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Vegan & Vegetarian diets: Nutrients at risk of deficiency

There are compelling reasons to be vegetarian and vegan in today's world where animals are treated like units of production and industrialised farming practices can be cruel and inhumane and contribute to ecological destruction. More and more people are turning to meat and animal-product free lives. Humans did evolve as hunter-gatherers however, and so our biochemistry requires nutrients that are sometimes derived only, or mainly, from animal sources. Vegans and vegetarians (Vs) are the groups most at risk for specific nutrient deficiencies (and this especially applies to the child-bearing years). It is very important that Vs know which nutrients they are most likely to lack and how to obtain them, to avoid significant impacts on their (and their children's) health. These impacts include problems with mood, cognition, fatigue, lowered immunity, growth & development and other. What follows is a brief discussion of some of the important at-risk nutrients. It is also important to note that there are so-called 'anti-nutrients' in plant foods like phytates, oxalic acid, and tannins that bind to nutrients and make them non-bioavailable (i.e., the body can't absorb them). These bind important minerals such as magnesium, calcium, zinc, manganese, and iron. While this can be reduced somewhat by soaking, grinding, and fermentation of the plant foods, and our bodies can adapt over time by making more of the enzyme phytase that breaks down phytate, it is still the case that animal sources of minerals such as iron are much more easily absorbed than plant sources.

Protein

Protein provides the building blocks of life – amino acids (AAs). These constantly build and repair our bodily tissues like muscles, skin, hair & bones, comprise our neurotransmitters, immune system, hormones, enzymes, signaling molecules and much more. There are 20 amino acids used by the body and some of these it makes from other ones, but nine of these can't be made and must be obtained from protein in the diet, these ones are called the essential amino acids. Animal protein is 'complete' because it supplies a full array of essential AAs whereas plant foods have lower levels of some of them which limits the body's use of all of them because they work together. Combining plant proteins, such as nuts and seeds, with animal proteins like dairy and eggs can improve the protein quality of a vegetarian diet. Vegans will need a combination of grains, legumes, nuts and seeds to meet their essential amino acid needs. It is possible to obtain enough protein from plant foods, but important that V diets are well-planned so that these foods are included daily, preferably in each meal. It's easy to be a V and live on lots of carbohydrates and not much protein. Whey powder, Greek yoghurt, white cheeses, eggs and legume/rice-based protein powders and legumes (lentils, chickpeas, beans) grains/nuts/seeds are options that can fill the gaps for V's. Soy is a good source of complete protein. Adequate protein helps retain muscle mass, avoids weight gain, and causes satiety (appetite control), improves energy, normalizes metabolism, and maintains health. How much protein do we need? The official dietary guideline recommendation of .8g per kg of body weight is very baseline and considered by many experts to be too low. Opinions vary (as do individual situations) but 1g per kg of body weight per day is often agreed as

a minimum to aim for - so 65g per day for a 65kg individual. Examples of approximate amounts in food sources are: 1 egg has about 6g protein, 100g of tofu has 8g, a small serve of salmon (100g) has 20g, ½ cup cooked lentils or chickpeas has 8g & 1 cup of Greek yogurt has 23g.

Try this experiment – have a protein rich breakfast (day 1) and a carb-rich breakfast (day 2) on two consecutive days and compare how you feel - see how long your appetite stays satiated after breakfast (e.g., 2-hours? 6=hours? before a hunger signal) & note your energy levels and mood through the day. Protