion. Horm Res. 2009;72(6):344-7. AIMS: To review cases of fetal/newborn goiter due to excess maternal iodine ingestion. **…** We reviewed the medical records of all patients that presented with congenital goiter in 2003. We used the PubMed search engine to conduct a review of publications addressing congenital goiter and excessive iodine intake. **…Maternal ingestion of large amounts of iodine due to an error in the manufacturing of a prenatal vitamin** caused a goiter in her fetus. Seven other women who received the same prenatal vitamin had newborn children with goiters. Three of these children were hypothyroid at the time of initial examination. Three patients (2 hypothyroid and 1 euthyroid) had thyroid scans with radioactive iodine; iodine uptake was elevated (>80%) in all 3, and in 1 the perchlorate washout test was positive. **…**The finding of congenital goiter and increased iodine uptake in a newborn is considered diagnostic of dyshormonogenesis, a permanent form of hypothyroidism. Our description is important because it demonstrates **that iodine excess during pregnancy may mimic some forms of dyshormonogenesis.** The differentiation between the two causes of newborn goiter may prevent the lifelong use of supplemental levothyroxine in patients with a transient abnormality.

Breastfeeding and maternal and infant iodine nutrition. Clinical Endocrinology. 70(5):803-9, 2009 May. Adequate concentration of iodine in breast milk is essential to provide for optimal neonatal thyroid hormone stores and to prevent impaired neurological development in breast-fed neonates. In many countries of the world, low iodine content of the breast milk indicates less than optimum maternal and infant iodine nutrition. The current WHO/ICCIDD/UNICEF recommendation for daily iodine intake (250 microg for lactating mothers) has been selected to ensure that iodine deficiency dose not occur in the postpartum period and that the iodine content of the milk is sufficient for the infant's iodine requirement

Iodine status and thyroid function of pregnant, lactating women and infants (0-1 yr) residing in areas with an effective Universal Salt Iodization program. Asia Pacific Journal of Clinical Nutrition. 18(1):34-40, 2009. Pregnant women, lactating women and infants were selected randomly in the regions where iodized salt coverage rate is more than 90% since 2000. Median Urinary Iodine (MUI) of infants, three groups of pregnant women (first, second and third trimester) and two groups lactating women (breastfeeding less than or more than six months) were 233, 174, 180, 147, 126 and 145 microg/L, respectively. Median milk iodine of lactating women was 163 microg/L. **Percentage of milk iodine < 150 microg/L of early lactating women was 40% less than that of late lactating women** ($p < 0.01$). **There was a positive correlation between urine iodine of infants and milk iodine of lactating women** ($r = 0.526$, $p = 0.000$)…. **Total 15.4% women's TSH were abnormal. Most of these women's urinary iodine were lower than 150 microg/L**.

Iodine Content of prenatal multivitamins in the United States. NEJM. 2009;360:939-940. The amount of iodine on the label was found not to be a good indicator of the amount in the product; in most cases it was less than stated and in some cases more. Kelp-based products were less reliable than products using potassium iodide. 127 non-prescription and 96 prescription prenatal vitamins were identified. 69% of non-prescription but only 28% of prescription products contained iodine at all, according to the label. 13 brands contained levels that were discordant by 50% or more with the amount on the label.

Iodine levels and thyroid hormones in healthy pregnant women and birth weight of their offspring. Eur J Endocrinol. 2009 Mar;160(3):423-9. Studied 239 women who had thyroid function and UIC at the first and third trimesters available. Conclusions: The present study suggests that iodine status during pregnancy may be related to prenatal growth in healthy women.

A study for maternal thyroid hormone deficiency during the first half of pregnancy in China. Eur J Clin Invest. 2009 Jan;39(1):37-42.

Prenatal induced chronic dietary hypothyroidism delays but does not block adult-type Leydig cell development. Am J Physiol Endocrinol Metab. 2009 Feb;296(2):E305-14.

Iodine deficiency in pregnancy and the effects of maternal iodine supplementation on the offspring: a review. Am J Clin Nutr. 2009 Feb;89(2):668S-72S**. The World Health Organization (WHO) recently increased their recommended iodine intake during pregnancy from 200 to 250 microg/d and suggested that a median urinary iodine (UI) concentration of 150-249 microg/L indicates adequate iodine intake in pregnant women.** Thyrotropin concentrations in blood collected from newborns 3-4 d after birth may be a sensitive indicator of even mild iodine deficiency during late pregnancy; a <3% frequency of thyrotropin values >5 mU/L indicates iodine sufficiency. New reference data & a simple collection system may facilitate use of the median UI concentration as an indicator of iodine status in newborns. In areas of severe iodine deficiency, maternal & fetal hypothyroxinemia can cause cretinism and adversely affect cognitive development in children; to prevent fetal damage, iodine should be given before or early in pregnancy. Whether mild-to-moderate maternal iodine deficiency produces more subtle changes in cognitive function in offspring is unclear; no controlled intervention studies have measured long-term clinical outcomes. Cross-sectional studies have, with few exceptions, reported impaired intellectual function & motor skills in children from iodine-deficient areas, but many of these studies were likely confounded by other factors that affect child development. In countries or regions where <90% of households are using iodized salt & the median UI concentration in school-age children is <100 microg/L, the WHO recommends iodine supplementation in pregnancy and infancy.

Iodine status of pregnant women and their progeny in the Minho Region of Portugal. Thyroid. 2009 Feb;19(2):157-63. … in Portugal, a country that the International Council for Control of Iodine Deficiency Disorders considered, in 2004, to have probably reached iodine sufficiency. … [Results of this study] suggest that iodine supplementation should be implemented throughout pregnancy and lactation in Portugal.

Gestational thyroid function abnormalities in conditions of mild iodine deficiency: early screening versus continuous monitoring of maternal thyroid status Eur J Endocrinol. 2009 Jan 29. Conclusions: In mildly ID areas thyroid function testing early in gestation seems to be only partly effective in identifying thyroid underfunction in pregnant women. Indeed, in our series more than 40% hypothyroid women would not have been diagnosed had we limited our observation to early thyroid function tests alone. Although thyroid

autoimmunity carried a 5-fold increased risk of hypothyroidism, iodine deficiency seems to be a major determinant in the occurrence of thyroid underfunction. Adequate iodine supplementation should be strongly recommended to meet the increased hormone demand over gestation.

Colostrum iodine and perchlorate concentrations in Boston-area women: a cross-sectional study. Clin Endocrol (Oxf). 2009 Feb;70(2):326-30 OBJECTIVE: To measure levels of colostrum iodine, which has not been previously measured… RESULTS: Sufficient colostrum was obtained to measure iodine in 61 samples … . Median colostrum iodine content was 51.4 micromol/l (range 21.3-304.2 microg/l)., CONCLUSIONS: Iodine is present in human colostrum and thus available for breastfeeding infants immediately after birth.

CB Note:

These researchers report that the **median colostrum iodine content was 51.4** micromol/l, with a very wide range (21.3-304.2). As described earlier (Breastfeeding and maternal and infant iodine nutrition. Clin Endocrinol (Oxf). 2008 Oct 6.) in areas of iodine sufficiency **breast milk iodine concentration should be in the range of 100-150 mug/dL**. That means that we must interpret this research as indicating that colostrum can and does contain iodine, but the amount is generally often well below the level found in the milk of women who are iodine sufficient. It would be interesting to evaluate the colostrum iodine content among women who have biochemical evidence of being iodine sufficient versus those who are not. In any case, it appears that like milk, the iodine content of colostrums varies significantly, most likely depending on the mother's state of adequacy or inadequacy. **Iodine is clearly one more nutrient for which we must not assume that mother's milk or colostrum will automatically deliver the necessary level to the baby if mother's own iodine status is poor. At the same time, it is also now clear that we must not assume that her iodine status is adequate. This will require some serious re-thinking of our current maternal-child nutrition recommendations in order to assure iodine adequacy for all.**

Thyroid disorders during pregnancy .Dtsch Med Wochenschr. 2009 Jan;134(3):83-6.

Is maternal diet supplementation beneficial? Optimal development of infant depends on mother's diet. Am J Clin Nutr. 2009 Feb;89(2):685S-7S . **…** Whatever the limitations of our current state of knowledge, it is apparent that pregnancy and lactation are periods during which good nutrition is exceptionally important. The infant is not protected from the inadequate diet of the mother.

Maternal milk concentration of zinc, iron, selenium, and iodine and its relationship to dietary intakes. Biol Trace Elem Res. 2009 Jan;127(1):6-15. … Rio Grande WIC: The lactating mothers consumed significantly less Zn, Se, and I when compared to the Recommended Dietary Allowances (RDA) even though Fe intake was higher than the RDA value. Breast milk concentration of Zn, Fe, and Se were in agreement within the range of representative values for Constituents of Human Milk but Iodine was at significantly lower concentration than the representative value.

2008

Iodine status of the U.S. population, National Health and Nutrition Examination Survey 2003-2004. Thyroid. 2008 Nov;18(11):1207-14. BACKGROUND: Since 1971, the general U.S. population has been monitored for dietary iodine sufficiency by urinary iodine (UI) measurements through the National Health and Nutrition Examination Survey (NHANES). This report presents the UI levels for the population participating in NHANES 2003-2004. It is the third assessment of the U.S. population since NHANES III (1988-1994), when the median UI level was observed to decrease from NHANES I (1971-1974). METHODS: In 2003-2004, a stratified, multistage, probability sample of approximately 5000 participants per year were selected to participate in NHANES Household interviews, and specimen collection were performed. UI level was measured by inductively coupled plasma mass spectrometry on a random subsample of 2526 participants aged 6 years and older. RESULTS: The **median UI level** for the general U.S. population in 2003-2004 **was 160 microg/L** (95% confidence interval [CI] 146-172), and 11.3 +/- 1.8% of the population had a UI level below 50 microg/L. Children had a higher UI level than adolescents and adults. **Among all (pregnant and nonpregnant) women of reproductive age, the median UI level was 139 microg/L** (95% CI

117-156), **15.1 +/- 3.2% women had a UI level <50 microg/L**, and Non-Hispanic blacks in this group had a lower UI level than other racial/ethnic groups. **CONCLUSIONS: These findings affirm the stabilization of the UI level and the adequate iodine nutrition in the GENERAL U.S. population since 2000. Future surveys designed to achieve UI levels representative of pregnant women can improve the estimate of iodine sufficiency in this population subgroup. Continued monitoring of the population for iodine sufficiency is warranted because of groups at risk for iodine deficiency disorders.**

CB note:

Some key points from the above report that I don't want to get lost: Although the average UI in this large US study (160 mcg/L) was interpreted as reflecting adequacy of iodine, **the median UI level for <u>women</u> was 139; in several studies a UI of <150 is described as indicating iodine deficiency.** There are many issues about how iodine sufficiency is assessed, but it looks like an important observation to mark that even if the "general" US population is fine, women (pregnant or not) are much less likely to achieve the value the NHANES researchers describe as adequate iodine status. Additionally, note that they also report that about 15% of women had a UI of <50! Fifteen percent of the women is a lot of people (some at reproductive age) with seriously poor iodine status.

Iodine status and thyroid volume changes during pregnancy: results of a survey in Aran Valley (Catalan Pyrenees, Spain.) J Endocrinol Invest. 2008 Oct;31(10):851-5 The Aran Valley has a long-standing history of iodine deficiency. … As of 2000, iodine deficiency among pregnant women in the Aran Valley was still very high… preconceptional supplements with iodine are required for its prevention.

Perinatal and chronic hypothyroidism impair behavioural development in male and female rats. Exp Physiol. 2008 Nov;93(11):1199-209.

Perinatal iodine deficiency in the Far East. Vopr Pitan. 2008;77(5):65-8.

Maternal and infant thyroid disorders and cerebral palsy. Semin Perinatol. 2008 Dec;32(6):438-4. … A major research priority should be to assess the effects on CP risk of thyroid supplementation in transient hypothyroxinemia of prematurity. Iodine deficiency can be addressed by inexpensive and well-established public health measures, and thyroid hormone deficiency can be addressed by inexpensive and well-established clinical measures. If a causal chain can be established that links iodine and thyroid hormone to risk of CP, the potential for introducing very cost-effective ways of reducing the burden of CP will be considerable.

Iodine balance, iatrogenic excess, and thyroid dysfunction in premature newborns. Semin Perinatol. 2008 Dec;32(6): 407-12 … The iodine intake of newborns is entirely dependent on the iodine content of breast milk and the formula preparations used to feed them. An inadequate iodine supply (deficiency and excess) might be especially dangerous in the case of premature babies. The minimum recommended dietary allowance is different depending on age groups. **The iodine intake required is at least 15 microg/kg/d in full-term infants and 30 microg/kg/d in preterms.** Premature infants are in a situation of iodine deficiency, precisely at a stage of psychomotor and neural development that is extremely sensitive to alterations of thyroid function.

Iodine deficiency in 2007: global progress since 2003. Food Nutr Bull. 2008 Sep;29(3):195-202 Conclusions: Global progress in controlling iodine deficiency has been made since 2003, but efforts need to be accelerated in order to eliminate this debilitating health issue that affects almost one in three individuals globally. Surveillance systems need to be strengthened to monitor both low and excessive intakes of iodine.

Micronutrient status, cognition and behavioral problems in childhood. Eur J Nutr. 2008;47 Suppl 3:38-50.

Reference values for neonatal thyroid volumes in a moderately iodine-deficient area. J Endocrinol Invest. 2008 Jul;31(7):642-6. The reference ranges of thyroid volumes in neonates vary according to the iodine status of a specific region. In different studies, it ranged between 0.47 and 1.62 ml. It has been previously shown that Bursa city was a moderately iodine-deficient area. We therefore aimed at determining normal reference ranges of neonatal thyroid volumes in our moderately iodine-deficient area. … Conclusion: Normal thyroid volumes in neonates vary

between different regions. Local reference values should be used in thyroid volume assessment. Our results are in concordance with the literature and can be used as reference values for our region.

CB note:

These researchers (above) found that in their "moderately iodine -deficient area" neonates have evidence of poorer iodine status (i.e. larger thyroid volume) than elsewhere. They appear to suggest using a local regional average to assess inadequacy to better reflect their population. However, just re-labeling poor iodine status as "OK for around here" is unlikely to be helpful. **Establishing lower iodine reference values as regionally "normal" because they are commonly seen seems like a recipe for missing infants at risk.** It reminds me of the old vitamin D tables that gave significantly lower blood levels as "normal" if the measurement was done in the winter. It was "normal" only in the mathematical sense of the word because deficiency was in fact very common in the winter especially. However, as we have been learning in the vitamin D world, "averages" and "normal values" in this situation are not the same thing as "healthiest" values.

Iodine deficiency, more than cretinism and goiter. Med Hypotheses. 2008 Nov;71(5):645-8. Recent reports of the World Health Organization show iodine deficiency to be a worldwide occurring health problem. … iodine deficiency may give rise to clinical symptoms of hypothyroidism without abnormality of thyroid hormone values. [Hypothesis discussed here that there may be a relationship] between iodine deficiency and obesity, attention deficit hyperactivity disorder (ADHD), psychiatric disorders, fibromyalgia, and malignancies.

Iodine prophylaxis using iodized salt and risk of maternal thyroid failure in conditions of mild iodine deficiency. J Clin Endocrinol Metab. 2008 Jul;93(7):2616-21.

Inadequate iodine nutrition of pregnant women from Extremadura [Spain] Eur J Endocrinol. 2008 Oct;159(4):439-45.

Iodine deficiency disorders and their prevention in India. Rev Endocr Metab Disord. 2008 Sep;9(3):237-44**.** New insights on the high prevalence of functional decompensation of the thyroid among newborn and children from several states of India as well as neighbouring countries of Nepal and Bhutan helped to prevent nutritional iodine deficiency and iodine deficiency disorders through country-wide iodized salt prophylaxis. Presently on the basis of scientific studies, salt iodization in India is saving millions of children from neonatal hypothyroidism related psycho-physical retardation.

Can neonatal TSH screening reflect trends in population iodine intake. Thyroid. 2008 Aug;18(8):883-8. The distribution of neonatal blood thyroid-stimulating hormone (TSH) concentrations has been used as an index reflecting population dietary iodine intake, with higher concentrations being indicative of lower iodine intake. We examined this distribution in neonates born in Ireland, where the pregnant population has shown a recent decline in urinary iodine (UI) excretion. … Conclusions: These data support a link between fetal thyroid function and a fall in maternal iodine intake. While the findings of the proportion of blood TSH values >5.0 mIU/L exclude severe maternal or fetal iodine deficiency, a trend toward increasing TSH may provide an early indication of impending iodine deficiency. The findings assume greater importance in the context of declining UI reported from many developed countries even where the proportion of blood TSH values >5.0 mIU/L is <3%, thus excluding severe maternal and fetal iodine deficiency.

Neurodevelopmental and neurophysiological actions of thyroid hormone. J Neuroendocrinol. 2008 Jun;20(6):784-94 For over 100 years, thyroid hormones have been known to be essential for neonatal neurodevelopment but whether they are required by the foetal brain remains a matter of controversy. For decades, the prevailing view was that thyroid hormones are not necessary until after birth because circulating levels in the foetus are very low and the placenta forms an efficient barrier to their transfer from the mother. … It is now clear that thyroid hormones are essential for both foetal and post-natal neurodevelopment and for the regulation of neuropsychological function in children and adults. …

Methods to assess iron and iodine status. Br J Nutr. 2008 Jun;99 Suppl 3:S2-9. Four methods are recommended for assessment of iodine nutrition: urinary iodine concentration, the goitre rate, and blood concentrations of thyroid stimulating hormone and thyroglobulin. These indicators are complementary, in that **urinary iodine** is a sensitive indicator of recent iodine intake (days) and **thyroglobulin** shows an intermediate response (weeks to months), whereas changes in the **goitre rate** reflect long-term iodine nutrition (months to years). **Spot urinary iodine concentrations** are highly variable from day-to-day and should not be used to classify iodine status of individuals. International reference criteria for thyroid volume in children have recently been published and can be used for identifying even small goitres using thyroid ultrasound. Recent development of a **dried blood spot thyroglobulin assay** makes sample collection practical even in remote areas. **Thyroid stimulating hormone** is a useful indicator of iodine nutrition in the newborn, but not in other age groups.

Iodine: deficiency and therapeutic considerations. Altern Med Rev. 2008 Jun;13(2):116-27. … The safety of therapeutic doses of iodine above the established safe upper limit of 1 mg is evident in the lack of toxicity in the Japanese population that consumes 25 times the median intake of iodine consumption in the United States. …

The many reasons why goiter is seen in old paintings. Thyroid. 2008 Apr;18(4):387-93.

The results of the "tiromobil" epidemiological trial of pregnant women in the Russian Federation. Ter Arkh. 2008;80(2):78-81. CONCLUSION: Most of the pregnant women in the regions studied were at risk of diseases associated with iodine deficiency. Prevention of iodine deficiency is not adequate.

Analysis of food supplements containing iodine: a survey of Italian market[in Italy]. Clin Toxicol (Phila). 2008 Apr;46(4):282-6. Aim: Compare claimed concentrations of iodine with measured ones in various iodine-supplemented products … Analytical values resembled those declared in the label in fewer than half of the examples… Labeling of iodine-rich food supplements appears to be unreliable …

Iodine in breast milk of nursing mother in normal and with premature birth. Vopr Pitan. 2008;77(6):75-8. Iodine content in breast milk depends on the consumption level of iodine. Iodine deficiency in mothers results in inadequate iodine status of neonates. Iodine supplements at any gestation stage normalized iodine content in breast milk. [Study done in Russia.]

Naturally occurring iodine in humic substances in drinking water in Denmark is bioavailable and determines population iodine intake. Br J Nutr. 2008 Feb;99(2):319-25.

Breastfeeding and maternal and infant iodine nutrition. Clin Endocrinol (Oxf). 2008 Oct 6. Thirty six MEDLINE studies between 1960 – 2007.Conclusions: Adequate concentration of iodine in breast milk is essential to provide for optimal neonatal thyroid hormone stores and to prevent impaired neurological development in breastfed neonates. In many countries of the world, low iodine content of the breast milk indicates less than optimum maternal and infant iodine nutrition. The current WHO/ICCIDD/UNICEF recommendation for daily iodine intake (250 mug for lactating mothers) has been selected to ensure that iodine deficiency does not occur in the postpartum period and that the iodine content of the milk is sufficient for the infant's iodine requirement.

Intake of iodine and perchlorate and excretion in human milk. Environ Sci Technol. 2008 Nov 1;42(21):8115-21.

Treating iodine deficiency: long-term effects of iodine repletion on growth and pubertal development in school-age children. Thyroid. 2008;18(4):449-54.[Azerbaijan] Long-term correction of severe ID leads to sustained improvement of linear growth accompanied by a normalization of the time of onset of pubertal development for both sexes.

The complex hygienic characteristics preventive iodine deficiency in population of Siberia. Vopr Pitan. 2008;77(2):59-63. … The study showed that 58.3-88.1% of examined children … suffer from iodine deficiency. …Preventable iodine deficiency … is the reason for many illnesses. It is an important and until now an unresolved problem of the Krasnoyarsk areas.

Status of iodine nutrition of children until 1 year: consequences on the thyroid function. Arch Pediatr. 2008 Aug;15 (8):1276-82. Iodine status is not optimal in French population of hospitalized children in the first year. They also found no clear relationship between iodine status and thyroid function.

Intake of iodine and perchlorate and excretion in human milk. Environ Sci Technol. 2008 Nov 1;42(21):8115-21.

Iodine prophylaxis using iodized salt and risk of maternal thyroid failure in conditions of mild iodine deficiency. J Clin Endocrinol Metab. 2008 Apr 15

Transient neonatal hypothyroidism due to amiodarone administration during pregnancy--two cases report and review of literature. Arq Bras Endocrinol Metabol. 2008 Feb;52:126-30.

Iodine deficiency in pregnant women residing in an area with adequate iodine intake. Nutrition. 2008 May;24(5):458-61.Conclusion: This observational study demonstrated that, despite the adequate supplementation of iodine intake, most pregnant women appear not to be protected against iodine deficiency. If confirmed in larger case studies, this finding claims the attention of relevant professionals to monitor iodine nutrition during gestation, assuming that ordinary supplementation of iodine intake seems to be sufficient only in non-gestational conditions.

Establishment of reference range for thyroid hormones in normal pregnant Indian women. BJOG. 2008 Apr;115(5):602-6

Iodide concentrations in matched maternal serum, cord serum, and amniotic fluid from preterm and term human pregnancies. Reprod Toxicol. 2008 Jan;25(1):129-32.

The influence of gestational stage on urinary iodine excretion in pregnancy. J Clin Endocrinol Metab. 2008 May;93(5):1737-42.

Association of first-trimester thyroid function test values with thyroperoxidase antibody status, smoking, and multivitamin use. Endocr Pract. 2008 Jan-Feb;14(1):33-9.

Hypothyroidism and pregnancy: impact on mother and child health. Ann Biol Clin (Paris). 2008;66(1):43-51.

Amniotic fluid iodine concentrations do not vary in pregnant women with varying iodine intake. Br J Nutr. 2008 21:1-4

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Reaching optimal iodine nutrition in pregnant and lactating women and young children: programmatic recommendations. Public Health Nutr. 2007 Dec;10(12A):1527-9.

Prevention and control of iodine deficiency in pregnant and lactating women and in children less than 2-years-old: conclusions and recommendations of the technical consultation. Public Health Nutr. 2007 Dec;10(12A):1606-11

The goitre rate, its association with reproductive failure, and the knowledge of iodine deficiency disorders (idd) among women in ethiopia: cross-section community based study. BMC Public Health. 2007 Nov 8;7(147):316.

The impact of iodised salt or iodine supplements on iodine status during pregnancy, lactation and infancy. Public Health Nutr. 2007 Dec;10(12A):1584-95.

Reproductive age in the United States Of America. Public Health Nutr. 2007 Dec;10:1532-9; Discuss 1540-1.

The importanceof iodine nutrition during pregnancy. Public Health Nutr. 2007 Dec;10(12A):1542-6. Conclusions: Iodine prophylaxis should be given systematically to women during pregnancy. In most public health programmes dealing with the correction of iodine deficiency disorders, iodised salt has been used as the preferred means to deliver iodine to households. Iodised salt, however, is not the ideal means of delivering iodine in the specific instances of pregnancy, breast-feeding and complementary feeding because of the need to limit salt intake during these periods. In European countries, presently it is proposed that iodine is given to pregnant women and breast-

feeding mothers by systematically administering multivitamin tablets containing iodine in order to reach the recommended dietary allowance of 250 microg iodine day-1.

Iodine requirements during pregnancy, lactation and the neonatal period and indicators of optimal iodine Nutrition. Public Health Nutr. 2007;10(12A):1571-80; Discussion 1581-3.Conclusions: Pregnant women and young infants, but especially the second group, are more sensitive to the effects of an iodine deficiency (ID) than the general population because their serum thyroid-stimulating hormone (TSH) and thyroxine are increased and decreased, respectively, for degrees of ID that do not seem to affect thyroid function in the general population. Systematic neonatal thyroid screening using primary TSH could be the most sensitive indicator to monitor the process of ID control.

Iodine deficiency and brain development in the first half of pregnancy. public health nutr. 2007;10 (12A): 1554-70. An inadequate supply of iodine during gestation results in damage to the foetal brain that is irreversible by mid-gestation unless timely interventions can correct the accompanying maternal hypothyroxinemia. Even mild to moderate maternal hypothyroxinemia may result in suboptimal neurodevelopment. This review mainly focuses on iodine and thyroid hormone economy up to mid-gestation, a period during which the mother is the only source for the developing brain of the foetus. The cerebral cortex of the foetus depends on maternal thyroxine (T4) for the production of the 3',3,5-tri-iodothyronine (T3) for nuclear receptor-binding and biological effectiveness.Maternal hypothyroxinemia early in pregnancy is potentially damaging for foetal brain development. Direct evidence has been obtained from experiments on animals: even a relatively mild and transient hypothyroxinemia during corticogenesis, which takes place mostly before mid-gestation in humans, affects the migration of radial neurons, which settle permanently in heterotopic locations within the cortex and hippocampus. Behavioural defects have also been detected.The conceptus imposes important early changes on maternal thyroid hormone economy that practically doubles the amount of T4 secreted something that requires a concordant increase in the availability of iodine, from 150 to 250-300 microg I day- 1. Women who are unable to increase their production of T4 early in pregnancy constitute a population at risk for having children with neurological disabilities. As a mild to moderate iodine deficiency is still the most widespread cause of maternal hypothyroxinemia, the birth of many children with learning disabilities may be prevented by advising women to take iodine supplements as soon as pregnancy starts, or earlier if possible, in order to ensure that their requirements for iodine are met.

Iodine deficiency, iodine content of salt and knowledge of iodine supplementation in the Dominican Republic. J Trop Pediatr. 2007 Jun;53(3):214-6.

The declaration of nutrition, health, and intelligence for the child-to-be. Nutr Health. 2007;19:85-102.

Increase in congenital hypothyroidism in new york state and in the United States. Mol Genet Metab. 2007 Jul;91(3):268-77. Mandated screening of newborns for congenital hypothyroidism (CH) in NYS was initiated in l978. Currently, every newborn screening program in the U.S. includes CH in its panel. Between 1978 and 2005, 7.4 million newborns were screened for CH in NYS. In NYS, between 1978 and 2005, the incidence of CH has increased by 138%. Nationwide (excluding NYS data), with nearly 58 million infants screened between 1987 and 2002, the incidence has increased 73% between 1987 and 2002. These data and possible reasons for the increases are discussed, though no definitive causes are identified.

Iodine supplementation during pregnancy: a public health challenge. Trends Endocrinol Metab. 2007 Nov;18(9): 338-43. Iodine deficiency remains the most frequent cause worldwide, after starvation, of preventable mental retardation in children. It causes maternal hypothyroxinemia, which affects pregnant women even in apparently iodine-sufficient areas, and often goes unnoticed because L-thyroxine (T4) levels remain within the normal range, and thyroid-stimulating hormone (TSH) is not increased. Even a mild hypothyroxinemia during pregnancy increases the risk of neurodevelopmental abnormalities, and experimental data clearly demonstrate that it damages the cortical cytoarchitecture of the fetal brain. The American Thyroid Association (ATA) recommends a supplement of 150 microg iodine/day during pregnancy and lactation, in addition to the use of iodized salt. We discuss the importance of iodine supplementation to ensure adequate T4 levels in all women who are considering conception and throughout pregnancy and lactation.

Evaluating iodine deficiency in pregnant women and young infants-complex physiology with a risk of misinterpretation. Public Health Nutr. 2007 Dec;10(12A):1547-52; Discussion 1553.

The adverse effects of mild-to-moderate iodine deficiency during pregnancy and childhood: a review. Thyroid. 2007 Sep;17(9):829-35. Iodine is required for the production of thyroid hormones, which are essential for normal brain development, and the fetus, newborn, and young child are particularly vulnerable to iodine deficiency. The iodine requirement increases during pregnancy and recommended intakes are in the range of 220-250 microg/day. Monitoring iodine status during pregnancy is a challenge. New recommendations from World Health Organization suggest that a median urinary iodine concentration >250 microg/L and <500 microg/L indicates adequate iodine intake in pregnancy. Based on this range, it appears that many pregnant women in Western Europe have inadequate intakes. A recent Swiss study has suggested that thyroid-stimulating hormone concentration in the newborn is a sensitive indicator of mild iodine deficiency in late pregnancy. The potential adverse effects of mild iodine deficiency during pregnancy are uncertain. Controlled trials of iodine supplementation in mildly iodine-deficient pregnant women suggest beneficial effects on maternal and newborn serum thyroglobulin and thyroid volume, but no effects on maternal and newborn total or free thyroid hormone concentrations. There are no long-term data on the effect of iodine supplementation on birth outcomes or infant development. New data from well-controlled studies indicate that iodine repletion in moderately iodine-deficient school-age children has clear benefits: it improves cognitive and motor function; it also increases concentrations of insulin-like growth factor 1 and insulin-like growth factor-binding protein 3, and improves somatic growth.

National trends in iodine nutrition: is everyone getting enough? Thyroid. 2007 Sep;17(9):823-7. Iodine deficiency is an important public health problem worldwide. Until the 1920s, endemic iodine deficiency disorders were prevalent in the Great Lakes, Appalachian, and Northwestern regions of the United States. Iodized salt was responsible for eliminating endemic goiter in the United States & remains the mainstay of iodine deficiency disorder eradication efforts worldwide. Although urinary iodine values have decreased by 50% since the early 1970s, the USA remains iodine sufficient. However, U.S. iodine nutrition, particularly among women of childbearing age, may remain an area worthy of public health concern. There is a wide amount of variation in the iodine content of some common foods, & the iodine content of foods is not well reflected by package labeling. There needs to be increased awareness of the importance of adequate iodine nutrition, particularly during pregnancy & lactation, among the U.S. public.

Iodine nutrition in pregnancy and lactation in Iran. Public Health Nutr. 2007 Dec;10(12A):1596-9. The currently recommended intake of iodine through universal salt iodization may not be adequate for pregnant & lactating women, & supplementation during pregnancy & lactation should be further considered in light of the latest recommendations.

Iodine nutrition of pregnant and lactating women in Hong Kong, where intake is of borderline sufficiency. Public Health Nutr. 2007 Dec;10(12A):1600-1 The currently recommended intake of iodine through universal salt iodization may not be adequate for pregnant and lactating women, and supplementation during pregnancy and lactation should be further considered in light of the latest recommendations.

Obstetric management of thyroid disease. Obstet Gynecol Surv. 2007 Oct;62(10):680-8; Quiz 691.

Thyroid disorders in pregnancy and after delivery. Przegl Lek. 2007;64(3):159-64.

Reaching optimal iodine nutrition in pregnant and lactating women and young children: programmatic recommendations. Public Health Nutr. 2007 Dec;10(12A):1527-9.

Reflections on mental retardation and congenital hypothyroidism: effects of trace mineral deficiencies. Sante. 2007 Jan-Mar;17(1):41-50.

Assessment of intertrimester and seasonal variations of urinary iodine concentration during pregnancy in an iodine-replete area. Clin Endocrinol (Oxf). 2007 Oct;67(4):577-81.

Chronic maternal dietary iodine deficiency but not thiocyanate feeding affects maternal reproduction and postnatal performance of the rat. Indian J Exp Biol. 2007 Jul;45:603-9.

Thyroid hormones, learning and memory. Genes Brain Behav. 2007 Jun;6 Suppl 1:40-4. Thyroid hormones (THs), T3 & T4, have many physiological actions & are essential for normal behavioral, intellectual & neurological

development. THs have a broad spectrum of effects on the developing brain & mediate important effects within the CNS throughout life. Insufficient maternal iodine intake during gestation & TH deficiency during human development are associated to pathological alterations such as cretinism & mental retardation. In adulthood, thyroid dysfunction is related to neurological & behavioral abnormalities, including memory impairment. Analysis of different experimental models suggests that most of the effects on cognition as a result of thyroid dysfunction rely on hippocampal modifications. Insufficiency of THs during development thus alters hippocampal synaptic function and impairs behavioral performance of hippocampal-dependent learning and memory tasks that persist in euthyroid adult animals. In the present review, we summarize the current knowledge obtained by clinical observations & experimental models that shows the importance of THs in learning & mnemonic processes.

Iodine and thyroid hormones during pregnancy and postpartum. Gynecol Endocrinol. 2007 Jul;23:414-28. Iodine is a trace element essential for synthesis of the thyroid hormones, triiodothyronine & thyroxine. These hormones play a vital role in the early growth & development stages of most organs, especially the brain. The World Health Organization has declared that, after famine, iodine deficiency is the most avoidable cause of cerebral lesions including different degrees of mental retardation & cerebral paralysis. The main function of iodine in vertebrates is to interact with the thyroid hormones. During pregnancy sufficient quantities of iodine are required to prevent the appearance of hypothyroidism, trophoblastic & embryonic or fetal disorders, neonatal & maternal hypothyroidism, & permanent sequelae in infants. Thyroid hormone receptors & iodothyronine deiodinases are present in placenta & central nervous tissue of the fetus. A number of environmental factors influence the epidemiology of thyroid disorders, & even relatively small abnormalities & differences in the level of iodine intake in a population have profound effects on the occurrence of thyroid abnormalities. The prevalence of disorders related to iodine deficit during pregnancy & postpartum has increased. Iodine supplementation is an effective measure in the case of pregnant & lactating women. However, it is not implemented & the problem is still present even in societies with theoretically advanced health systems. During pregnancy & postpartum, the WHO recommends iodine intake be increased to at least 200 mcg/day. Side-effects provoked by iodine supplementation are rare during pregnancy at the recommended doses.

Iron deficiency predicts poor maternal thyroid status during pregnancy. J Clin Endocrinol Metab. 2007 Sep;92 (9):3436-40. Pregnant women are often iron deficient, and iron deficiency has adverse effects on thyroid metabolism. Impaired maternal thyroid function during pregnancy may cause neurodevelopmental delays in the offspring. Our objective was to investigate whether maternal iron status is a determinant of TSH and/or total T(4) (TT4) concentrations during pregnancy. …Conclusion: Poor maternal iron status predicts both higher TSH and lower TT4 concentrations during pregnancy in an area of borderline iodine deficiency**.**

To correct iodine deficiency in pregnancy: another salutary lesson from Tasmania. Med J Aust. 2007 Jun 4;186(11):574-6.

The diagnostic criteria of graves' disease and especially the thyrotropin receptor antibody; our own experience. Hell J Nucl Med. 2007 May-Aug;10(2):89-94.

Subclinical hypothyroidism and pregnancy. J Gynecol Obstet Biol Reprod (Paris). 2007 Nov;36(7):688-93.

Iodine supplementation for pregnancy and lactation: United States and Canada: recommendations of the american thyroid association. Thyroid. 2007 May;17(5):483-4.

Placental tissue iodine level and blood magnesium concentration in pre-eclamptic and normal pregnancy. Int J Gynaecol Obstet. 2007 Aug;98(2):100-4. Results: Placental tissue iodine levels were lower in women with severe pre-eclampsia than in healthy pregnant …as were blood magnesium levels ….There was a positive correlation between placental tissue iodine levels and blood magnesium levels in women with severe pre-eclampsia ($r=0.55$, $P<0.05$), but no such correlation was observed in healthy pregnant women ($r=0.23$, $P=0.41$). Conclusion: Mg assimilation is known to be defective when iodine levels are insufficient. In northeast Anatolia, where iodine deficiency is common, clinical trials of iodine supplementation should be considered for pre-eclamptic therapy.

Clinical and biological consequences of iodine deficiency during pregnancy. Endocr Dev. 2007;10:62-85. The main change in thyroid function associated with the pregnant state is the requirement of an increased production of thyroid hormone that depends directly upon the adequate availability of dietary iodine & integrity of the glandular machinery. In healthy pregnant women, physiological adaptation takes place when the iodine intake is adequate,

while this is replaced by pathological alterations when there is a deficient iodine intake. Pregnancy acts typically, therefore, as a revelator of underlying iodine restriction. Iodine deficiency has important repercussions for both the mother & the fetus, leading to hypothyroxinemia, sustained glandular stimulation & finally goitrogenesis. Furthermore, because severe iodine deficiency may be associated with an impairment in the psychoneurointellectual outcome in the progeny, because both mother & offspring are exposed to iodine deficiency during gestation (& the postnatal period), & because iodine deficiency is still prevalent today in several large regions of the world, iodine supplements should be given systematically to pregnant & breastfeeding mothers. Particular attention is required to ensure that pregnant women receive an adequate iodine supply, in order to reach the ideal recommended nutrient intake of 250 mcg iodine/day.

Autism: transient in utero hypothyroxinemia related to maternal flavonoid ingestion during pregnancy and to other environmental antithyroid agents. J Neurol Sci. 2007 Nov 15;262(1-2):15-26.

Smoking and environmental iodine as risk factors for thyroiditis among parous women. Eur J Epidemiol. 2007;22(7):467-72.

Local blood flow in the dorsal hippocampus and cerebellar cortex in the offspring of iodine-deficient rats. Neurosci Behav Physiol. 2007 Jun;37(5):495-8.

Short-term changes in maternal and neonatal urinary iodine excretion. Thyroid. 2007 Mar;17(3):219-22.

General background on the hypothalamic-pituitary-thyroid (hpt) axis. Crit Rev Toxicol. 2007;37(1-2):11-53.

Evaluating the roles of follicle-stimulating hormone receptor polymorphisms in gonadal hyperstimulation associated with severe juvenile primary hypothyroidism. J Clin Endocrinol Metab. 2007 Jun;92(6):2312-7.

Nutrition and the developing brain: nutrient priorities and measurement. Am J Clin Nutr. 2007;85(2):614S-620S

Effect of the level of iodine in the diet of pregnant ewes on the concentration of immunoglobulin g in the plasma of neonatal lambs following the consumption of colostrum. Br J Nutr. 2007 Feb;97:315-20.

Urine iodine measurements, creatinine adjustment, and thyroid deficiency in an Adult United States population. J Clin Endocrinol Metab. 2007 Mar;92(3):1019-22.Hypothyroidism: From the Desire for Pregnancy to Delivery. Gynecol Obstet Fertil. 2007 Mar;35(3):240-8.

Maternal smoking and infant feeding: breastfeeding is better and safer. Matern Child Health J. 2007;11(3):287-91.

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Urinary iodide assessment of the adult population in Catalonia. Med Clin (Barc). 2006 Nov 18;127:730-3.

Iodine excretion with urine and thyrotrophic hormone concentration in normal and complicated pregnancies in the industrial region of iodine deficiency. Wiad Lek. 2006;59(9-10):612-7.

Radioiodine therapy for women with graves' disease and the risk of foetal hypothyroidism if they are later found to be pregnant. Ned Tijdschr Geneeskd. 2006 Dec 30;150(52):2845-8.

Food restriction induced thyroid changes and their reversal after refeeding in female rats and their pups. Acta Biol Hung. 2006 Dec;57(4):391-402.

Effect of environmental iodine deficiency (eid) on foetal growth in Nigeria. Indian J Med Res.2006;124(5):535-44.

Selenium and goiter prevalence in borderline iodine sufficiency. Eur J Endocrinol. 2006 Dec;155(6):807-12.

Brain MR spectroscopy findings in neonates with hypothyroidism born to mothers living in iodine-deficient areas. AJNR Am J Neuroradiol. 2006 Nov-Dec;27(10):2083-7.

Status of iodine nutrition n france: prevention of iodine deficiency in pregnant and lactating women. Ann Endocrinol (Paris). 2006 Sep;67(4):281-6.

Thyroid function and thyroid autoimmunity at the late pregnancy: data from 664 pregnant women. Zhonghua Fu Chan Ke Za Zhi. 2006 Aug;41(8):529-32.

Effects of nutrients (in food) on the structure and function of the nervous system: Update on dietary requirements for brain. Part 1: Micronutrients. J Nutr Health Aging. 2006 Sep-Oct;10(5):377-85.

Iodine supplementation for pregnancy and lactation-United States and Canada: Recommendations of the American Thyroid Association. Thyroid. 2006;16(10):949-51. The fetus is totally dependent in early pregnancy on maternal thyroxine for normal brain development. Adequate maternal dietary intake of iodine during pregnancy is essential for maternal thyroxine production & later for thyroid function in the fetus. If iodine insufficiency leads to inadequate production of thyroid hormones & hypothyroidism during pregnancy, then irreversible fetal brain damage can result. In the USA, the median urinary iodine (UI) was 168 mcg/L in 2001-2, well within the range of normal established by the World Health Organization (WHO), but whereas the UI of pregnant women (173 mcg/L; 95% CI 75-229 mcg/L) was within the range recommended by WHO (150-249 mcg/L), the lower 95% CI was less than 150 mcg/L. Therefore, until additional physiologic data are available to make a better judgment, the American Thyroid Association recommends that women receive 150 mcg iodine supplements daily during pregnancy and lactation and that all prenatal vitamin/mineral preparations contain 150 mcg of iodine.

The function of thyroid gland during the course of pregnancy. Georgian Med News. 2006 Sep;(138):68-70.

Micronutrients in women's reproductive health: II. Minerals and trace elements. Int J Fertil Womens Med. 2006 May-Jun;51(3):116-24.

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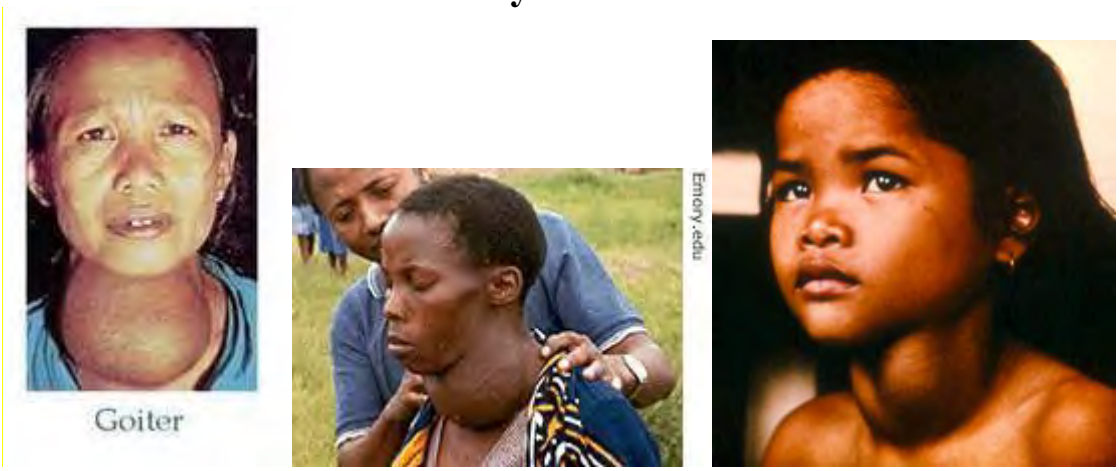
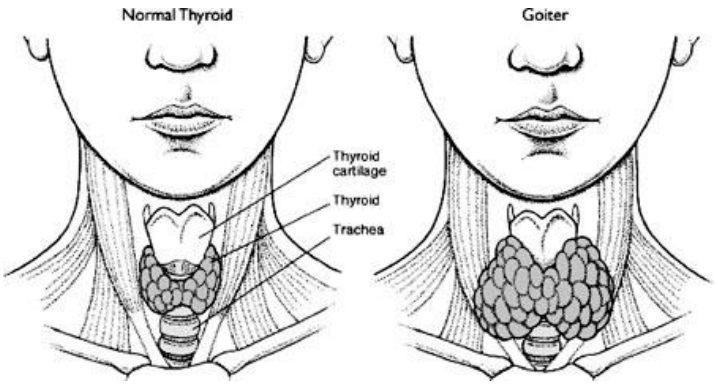
Thyroid hormones and fetal brain development. Minerva Ginecol. 2005 Aug;57(4):367-78.

Iodine Deficiency Disorders: Goiter



http://motherchildnutrition.org/early-malnutrition-detection/images/goitre.jpg



http://medicine-science.com/wp-content/uploads/2011/09/Iodine-Deficiency.jpg

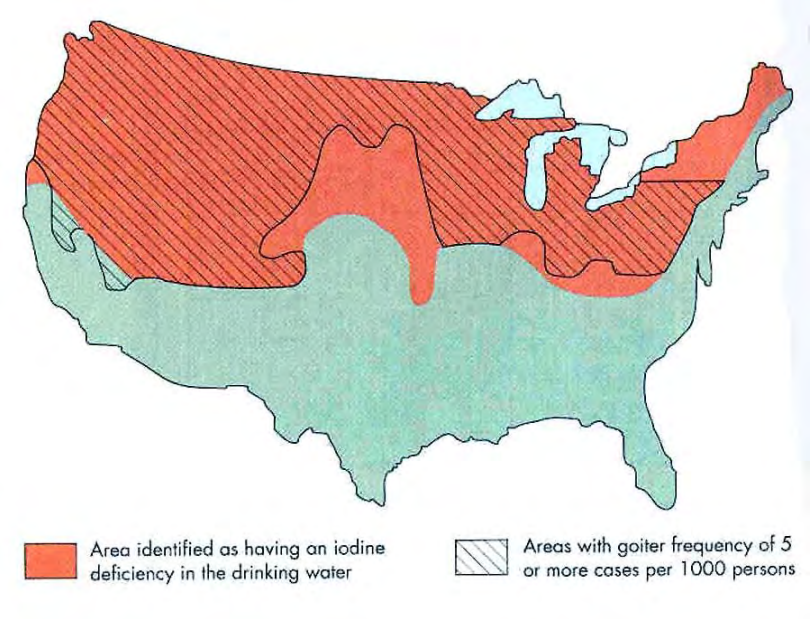
Iodine Deficiency Disorders:

Vulnerability to thyroid cancer from radioactive iodine exposure: "The Chernobyl Necklace" … Ukraine is a low iodine region.

Iodine Deficiency Disorders: The American "Goiter Belt"

Map showing spatial correlation between the former "Goiter Belt" in the northern U.S. and areas where the iodine content of drinking water is naturally low.

www.uwsp.edu/gEo/faculty/ozsvath/images/ goiter_belt.htm



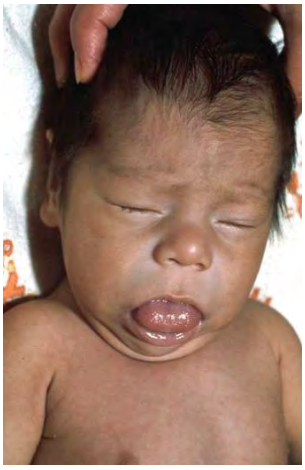
The start of the movement to iodize salt in America.

You often have to look Closely to see if salt is iodized or not.

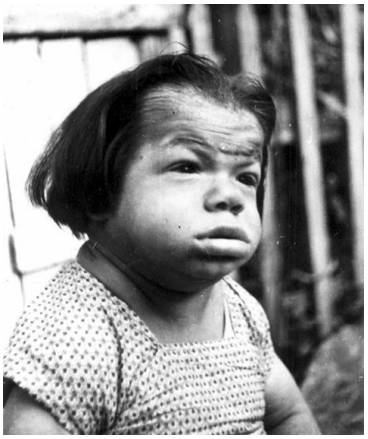
Some sea salt is iodized but most is not.

Iodine Deficiency Disorders: Cretinism

Iodine Deficiency is the Number One Cause of Preventable Mental Retardation in the World.



Cretinism



MeritCare Health System

Aunt Cathy
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Aunt Cathy's Guide to Nutrition: A Vitamin B12 Update

(Minimal Reference Version)

Vitamin B12 is needed in only tiny amounts, and unlike most B vitamins, it is stored well in the body. Most Americans eat foods that provide lots of it. So there shouldn't be any problem with vitamin B12, right? This is a Trick Question of course; if there were no problem I would not be here talking about it! ☺

Most references for the information provided here are included at the end. A few newer ones are sprinkled around in the text. As always, this handout is not intended to take the place of your physician or health care provider. It is simply a summary of the most recent information available in the scientific literature on this topic as of the date shown.

What does B12 do?

1. B12 is involved in making important chemical messengers and myelin in the brain and nervous system, so some of the major symptoms of deficiency are neurologic problems.

2. B12 is involved in the making DNA, the genetic center of every cell in the body. It is especially important during periods of growth (pregnancy, infancy and childhood), and in tissues that continually make a lot of new cells (red blood cells and the armies of cells in the immune system.)

What happens if B12 is too low?

Besides serious nerve damage and mental confusion, B12 deficiency damages the retina of the eye, and may play a role in conditions such as heart disease, stroke, Alzheimer's disease, incontinence and loss of hearing.

When deficiency is severe, people can have unusually high heart rates and have trouble breathing. Vitamin B12 deficiency causes changes in testicular tissues in men, and it may be related to increased risk of breast cancer in older women.

During pregnancy, inadequate B12 causes birth defects such as neural tube defects and brain damage. A new study suggests that underlying vitamin B12 deficiency may be involved in the development of HELLP Syndrome, a serious complication of pregnancy. [HELLP syndrome-like by vitamin B12 Deficiency: Report of seven cases. J Gynecol Obstet Biol Reprod (Paris). 2009 Mar 20]

What foods have B12?

The only natural food sources are animal products like meat, poultry, fish, milk, cheese and eggs. Other foods may have it added.

Who is at risk of low B12 status?

1. **People with <u>inadequate B12 in their diet</u>.**

   Strict Vegans (people who use no animal products) **and their breast-fed babies** are at high risk unless they take a B12 supplement. **Some people just eat a really poor diet** that happens to be very low in both meats and dairy foods.

2. **Some people <u>do not absorb</u> B12 well in spite of an adequate diet.**

   <u>Stomach problems</u> that may decrease B12 absorption:
   Gastrectomy (stomach removal);
   Gastric surgery for weight loss
   [Anemia after bariatric surgery: more than just iron deficiency. Nutr Clin Pract. 2009]
   Low stomach acid production or atopic gastritis (both common problems among the elderly);
   Infection with H. Pylori, a bacteria that causes ulcers and gastritis;
   Genetic factors causing low levels of "Intrinsic Factor," a B12 carrier made in the stomach.

<u>Conditions that affect the part of the small intestine</u> where it joins the large intestine (called the "terminal ileum"):

Surgical removal of that part of the intestine;
Crohn's disease (inflammatory bowel disease) or celiac disease;
Overgrowth of the intestine surface by bacteria or parasites such as giardia. This is especially common among adults older than 70 who have chronic diarrhea, loss of appetite, or nausea.

[Vitamin B12 status, methylmalonic acidemia, and bacterial overgrowth in short bowel syndrome. J Pediatr Gastroenterol Nutr. 2009 Apr;48(4):495-7.]

<u>Some medications interfere with absorption of B12 from food</u>.

Medications probably account for the surprisingly greater number of younger adults now being found to be deficient in B12. Drugs that block stomach acid production (like **Tagamet, Zantac and especially "proton pump inhibitors" like Prilosec, Nexium, Previcid and Protonics**) and the diabetes drug **Metformin (Glucophage)** all interfere with B12 absorption. Additionally, people with low vitamin B12 status are at great risk if **nitrous oxide anesthesia** is used.

<u>People with autoimmune disorders such as insulin-dependent diabetes, celiac disease, multiple sclerosis, and certain thyroid disorders have a higher risk of deficiency for several reasons</u>.

Sometimes it is related to nutrient malabsorption related to intestinal damage from poorly controlled celiac disease. However, as another autoimmune disorder, the severe vitamin B12 deficiency called pernicious anemia is also more common in this population. In some people with celiac disease, neurologic symptoms are not uncommon … it is important to monitor their B12 levels carefully.

In insulin dependent diabetes or multiple sclerosis, however, neurologic symptoms of pernicious anemia are often missed because they are written off as likely due to neurologic damage from those overriding conditions. An adult friend of mine with type 1diabetes experienced extremely debilitating neurologic symptoms because of having developed the autoimmune disease pernicious anemia. She could no longer walk and the pain was severe. Her symptoms were ascribed to complications of diabetes,

and I am sorry to report that it took quite a lot of pressure and several months to get the health care professionals involved in her care to check her vitamin B12 level.

She has improved greatly on vitamin B12 shots since then, but the painful neurologic damage will never be completely gone. Pernicious anemia has been documented in adolescents with diabetes, celiac disease, and autoimmune thyroid disorders as well as in adults, especially among those already identified as having two or more autoimmune diseases. [Pernicious anemia in an adolescent with type 1 diabetes mellitus. Arch Pediatr Apr;16(4):357-9]

Interestingly, parenteral vitamin B12 does look like it can be helpful in diabetic neuropathy, whether related to underlying pernicious anemia or not. [Vitamin B12 may be more effective than nortriptyline in improving painful diabetic neuropathy. Int. J. Food Sci 2009 Feb 12:1-6)]

How is B12 deficiency recognized?

Most commonly it is recognized when a blood test called a CBC shows red blood cells that are very large ("macrocytic anemia.") Unfortunately, this is a very **late-appearing symptom** and some nerve damage will have already happened by the time the problem is recognized. **It takes up to three years for symptoms of deficiency to develop**, so people often fail to associate the symptoms with a change in diet or health (such as having had stomach surgery, starting to use a certain medication, or deciding to follow a vegan diet.)

Some researchers estimate that as many as **30% of elderly people have unrecognized B12 deficiency**, often due to changes in the stomach and intestine caused by aging. This can contribute to symptoms such as confusion and other mental changes; correcting B12 inadequacy often results in great improvement.

Doctors can check **B12 levels in the blood**, and there are other markers called **homocysteine** and **methylmalonic acid (MMA).** This testing is not commonly done unless symptoms or risk factors suggest that there is a problem. However, it is impractical, expensive and unnecessary to do these tests regularly on everyone.

What should be done?

Quite a lot can be done to decrease the likelihood of B12 deficiency ever developing. Why risk possible inadequacy? **Assuring adequacy** is by far more cost-effective, health-protective and safe than waiting to act until symptoms of inadequacy become apparent.

1. **An inexpensive generic standard multivitamin with minerals is likely a very good investment for most people.** These provide the adult RDA of 2 mcg of well-absorbed B12. Products designed for older adults (**"Silver"-type multivitamins**) often have 25 mcg. Some have quite a lot more, as do some "B-100 complex" supplements. **Some researches now recommend >50 mcg/day. B12 is a very safe vitamin and overdose is extremely unlikely.** For some of the conditions (such as **low stomach acid**), simply taking a generous amount of vitamin B12 in a supplement form can solve the problem.

2. **For other conditions (such as surgical removal of the stomach or part of the intestine or autoimmune-related pernicious anemia), prescription B12 shots are often needed** to assure that there is enough in the body. New techniques include nasal inhalers, sub-lingual (under the tongue) versions, or extremely high oral doses of B12. As always, it is extremely important to monitor the effectiveness of any of these methods.

Summary:

Vitamin B12 deficiency is not uncommon (although it is often unrecognized) and it is very dangerous.

Certain diet patterns or health conditions increase the risk of unrecognized B12 deficiency. People with <u>any</u> of the risk factors described above should be sure to ask their doctors about this issue. Sharing this column with the doctor may be helpful.

The problem of unrecognized vitamin B12 deficiency is just one of the many reasons why it is regarded as "prudent" for all adults to take a daily multivitamin. (Journal of the American Medical Association, June 2002.)

(References and abstracts are available on the full-reference version)

Sanford Medical Center

Aunt Cathy's Guide To:

Vitamin B12 Absorption

(not scientifically correct)

Aunt Cathy

Cathy Breedon PhD, RD, CSP, FADA
Clinical/Metabolic Nutrition Specialist
Sanford Medical Center and
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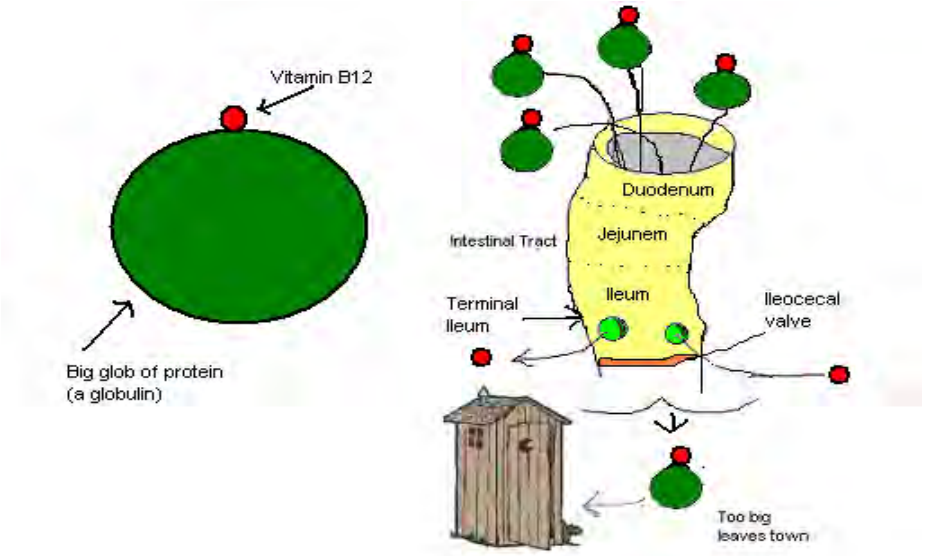
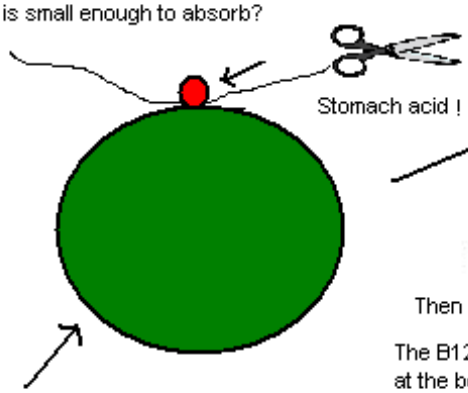
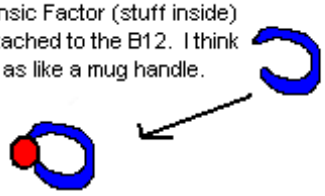


How do you cleave the glob off the B12 so it is small enough to absorb?



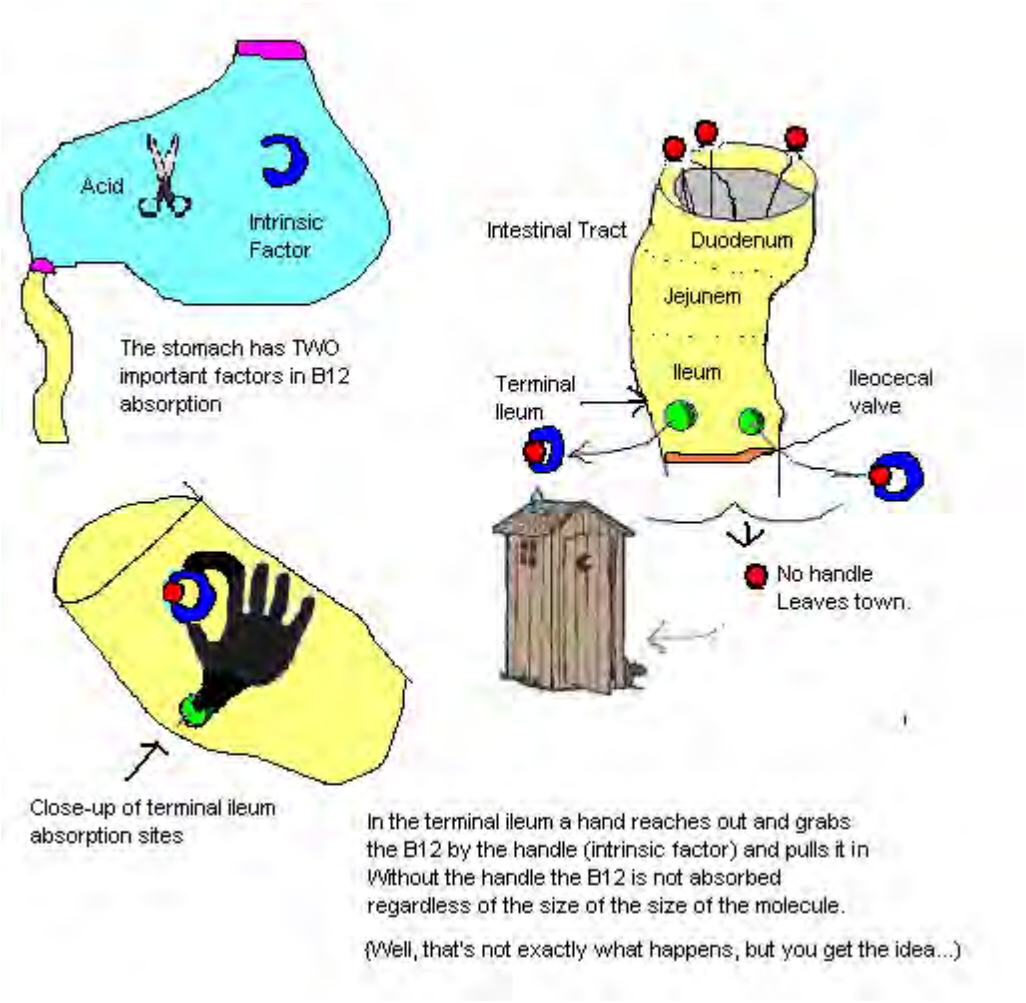
Then what happens?

Then (also in the stomach) "Intrinsic Factor (stuff inside) is attached to the B12. I think of IF as like a mug handle.



Then what?

The B12 with its handle enters the intestines and way at the bottom of the small intestine where it meets the colon, there is one spot where ha hand reaches out and grabs the handle to pull B12 in. This place (the "terminal ileum") is the only spot in the intestines where B12 can be absorbed.



Health situations that can impair vitamin B12 absorption:

1. Having inadequate stomach acid due to aging (achlorhydria) or the use of PPI acid blocking medications for gastroesophageal reflux means that the protein glob cannot be removed and the B12 is too big to absorb. **Solution:** The form in vitamin pills is just the vitamin B12 without the protein glob, so the problem is eliminated.

2. Failure to make or use intrinsic factor in the stomach (as in the genetic condition pernicious anemia or in people with stomach removal, stomach damage or gastric bypass surgery.) **Solution:** The "handle" is not available to efficiently absorb B12 regardless of the molecular size. This requires an alternate route of administration, such as B12 shots or supplement forms that are inhaled or sublingual.

3. The diabetes medication Metformin (Glucophage) impairs vitamin B12 absorption in the intestine. **Solution:** A generous intake can help, but vitamin B12 levels should be monitored for anyone on this medication, especially with long term use. Again, looking at "Mean Cell Volume" on a blood test will not detect a problem soon enough. At least a vitamin B12 serum level should be monitored.

4. Injury to terminal ileum can impair absorption as well: bacterial overgrowth, inflammatory bowel disease, poorly controlled celiac disease, surgical removal, etc. **Solution:** This may require an alternate route of administration, such as B12 shots or supplement forms that are inhaled or sublingual.

Sanford Medical Center

Aunt Cathy's Guide to:

Choosing Appropriate Infant Milks and Formulas

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Part 1: Nutrition Issues in Breastfeeding.

The ideal food for most babies is **human milk.** Even for this nearly Universal Truth however, there are exceptions (e.g. infants with the rare inborn metabolic error "galactosemia" may not have human milk.) Formulas are attempts to provide similar nutrition for healthy babies who are not breast-fed, or to meet the nutritional requirements of infants with special health problems. The American Academy of Pediatrics recommends human milk for at least the first year of life.

Although it is less common in America than in other nations, nursing through the second year (or even longer) is also beneficial and the practice is increasing. [However, it is important to note that, for reasons described later, it is not recommended to breastfeed the baby exclusively without the addition of selected other foods after six months, and without vitamin D supplementation throughout breastfeeding.]

This part of the paper will focus primarily on some evolving issues regarding the assurance of macronutrient and micronutrient adequacy in human milk. Commercial formulas and cow's/goat's milk issues in infant feeding will follow.

[For a more complete discussion of the many benefits of human milk and a review of the data now available that demonstrates its clear superiority to any formula for most babies, please see my separate paper entitled "Some Issues in Breastfeeding."]

Macronutrients: Protein, Carbohydrate and Lipids

The best infant diets are those which provide adequate but not excessive amounts of calories, protein, vitamins, minerals and fluid, with a distribution of calories from carbohydrate, protein and fat in the "desirable range". This is the range within which babies have been seen to grow well without excessive metabolic stress (Fomon, 1974.) It appears that most babies are fairly flexible little people and tend to do well within a fairly broad range of feeding practices.

Percent of calories from:	CHO	PRO	FAT
Desirable range:	35 - 65	7 - 16	30 - 55
Human milk:	38	7	55

Protein

Why is human milk at the lower end of the range in protein?

Human milk has a protein content on the lower end of the range and a fat content on the upper end. This is acceptable because the forms of protein and fat are so perfectly suited to baby's immature digestive and metabolic systems that absorption and utilization of these nutrients is optimal. The protein content of human milk will continue to stay in the appropriate range even when mothers are protein deficient. This is because protein goes into the milk at mother's expense if there is an inadequacy.

No other food has protein that is so well absorbed or well utilized, so it is best to avoid the extremes of the "desirable range" if something other than human milk is fed. In other words, a diet that provides only 7% of calories as protein from formula or any other source could be inadequate for optima growth.

As discussed in a later section, commercial formulas do provide a more generous percentage of calories as protein for that reason (milk-based formulas provide ~9-11 % of calories as protein, and soy products provide 11-13%. But both human milk and formula protein adequacy can be compromised by practices such as adding lots of additional carbohydrate or fat calories for babies with higher calorie needs, or giving a substantial amount of cereals, fruits or juices to the diet.

Neither the protein nor calcium content of human milk is greatly affected by current maternal diet, but that does mean that maternal dietary inadequacies will be compensated for by a loss from the mother's stores or tissues. For that reason, a poor intake is certainly not optimal for mother's health. **Mother and baby should not be in competition for nutrients**. There are also specific examples of the many benefits associated with assuring the adequacy and absorbability of maternal calcium intake during both pregnancy and breastfeeding.

For example, the adequacy of current calcium intake and absorption has been shown to decrease the developing baby's exposure to harmful substances that may be stored in the mother's bones. This includes **heavy metals like lead.** If the mother has to mobilize her bone calcium to replace blood calcium lost to the fetus or the milk, any lead present in her bones would be freed and enter the bloodstream along with the calcium. It would therefore reach both mother and baby.

Carbohydrate

The carbohydrate of human milk is lactose …a combination of glucose and another simple sugar (a monosaccharide) called galactose. The lactose is broken apart by lactase enzyme and the two monosaccharides are then small enough to be absorbed. Failure to break it apart means the lactose will not be absorbed. If the problem is severe enough this can result in wasted calories, diarrhea and intestinal gassiness … the classical picture of "lactose intolerance."

So how common is lactose intolerance in infants? Actually, babies all around the world are rarely truly "lactose intolerant" even in populations who become less able to digest lactose as they get older. Babies can be temporarily lactose intolerant due to intestinal damage due to malnutrition, infection, or certain diseases like unrecognized celiac disease (after gluten has been introduced.) But even then, the benefits of continuing to provide human milk far outweigh any potential problem with lactose in most instances.

The popular conception that lactose intolerance is a big problem with infants is very overblown, and it is primarily a marketing opportunity. As discussed later, many formulas that are advertised as lactose free also have other changes in their construction that can contribute to baby's tolerance.

Lipids: Fats and Sterols

Cholesterol One of the components of human milk that is not in any formula is ready-made cholesterol. Cholesterol is actually a very important structural sterol, being a key component of all cell membranes and the myelin around nerves. Babies need to grow rapidly so they need to make lots of new cell membranes, and they need to myelinate their nervous system in utero and in the first two years after delivery. Several hormones and bile are also made out of cholesterol.

We have always assumed that babies could simply make their own cholesterol from the other substances in formula. However, if a baby had difficulty making the optimal amount of cholesterol, no commercial formulas would help him/her out. But human milk would provide that extra boost.

[There is a rare genetic condition of severe inability to produce cholesterol called Smith-Lemli-Opitz Syndrome. Impairment of cholesterol production is so severe that even the human milk pre-formed cholesterol content is insufficient to solve the problems for several reasons. However, babies having difficulty producing optimal cholesterol temporarily for reasons of serious illness or prematurity might truly benefit from having some delivered "ready-made."]

Essential fatty acids **The fatty acid distribution depends on the mother's diet,** and in most instances in America, people take in generous total fat (or other calorie sources,) and sufficient amounts of linoleic and alpha-linolenic acids from plant oils (the "essential" fatty acids.) It is not difficult to assure caloric adequacy and adequate amounts of these two essential fatty acids for the fetus and for human milk.

However, it now appears that some <u>other</u> fatty acids may also be "essential" because the ability of some people to make enough of them on their own is insufficient. Pregnancy and lactation in particular appear to be periods where some people fail to make an optimal amount from the two 18-carbon essential vegetable oils.

One example of a potentially essential form of fat is the 22-carbon omega-3 fat called **DHA** (DocosaHexaenoic Acid). **DHA is critical to brain and retinal development.** Our assumptions have been that this fat can be readily made from alpha-linolenic acid by way of an intermediate 20-carbon fat called EPA (Eicosapentaenoic Acid.). Now it appears that the omega-3 fats EPA and DHA, and the 20 carbon omega-6 fat ARA (Arachidonic Acid) are "conditionally essential." In other words, some people can make enough on their own and some people cannot, and they are especially unable to do it during pregnancy and lactation when providing DHA is so important for brain development.

Milk DHA levels can be quite variable depending on the mother's current intake and stores, and worldwide the DHA content of human milk has been found to be decreasing. This is now seen to be a serious issue during pregnancy as well. **Bottom line: It is now recognized that the ability of most humans to produce DHA from the essential plant fatty acid linolenic acid via EicosaPentaenoic Acid (EPA) is much less than was presumed.**

Long-Chain Omega 3 Fats in Mother's Milk:

Fetal and Infant Development Issues:

The discussion of omega-3 fats in particular is included here because it is unrelated to the macronutrient (calorie) function of fat discussed later. Oils rich in omega-3 fatty acids perform many specific important metabolic functions. They have important implications in pregnancy and infant nutrition in particular. As described, DHA is a major fat of the brain, and research is growing that providing some pre-formed DHA is advantageous. Other health benefits continue to be identified, including the (so far) a possibility of decreased risk of preterm delivery and decreased risk of allergies.

> [There are <u>many</u> additional health benefits identified for other age groups as well, including maintaining cognition as we age, and issues related to attention and mood. These are described in some detail in my paper "All Those Lipids: Recommendations for Using Different Types of Fats and Oils (Omega-3, Omega-6 and Monounsaturated Oils)" That paper also explains the relationship of the different fatty acids more clearly … and it has pictures!]

Food sources of EPA and DHA: Fish and fish oil provide ready-made EPA and DHA. Taken during pregnancy they improve the DHA content of the fetal brain, and during lactation it increases the amount of pre-formed DHA provided to the infant.

The "pre-formed" part is important: it is now recognized that there is considerable variation in the ability of different individuals to efficiently operate the pathways that make alpha-linolenic acid into EPA and then into DHA. Alpha-linolenic acid is the form of omega-3

fat found in plants. Flax, canola and walnut oil are the most generous sources. Many --- perhaps even most ---people can use it to make the DHA as needed. But for many people there is a clear benefit from getting at least some EPA and DHA "ready-made" in fish and fish oil supplements. This appears to be particularly true during pregnancy and lactation.

That means that many people must rely on an outside source of EPA and DHA to assure adequacy for their own needs and for the baby. In essence, this means that for some people, these fats are also "essential" because that term means that a person cannot make enough on their own.

This discovery of impaired ability to make adequate EPA and DHA from linolenic acid is well demonstrated now. For example, it is one of the reasons behind the recommendation of the American Heart Association that people eat fatty fish twice a week or take supplemental fish oil because that is the ready-made source of both EPA and DHA. So, clearly, we need to look closer at the adequacy of the mother's diet and nutritional status in general.

Many health professionals erroneously assume that mother's milk will have all the nutrients needed by the baby regardless of mother's nutrient intake. As noted earlier, it is the same concept as the old "perfect parasite" theory of a generation or two ago that presumed that babies simply took whatever they needed from the mother's body during pregnancy. That view has been disproved and discarded long ago, but the same old idea continues to be erroneously applied to the concept of nutritional adequacy in both pregnancy and lactation.

DHA made from an algae source is also available as a supplement, and it is the kind used in some supplements designed for pregnant women and in some children's gummi DHA supplements. This is the same form used to provide pre-formed DHA in infant formulas. It can be a reasonable source of DHA depending on the dosage or amount of DHA per-gummi. And comparison shopping shows that gummi-type DHA supplements for often children provide very little DHA per gummi and they can be quite costly. **Additionally**, **the algae-based products do NOT contain any EPA … the omega-3 fat between linolenic acid and DHA.**

EPA has many metabolic roles in the body involving inflammation, blood clotting, the immune system and other functions, and a person with an inability to produce DHA will likely have a difficulty making EPA as well. For that reason, fish oil as a supplement for pregnant and nursing women has advantages over the products that only provide DHA. **Fish oil supplements are easily available now that are free of mercury and other substances that would be of concern when eating fish to get these special oils.**

Do breast-fed babies need anything else?

A Look at Micronutrients: Vitamins and Minerals

Maternal diet/stores CAN be a factor in the amount of several vitamins and minerals in mother's milk as well. These include iodine, zinc, selenium, all the B-vitamins and vitamin C, so attention must be paid to the adequacy of her intake. The fat soluble vitamins (A, D, E and K) are now being re-evaluated in this regard as well.

This is a surprise to many health professionals because earlier models of prenatal and infant nutrition were based on assumptions that the fetus was a "perfect parasite" taking everything it needed, even at mother's expense. The same assumption carried over to assumptions about the nutritional content of human milk.

This was all in the absence of being able to confirm things scientifically. However, now that these issues have been able to be evaluated, **it is clear that the presumption of nutritional adequacy provided to the fetus or breastfed infant needs to be replaced with careful attention to a number of nutrients in the mother's diet.**

Micronutrient Issues: Vitamins

Vitamin D

An epidemic of vitamin D inadequacy in people of all ages has been the focus of literally hundreds of recent reports in the scientific literature. For years, vitamin D inadequacy has been assumed to be a non-issue because most of the time, deficiency lacks the only symptom that has traditionally led physicians to even look for it: that is, overt bone deformity in children.

It has long been (erroneously) assumed that everybody easily produces generous amounts of vitamin D from the action of sunlight on skin. Additionally, as vitamin D is found naturally in very few foods, it has been added to milk and a few other foods more recently in the US. However, the **amount** currently added is insufficient to maintain appropriate blood vitamin D levels in most cases. **Vitamin D deficiency is now recognized as very common, very dangerous, very often unevaluated and rarely corrected. The health consequences are very serious, but the entire situation is very easy to fix once the issue is recognized.**

Maternal/child vitamin D deficiency issues deserve a close look here.

[The following is an excerpt on specific vitamin D deficiency issues in lactation from my paper "Aunt Cathy's Guide: My Current Top Five Ways to Improve Your Family's Nutrition."

There is <u>much</u> more on multiple vitamin D issues in that publication, including recommendations for action. A version is also available with many references from reports in the scientific literature.]

Vitamin D Inadequacy in Breastfeeding Alert

Interestingly, mother's milk is an amazingly nutritious food and breastfeeding is certainly encouraged. However, the milk does not contain vitamin D. This is probably because when people were invented nobody lived in Fargo. As an adaptation to live well up here, we need to have a furnace, a coat, really good mittens and vitamin D. It is that simple. It is also a possibility that the milk would provide adequate amounts if the mother herself were not vitamin D deficient. This question is being studied, but in the meantime, for the health of both mother and baby, it is best to assume that it provides too little unless it is actually checked.

Because of the finding of serious vitamin D deficiency in many breast-fed babies, in 2003 the American Academy of Pediatrics recommended that breastfed babies be given "at least 200 iu of vitamin D by two months of age." **In 2008 that recommendation was changed to 400 iu/day for ALL infants and they recommended starting it right away** because many babies were actually born with inadequate stores of vitamin D because their mothers were deficient during pregnancy (in spite of taking prenatal vitamins.)

This recommended change also included formula-fed babies and not just breast-fed babies because the standard formulas provided 400 iu only when about a quart (32 oz) a day is consumed. Newborns usually take only about 20 oz, so formula-fed infants would also fail to obtain 400 iu without supplementation.

This change brings US recommendations in line with those of their Canadian colleagues who have recommended 400 iu for babies, and at least 800 iu for everyone else up there for several years now. Here are some details of the kind of research that led to this change in recommendation:

A recent study in Boston of 380 healthy infants and toddlers who were seen for a routine health visit evaluated the prevalence of vitamin D inadequacy or overt deficiency. Forty four of 365 children,**12%, had levels lower than 20 ng/mL (clearly deficient)** and 146 children **(40%) had inadequate vitamin D status** based on levels below an accepted optimal threshold (≤30 ng/mL.*)

[Prevalence of Vitamin D Deficiency Among Healthy Infants and Toddlers. ***Arch Pediatr Adolesc Med.*** 2008;162(6):505-512.
Neonatal vitamin D status at birth at latitude 32 degrees 72': evidence of deficiency. J Perinatol. 2007 Sep;27(9):568-71.]

The same Boston authors studied the therapeutic amounts of vitamin D supplementation needed to correct the low vitamin D status of the children. They concluded that these two approaches were effective for bringing low vitamin D levels into the range of ≥30 ng/mL* within a 6 week treatment period: Daily 2000 IU vitamin D2 or D3, **or** Weekly 50,000 IU vitamin D2.

[Treatment of Hypovitaminosis D in Infants and Toddlers.
J Clin Endocrinol Metab. 2008 Apr 15.]

*However, note that a report described earlier suggested that the healthiest ranges of serum vitamin D may in fact be above this "optimal threshold" of ≥30 ng/mL, and that it might be in the range of 36-48 ng/mL. [Optimal serum 25- hydroxyvitamin D levels for multiple health outcomes. Adv Exp Med Biol. 2008;624:55-71.]

Many other approaches to therapeutic supplementation are being investigated as well.

There are concerns about inadequacy of vitamin D in breastmilk (or in any infant feeding regimen) in MANY areas beyond its relationship to the pattern of overt bone deformity we call rickets. Most are not visible.

Inadequacy of vitamin D is now known to be an independent risk factor for an ever-widening range of negative health conditions:

"All-Cause Mortality"

Asthma Diabetes (both **Type 1** & **Type 2)**

Cancer of the Breast, Colon, Prostate, Pancreas
and other types, with roles in both prevention and treatment.

Cardiovascular Disease
both heart attack and especially congestive heart failure

Depression and **Dementia**

Developmental Problems

End-Stage Renal Disease

Immune System Compromise

Lupus, Fibromyalgia and **Scleroderma**

Multiple Sclerosis

Osteoarthritis, Osteomalacia and **Osteoporosis**

Pain in Muscle, Nerve and Bone

Pre-eclampsia in Pregnancy

Rheumatoid Arthritis

Sarcopenia (muscle weakness) and **Falls**

Clearly, assuring the mother's vitamin D adequacy is very important to her health as well as the health of her infant, but this is a topic outside the scope of the present article.

"The recommended adequate intakes for vitamin D are inadequate, and, in the absence of exposure to sunlight, a *minimum* of 1000 IU vitamin D is required to maintain a healthy concentration of 25(OH)D in the blood."

Optimal serum 25- hydroxyvitamin D levels for multiple health outcomes. Adv Exp Med Biol. 2008;624:55-71.

Prevalence of Vitamin D Deficiency Among Healthy Infants and Toddlers *Arch Pediatr Adolesc Med.* 2008;162(6):505-512. Treatment of Hypovitaminosis D in Infants and Toddlers. J Clin Endocrinol Metab. 2008 Apr 15.] Prevalence of Vitamin D Deficiency Among Healthy Infants and Toddlers *Arch Pediatr Adolesc Med.* 2008;162(6):505-512. Vitamin D Status: Measurement, Interpretation, and Clinical Application. Ann Epidemiol. 2008 Mar 8. Sunlight, UV-radiation, vitamin D and skin cancer: how much sunlight do we need? Adv Exp Med Biol. 2008;624:1-15. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S. Neonatal vitamin D status at birth at latitude 32 degrees 72': evidence of deficiency. J Perinatol. 2007 Sep;27(9):568-71.Am J Clin Nutr. 2004 Mar;79(3):362-71)]
[See my "Top Five" handout for much more on vitamin D.]

This topic is absolutely mushrooming in the scientific literature and the issue is too big to describe thoroughly. Note that the references cited above were from 2007 and 2008. Below are just a few of the 2008-9 references out there I had in one of my other papers, and the 2010 literature has even more Every day another study pops out! I just don't have time to organize it all in time for this Feb. 2011 paper to get where it has to go.

However, anyone interested in looking further into this issue can easily go to www.pubmed.org and enter the search term vitamin D. The response is overwhelming. You can also limit your search, say, by entering the words vitamin D infant or lactation, or whatever. "Pubmed" stands for "Public Medline." It is a free service provided by the National Library of Medicine at the National Institute of Health in Washington DC)

A Sample of Some of the Many 2007-2009 Vitamin D References in the Scientific Literature

2009

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Vitamin D Supplementation and Reduced Risk of Preeclampsiain Nulliparous Women. Epidemiology. 2009 May 15. Association of 25-Hydroxyvitamin D With Blood Pressure in Predominantly 25-Hydroxyvitamin D Deficient Hispanic and African Americans. Am J Hypertens. 2009 May 14. Effect of vitamin D supplementation in the institutionalized elderly. J Bone Miner Metab. 2009 May 15. Association between serum 25-hydroxyvitamin D level and upper respiratory tract infection in the Third National Health and Nutrition Examination Survey. Arch Intern Med. 2009 Feb 23;169(4):384- 90. Nutrition and health: guidelines for dental practitioners.Oral Dis. 2009 May 15. Circulating calcitriol concentrations and total mortality. Clin Chem. 2009 Jun;55(6):1163-70. Vitamin D and cardiovascular disease.Pharmacotherapy. 2009 Jun;29(6):691-708.Serum vitamin D, parathyroid hormone levels, and carotid atherosclerosis. Atherosclerosis. 2009 Jun 6. Prospective Study of Serum 25-Hydroxyvitamin D Level, Cardiovascular Disease Mortality, and All-Cause Mortality in Older U.S. Adults. J Am Geriatr Soc. 2009 Jun 22 Increased Levels of 25 Hydroxyvitamin D and 1,25-Dihydroxyvitamin D After Rosuvastatin Treatment: A Novel Pleiotropic Effect of Statins? [Crestor] Cardiovasc Drugs Ther. 2009 Jun 20.

2008

Prevalence of Vitamin D Deficiency Among Healthy Infants and Toddlers *Arch Pediatr Adolesc Med.* 2008;162 (6):505-512. Treatment of Hypovitaminosis D in Infants and Toddlers. J Clin Endocrinol Metab. 2008 Apr 15. Optimal serum 25- hydroxyvitamin D levels for multiple health outcomes. Adv Exp Med Biol. 2008;624:55-71. Sunlight, UV-radiation, vitamin D and skin cancer: how much sunlight do we need? Adv Exp Med Biol. 2008;624:1-15. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S.] [Diagnosis and treatment of vitamin D deficiency. Expert Opin Pharmacother. 2008 Jan;9(1):107-118. Prevalence of vitamin D deficiency among healthy infants and toddlers. Arch Pediatr Adolesc Med. 2008:162(6):505-512 Hypovitaminosis D among healthy children in the United States. .Arch Pediatr Adolesc Med. 2008:162(6):513-519. ndependent association of low serum 25-hydroxyvitamin D and 1,25-dihydroxyvitamin D levels with all-cause and cardiovascular mortality. Arch Intern Med. 2008:168(12):1340-1349. Vitamin D and cardiovascular disease risk. Curr Opin Clin Nutr Metab Care. 2008 Jan;11(1):7-12. Hypovitaminosis D in obese children and adolescents: relationship with adiposity, insulin sensitivity, ethnicity, and season. Metabolism. 2008 Feb;57(2):183-91. 25- Hydroxyvitamin D and Risk of Myocardial Infarction in Men A Prospective Study *Arch Intern Med.* 2008;168(11): 1174-1180. Diagnosis and treatment of vitamin D deficiency. Expert Opin Pharmacother. 2008 Jan;9(1):107-118. Vitamin D in Health and Disease. Clin J Am Soc Nephrol. 2008 Jun 4. Monthly ambient sunlight, infections and relapse rates in multiple sclerosis. Neuroepidemiology. 2008;31(4):271-9,

2007

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Vitamin K

A new focus on a previously unrecognized inadequacy of vitamin K in many Americans is showing that many people get far too little and that it contributes to serious health problems such as osteoporosis, kidney damage, calcification of the arteries, pre-eclampsia, diabetes and cancer of the liver and colon. This is in addition to the long recognized role of vitamin K as a tool needed when one needs to clot blood.

Until fairly recently (starting in about 2005) the blood-clotting function was the only known role of vitamin K. Another factor recently identified as contributing to inadequacy is our assumption that generous amounts of vitamin K are provided by intestinal bacteria. Because of this, little nutrition advice focused on this nutrient, it was not included in many multivitamin products, and even the MyPyramid.gov website neglected to include it (or vitamin D) in the sample two-week diet for nutritional adequacy evaluation.

However, it appears that we are all actually much more dependent on an outside source (dietary or supplement) than was assumed. Vitamin K status was (and still is) rarely evaluated, so it is still assumed that all is well. Recent research makes it clear that many people are in fact getting far too little of this nutrient, and it is hurting them.

Concerns about "toxicity" of vitamin K based on the observation that it dissolves in oil have also been shown to be incorrect. In fact, vitamin K is so non-toxic that there is not an upper end of safety identified for its intake. No-one has ever demonstrated an overdose. One reason it is not toxic is that it operatesna s a simple co-factor … a tool that must be present for certain things to move forward. It does not MAKE you clot your blood … it LET'S you clot your blood if your body is telling you to do it.

[Aside: People on the anti-coagulation drug **Coumadin** need to have a very consistent amount because the drug works by interfering with vitamin K. Inadequacy is dangerous for them too, however because it increases the volatility of coagulation. It also puts them at risk for osteoporosis, cardiovascular disease and cancers like everyone else. No one benefits from a vitamin deficiency situation. The Coumadin issue is a specific drug/nutrient interaction … not a general nutrition issue. **For people NOT on this drug, vitamin K is not scary … although inadequacy of vitamin K IS scary.**

Please see my paper "New Roles for Vitamin K" for all the details and references, and another paper I have available for health professionals specifically on the Coumadin issue and the new research that should significantly change how we manage it.]

Some of the new issues being identified have significant implications for pregnancy and lactation. Women who have insufficient vitamin K are at risk of hemorrhage at delivery and have an increased risk of pre-eclampsia. Their infants are at risk of intrauterine hemmorhagic events.

Consider that in America it is common to give infants a vitamin K shot at birth, to reduce the risk of hemorrhage in newborns who received inadequate vitamin K in utero. That means that overt consequential deficiency in the newborn was a common enough occurrence to make vitamin K administration at birth become a standard practice.

I think that means that we should look more closely at maternal vitamin K status (and everyone's for that matter.) For one thing, the vitamin K shot at birth does not protect against hemorrhagic events in either mom or fetus. Studies of newborns have demonstrated that some

children are born with evidence of earlier hemorrhagic events that can contribute to developmental delays.

Additionally, not all babies actually receive the vitamin K shot because of home delivery options, parents' right of refusal, etc. Teleologically, it would seem to be an inefficient plan to design people in such a way that infants all around the world would be born vitamin deficient and at great risk unless someone is on hand with a syringe full of vitamin K. This is an issue requiring attention from both the obstetric and pediatric medical experts working together.

In the meantime, mother's milk can easily be low in vitamin K if mother is low. And many mothers have been shown to be low. If the baby received the vitamin K shot, the low vitamin K status of her milk will not be an issue any more for the baby (Although it will still be a problem for mother.)

But any breastfed baby to whom that shot was not administered really needs to have vitamin K reliably provided. And again … at the moment it is not standardly in many vitamin supplement products. Additionally, it would be a good idea to provide that extra vitamin K to a formula-fed infant as well if the shot was not given … the amount provided in the formula does not provide a generous enough amount to compensate for a combination of low stores at birth and no vitamin K shot.

Vitamins B12 and B6

The B vitamins play many critical roles in metabolism and inadequacy can compromise the growth and development of the baby. In America, serious deficiency of B vitamins is presumed to be extremely rare, but it is now recognized that some of them need a much closer look. Most health professionals are aware that alcohol abuse frequently results in dangerous deficiency of thiamin and folic acid, and of course, perinatal alcohol abuse is even more problematic. But there are other specific concerns about vitamins B12 and B6 that deserve some special attention during both pregnancy and breastfeeding.

As described earlier, for <u>some</u> nutrients (e.g. calcium and protein,) a relatively deficient mother will still provide a good amount to the fetus/baby even at her own body's expense. However, **all of the water soluble vitamins (B vitamins and vitamin C) will fail to be provided optimally to the baby if mother is deficient … maternal needs for these nutrients must be met before she "shares."**

Vitamin B12

Recently, for example, it was found that **babies of mothers who had an inadequate intake of vitamin B12 have deficiency levels even if the mother's labs show her own vitamin B12 level to still be in the normal range.** Deficiency is extremely injurious to the nervous system of both mother and baby. The following are three circumstances that put people at special risk.

1. Because vitamin B12 is found naturally only in animal products, **vegans are well known to be at great risk** unless they take a vitamin supplement containing vitamin B12. There are MANY reports in the scientific literature about this problem and the damage to the infants when it occurs during pregnancy or lactation. But simply assuring that the vegan mother has been taking a supplement **regularly** for quite some time is all one needs to do.

   But if she has not been taking one, or has only begun to take vitamin B12 during pregnancy, for example, her vitamin B12 status could easily still be too low for the fetus/baby to receive the needed amount for optimal development. As vitamin B12 is extremely non-toxic, ideally in this situation a physician or other provider should consider giving her a therapeutic level to correct a suspected deficiency right away.

2. One of the less-well-recognized **emerging risk factors for vitamin B12 deficiency is among people who have GERD (gastro-esophageal reflux disease) and use PPI (proton pump inhibitor) medications that prevent gastric acid production.** Natural sources of vitamin B12 require the presence of gastric acid before it can be absorbed. [This is different from the role of Intrinsic Factor in vitamin B12 absorption.]

   People who use these medications cannot absorb vitamin B12 from natural sources, but they can easily get around this problem by taking a supplement that contains vitamin B12 … just like vegans but for a different reason. In this case it is because the crystalline B12 in supplements does not require the presence of acid in order to become absorbable. But also just like vegans, **if she has been taking the medication for a long time and has only recently begun to take supplemental vitamin B12, there may be a degree of deficiency sufficient to warrant giving a therapeutic amount.**

3. It is becoming increasingly common for women of childbearing age to have undergone **bariatric surgery (gastric bypass for weight loss)** prior to becoming pregnant. Long-term vitamin and mineral status in the women is rarely evaluated, but when it IS, there are several nutrients commonly found to be seriously inadequate even with the use of prescribed supplements.

   Some of these, like copper deficiency (generally extremely rare in the general public and therefore not monitored) are showing up as causes of serious neurologic damage. The potential damage to a fetus or breast-fed infant is huge. Additionally, months/years after the actual surgery many woman stop taking their prescribed supplements for a variety of reasons. This is even more common among people with less ability to afford them. Long term follow-up is rarely undertaken for anything besides weight status and effect on cholesterol or diabetes. By the time micronutrient inadequacies are recognized it is because they are severe enough to be visible … and that is often past the point where prevention of injury is an option.

   An additional important observation is that a study evaluating the nutritional status of people considering bariatric surgery found that **the majority had significant inadequacy of a number of nutrients even before having the surgery**. This may be because of a likely history of trying various restrictive or unbalanced diets to lose weight. But it is also

a reflection of the fact that many people whose appearance suggests that they are very "well-fed" are actually not "well-nourished" at all in terms of vitamins and minerals. In fact, intake of several vitamins and minerals is recognized in large national studies to be unsatisfactory in a large number of Americans.

[Please see my "Carnitine Explanations" paper for more information about another important problem issue that may be present in some people undergoing bariatric surgery.]

Deficiency of vitamin B12 is just one of several problems that are of great concern in the special pregnancy/lactation context. This mother may have <u>several</u> severe nutritional problems that are very likely to have gone unrecognized. Unfortunately, the simple multivitamin that solved vitamin B12 problems for vegans and PPI users is unlikely to be an adequate intervention here. What should be done about it is outside the scope of this paper, but vitamin B12 <u>shots</u> would likely be a needed. Heightening the awareness of healthcare professionals about the existence of the problem is a good place to start.

[Please see my "Vitamin B12" handout for more information about problem issues with this nutrient.]

Vitamin B6

Adequacy of **vitamin B6** in exclusively breast-fed infants has been found to rely often on gestationally accumulated stores. **For some infants, human milk alone without supplemental foods may be insufficient to meet vitamin B6 needs after 6 months of age** (*Pediatr Gastroenterol Nutr* 1996 23(1):38-44.) Earlier introduction of meats or the use of a multivitamin drop will correct this situation. Most infant vitamin drops contain vitamin B6 and they often contain iron, but they do not contain zinc. **Meats are the richest sources** of **vitamin B6 and well-absorbed iron and zinc … the three nutrients that have been observed to "drop out" of breastmilk after 6 months.**

This argues for reversing our most recent traditional pattern of introduction of solids by introducing meats by about age 6 months instead of introducing it after 10 months or later. This problem can also be addressed by using a crushable-type multivitamin with minerals instead of an infant vitamin drop; it contains <u>all three</u> of the micronutrients (zinc, iron and vitamin B6) that decrease so precipitously in mother's milk after 6 months. It can be crushed and added to baby food.

<u>Micronutrient Issues: Minerals</u>

Iron

The **iron** in human milk is very well absorbed – the best of them all, with estimates between 25% and 50% absorption. Compare this with the next best source of iron (meats, at about 20%) and with the much less absorbable form in plants and pills (which are only about

0.25-2% absorbed.) But although iron in human milk is well absorbed, but there is not a great deal of it.

Most term babies are presumed to have enough iron stored up so they do not "run out" until about 4 months of age. Since this is the age at which many babies begin to have the developmental skills to eat from a spoon, providing foods that are good iron sources plus the iron in mother's milk may be adequate.

On the other hand, one might argue for providing an additional source of iron (e.g. an iron drop) to avoid emptying baby's iron reserves before he/she actually "runs out." Premature babies often have poorer iron stores because the iron (like zinc, calcium and other minerals) is stored in the baby's body primarily in the third trimester of pregnancy. They simply get out of line too soon.

The iron "cost" of growth is high, and inadequacy of iron stores can have serious consequences. Anemia is associated with decreased ability to learn and to pay attention that can remain a problem for months after the anemia itself is corrected by treatment. Additionally, the "presumed iron stores" of the average term baby are just that … "presumed" … not "assessed." **Historically this approach has not always served us well**.

Iron-deficiency anemia has also been found to be associated with increased likelihood of being identified as having mild or moderate developmental delay in school. This is likely because iron has many important rolls in all of the cells of the body, including such tasks as oxygen transport, energy production, protection against environmental toxins, and function of brain neurotransmitters. For example, some iron-related brain-development functions in utero are on such a strict time-table that inadequacy of iron during that period can cause irreparable impairment.

As was the case with calcium, good iron status also decreases the absorption of lead from the environment, a known agent of severe injury to brain, bone and kidneys, and a contributor to hypertension. Iron deficiency results in an attempt to increase absorption of iron in the intestine, and the process accidentally increases the absorption of lead as well.

Reliance on hemoglobin to screen for poor iron status is risky without also having information about the adequacy of the person's iron intake. This is because hemoglobin levels can actually remain normal until iron stores are depleted. A low hemoglobin is a sign of trouble, but a normal one tells very little about the status of iron stores. Measures of iron stores (like a "ferritin" level) are rarely used at present in evaluating babies who appear to be healthy. But asking specific questions about regular iron supplement use and/or meat consumption tells us a lot about the likelihood of there being an unrecognized compromised iron status in a particular woman or infant.

There is some concern that providing additional iron to a breast-fed baby may decrease the effectiveness of one of the substances in human milk that helps to control bacterial growth. Lactoferrin in human milk binds iron that E. coli bacteria in the gastro-intestinal tract need in order to reproduce. Giving additional iron would make more free iron available to the bacteria as well as to the baby.

It is not clear that this is a big problem, however, since there are many other bacteria-fighting substances in human milk that are not affected by the presence of iron. Also, the fact that most formula-fed infants thrive while regularly receiving generous dietary iron that is not bound to lactoferrin suggests that is not a major problem. After all, these babies receive none of the many other protective substances in breast milk either.

Complicating the picture is the finding that the iron in infant cereal that has traditionally been used to provide iron in baby's diet may not be as well absorbed as had been believed. Its ability to provide useable iron to the infant has been questioned, but so far no one has questioned whether iron provided in the form of fortified cereal increases the risk of E coli infection in breast-fed (or any) infants.

Two feeding practices can sometimes have an effect on the absorption of iron in infants:

1) Iron supplements given with a (non-human) milk or formula feeding are likely to be less well absorbed compared with supplements fed with an acidic food or meat. Meat contains "Meat Protein Factor" which enhances absorption of inorganic iron from other foods fed with the meat.

2) Although in some cultures it is common to feed **tea** to infants, the tannins in it greatly reduce inorganic iron absorption in both infants and adults. This does not appear to be a problem for organic iron forms such as are found in breastmilk and meats, so feeding tea to breastfed infants does not induce iron deficiency anemia the way it can in those not breastfed.

   Interestingly, in some world situations the traditional feeding of tea to infants has actually been of great benefit in terms of child survival for the simple reason that the water fed to baby has been boiled and germs have been destroyed. Together, protective elements in mother's milk and boiling any water fed to baby are a terrific combination where bacteria and parasites make the water unsafe.

   However, there is a risk of iron (and zinc) deficiency in a non-breastfed infant who is regularly given tea, and people in many cultures do commonly give it. One way to solve this potential problem (besides encouraging breastfeeding) would be to advise them to **introduce meats earlier**, because the generous iron and zinc content is in a form that is unaffected by the presence of tannins, plus the effects of Meat Protein Factor can help avoid the problem.

Zinc

Iron often described as the micronutrient most likely to be deficient in Americans. However, it is useful to remember that **iron status is also the only non-electrolyte nutrient we evaluate** in many settings. Status of many other nutrients may be suboptimal, but **one that is particularly likely to be "iffy" in an individual with iron deficiency is zinc.**

This is because in nature iron and zinc tend to be distributed similarly in foods and they are also similarly affected by substances that impair or increase intestinal absorption. A person who is iron deficient may also be zinc deficient, although we rarely evaluate it and therefore do not recognize it. And if that person is iron deficient in spite of taking iron supplements and eating iron-fortified foods (which are usually NOT also fortified with zinc,) the odds are even greater that zinc adequacy may be compromised. The exception would be a person has relative iron deficiency because of excessive blood loss.

This is not to make a case for checking zinc levels in people's blood … the point is that **we can regard iron inadequacy as a marker/screening-tool for suspicion of unrecognized inadequacy of zinc in particular, and many other nutrients as well.** In general, people do not consume a diet that gives them a terrific amount of all the nutrients needed except for just the only one we check. Think of that low iron measure as the "canary in the coal mine" that tips you off to an otherwise invisible threat in time to do something about it.

Why is zinc such an issue here?

Zinc is a co-factor in over two hundred metabolic pathways in the body, including making DNA (the genetic center of every cell and hugely important for growth), making T-cells, and metabolizing alcohol and other potentially dangerous substances. Inadequacy is known to impair growth and the function of the immune system. However, zinc has been found to need some attention in breast-fed infants. The same mineral storage patterns are seen for both iron and zinc, with the third trimester being the major period of mineral accretion in the fetus. For this reason, preterm infants are also especially likely to have poor zinc stores.

For term infants, the combination of a well-nourished mother who provided normal fetal zinc stores and then provides human milk should meet growth needs until about age six months. After that time, zinc and iron may be inadequate as described earlier. Of course, a history of <u>poor</u> zinc nutrition of the mother complicates the picture further. Some studies have found that zinc supplementation of exclusively breastfed infants in these circumstances improves growth or other parameters of zinc adequacy [e.g. *Lancet* 2000 Jun 10;355(9220.)]

Supplementing a mother to maintain adequate zinc status does not correct this problem because the **zinc content of the milk begins to drop regardless of her zinc status**. As described earlier, a change in recommended "starter food" patterns has been suggested that includes an earlier introduction of meats (the most abundant source of bioavailable forms of both iron and zinc, and also a generous source of vitamin B6) in breast-fed infants [*Acta Paediatr* 1998;87(6); *J Mammary Gland Biol Neoplasia* 1999;4(3)].

Again, note that infant vitamin drops do <u>not</u> provide zinc (or any minerals except iron and sometimes fluoride) and they contain no folic acid. So if earlier introduction of meats is undesirable, the best way to assure adequacy of zinc, iron and vitamin B6 would be to give a crushed chewable children's multivitamin with minerals.

Nutrient levels will not exceed safe ranges with this dosage, and this approach also provides baby with the 400 iu of vitamin D recommended for all infants by the American

Academy of Pediatrics and the Canadian health groups as well. If texture is an issue, the pill can be crushed to a fine powder using a small mortar and pestle. These are sold in kitchen stores and discount stores (often for $10 or less) because they are used to crush fresh spices. The powder can be mixed into any baby food.

More information about the zinc content and foods, zinc absorption and some special zinc-related issues in fetal alcohol syndrome, are included in my handouts: "Nutrition Support of Iron Deficiency" and "Thinking about Prenatal Nutrition and Fetal Alcohol Syndrome (FAS.)"

Iodine

Another nutrient problem that has recently been found to need more attention is IODINE DEFICIENCY. In many parts of the world (including parts of the US) iodine deficiency is common, and the traditional international approach to solving it has been to add iodine to salt. However, it appears that the amount obtained from iodized salt is actually not sufficient during pregnancy, and that even in areas that have been thought to have corrected iodine deficiency many women obtain too little.

Iodine Deficiency Disease (IDD) is the number one cause of preventable mental retardation in the world. The resurgence of the problem of iodine deficiency in the US has great importance in pregnancy and lactation in particular because of the devastating effects on the intellectual development of the child. Iodine deficiency can also result in deafness, and a serious lack of energy in anyone affected because it impairs the function of the thyroid gland. **The World Health Organization is now increasing the recommendation for iodine intake by 25%, especially in pregnancy.**

Here is an excerpt from a presentation by UNICEF Deputy Executive Director Kul Gautam:

"… IDD is the single greatest cause of preventable mental retardation. Severe deficiencies cause cretinism, stillbirth and miscarriage. But even mild deficiency can significantly affect the learning ability of populations. Scientific evidence shows alarming effects of IDD. Even a moderate deficiency, especially in pregnant women and infants, lowers their intelligence by 10 to 15 IQ points, with incalculable damage to social and economic development of nations and communities. Today over 1 billion people in the world suffer from iodine deficiency, and 38 million babies born every year are not protected from brain damage due to IDD…"

UNICEF Deputy Executive Director Kul Gautam
This quotation comes from the website http://www.saltinstitute.org/Issues-in-focus/Food-salt-health/Iodized-salt-other-additives. It has much more information about the problems of (and solutions for) IDD.

[For more detail on the most recent research on this topic in the scientific literature, please see my handout "New Attention to an Old Problem: Iodine Deficiency in Pregnancy and Lactation"

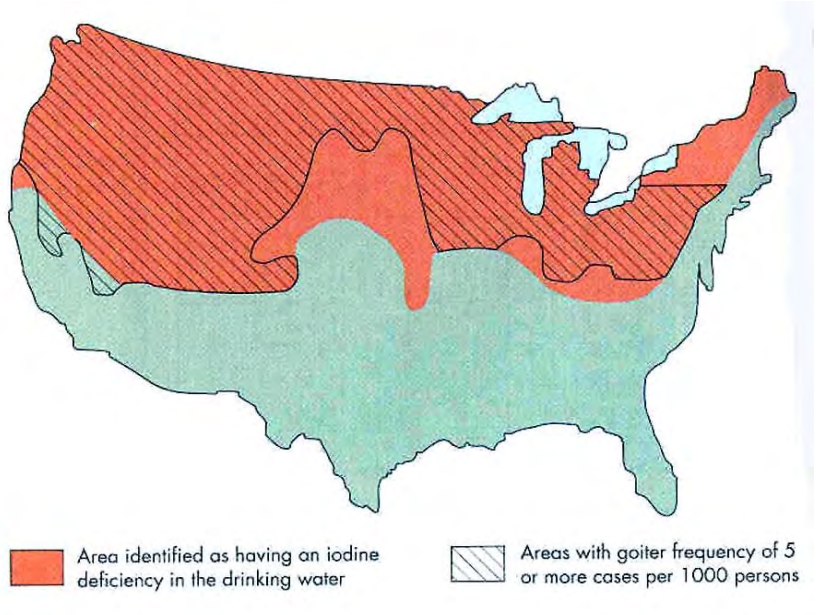
The area of the United States that used to be designated the "goiter belt" because of low iodine in the soil is shown on the map on the next page. The actual iodine content of foods depends on where they were grown, and some protection has likely been provided to the low-iodine regions by the fact that at least some produce may have been grown in an iodine-sufficient region.

This is a new issue to keep in mind as we promote **growing one's own food and buying from local producers** instead of transporting produce from far away. Local food production is terrific for many reasons, but if one lives in an iodine-poor region, it is important to assure iodine sufficiency via a demonstrably adequate intake from some form of iodine supplement.

Map showing spatial correlation between the former "Goiter Belt*" in the northern U.S. and areas where the iodine content of drinking water is naturally low.

www.uwsp.edu/gEo/faculty/ozsvath/images/goiter_belt.htm

[*Goiter is an abnormal enlargement of the thyroid gland, often due to iodine deficiency.]



Back home in America, many people under age 50 who live in iodine-poor regions of the country are quite unaware that they should select "iodized salt." The public health hoopla that accompanied the iodizing of salt in the early 1950s (yes, I remember it … I was THERE!) somehow faded away and the issue went off the radar. **Many people of child-bearing age today have no knowledge that this was once a widespread deficiency disease in the US of critical**

importance to everyone's health and especially dangerous to the development of infants and children … and they don't know it has come back

Even when one intends to buy the iodized salt, the packaging is often very similar and they are side-by-side on the shelf at the store. Most specialty salts that are popular now, like sea salt or exotic salts, are also not iodized. So generally, one should choose iodized salt if one uses salt at home, and people who use little salt should be sure to find an iodine supplement, especially if they live in the northern half of the country.

Additionally, we frequently are advised to cut back on salt for other health reasons, which can further limit iodine intake. Recently some national health recommendations pushed for an even lower daily sodium intake than before … instead of 3000 mg/day they recommended 1500 mg. I am not arguing against this recommendation … just pointing out the need to make sure that people who follow this health advice are not accidentally injured by iodine deficiency.

Remember that the choice of salt as the way to supplement dietary iodine was made well before ideas of sodium restriction were common for health reasons. Other factors have made an inadequate intake much more likely today. For example, in the 1950s people made most meals from scratch, so iodized salt would be added whenever salt was used in cooking. Now most of our sodium intake comes in the form of processed foods, which are high in salt but the salt is not iodized. Here is an excerpt from a website on this topic:

"…In the United States, from the outset, salt producers cooperated with public health authorities and made both iodized and plain salt available to consumers at the same price. **Even so, the Salt Institute estimates that only about 70% of the table salt sold in the United States is iodized.**

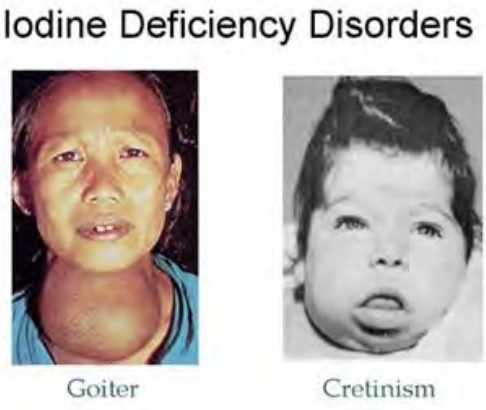
Salt used in processed foods is not iodized. Given that people are cooking less at home and buying either restaurant or processed foods, **iodine intakes in the U.S. have declined from about 250 µg/day to 157 micrograms/day. Public health authorities recommend 150 µg or more** and the need is particularly acute for expectant mothers. Daily Iodine intakes of 1,000 - 1,100 µg are safe for adults and children over 4 years of age…"

http://www.saltinstitute.org/Uses-benefits/Salt-in-Food/Essential-nutrient/Iodized-salt

Also, because it has long been assumed that the iodine deficiency problem was "solved**" in the US by the iodizing program, at present many vitamin pills contain no iodine at all, including many prenatal vitamins.** So, this is one more nutrient that a person should check for when they select a multivitamin.

The WIC Program recently added use of a prenatal vitamin without iodine as a nutrition risk factor for women enrolling in the program. That means that some low income women of childbearing age may soon begin to have this addressed.

At least an awareness of the problem is developing. However, **MOST women are NOT on the WIC Program so this problem is unlikely to be readily recognized. There is great potential for harm.**



There has been a resurgence of goiter development (a marker of iodine deficiency) in America as well as around the world, and thought to be a problem. Additionally, data it is often missed because it is no longer shows that average iodine intakes have decreased markedly in the US. It is also reported that on average iodine intake is sufficient here [Iodine status of the U.S. population, National Health and Nutrition Examination Survey 2003-2004. Thyroid. **2008** Nov;18(11):1207-14.]

However, when one stratifies the data it becomes clear that a great many women here (and around the world) do NOT have a sufficient iodine intake even when men generally do. The risk to fetal and maternal health is substantial, and easy to fix once the problem is recognized.

Major Point: The problem of iodine deficiency needs to be put back on our radar; this is a very newly recognized and extremely important health problem that needs attention.

Please see my paper "Aunt Cathy's Guide to Nutrition:
New Attention to an Old Problem:
Iodine Deficiency in Pregnancy and Lactation 2011"
for detail on this topic, including an annotated bibliography.

Some newer references are included here since this topic may be quite new to many readers and I don't want them to think I am making this stuff up! ☺

Iodine deficiency in infancy - a risk for cognitive development. Dtsch Med Wochenschr. 2010 Aug;135 (31-32):1551-6.Parameters of thyroid function throughout and after pregnancy in an iodine-deficient population. Thyroid. 2010 Sep;20(9):995-1001. Some subgroups of reproductive age women in the United States may be at risk for iodine deficiency. J Nutr. 2010 Aug;140(8):1489-94. Iodine intake and maternal thyroid function during pregnancy. Epidemiology. 2010 Jan;21(1):62-9.Georgian Med News. 2010 Jan; (178):65-8.Iodine deficiency in the prenatal period may form learning ability deficiency in the postnatal period. Epidemiology of iodine deficiency: Salt iodisation and iodine status. Best Pract Res Clin Endocrinol Metab. 2010 Feb;24(1):1-11. Iodine deficiency in pregnancy, infancy and childhood and its consequences for brain development. 2010 Feb;24(1):29-38.Iodine deficiency in pregnancy and the effects of maternal iodine supplementation on the offspring: a review. Am J Clin Nutr. 2009 Feb;89(2):668S-72S.

Fluoride

Fluoride is low in human milk and whether the mother's fluoride intake affects the amount in milk is still subject to some debate. The recommendations for using fluoridated water, fluoride drops, fluoride toothpaste and topical fluoride treatments have changed many, many times over the years that I have been involved in pediatric nutrition. They are being changed again this year regarding the recommended amount of fluoride to add to low-fluoride-containing water supplies.

The American Dental Association has a current list of very specific recommendations on all aspects of the topic of fluoride as it relates to dental issues. It is available at this website:

http://www.ada.org/public/topics/fluoride/infantsformula.asp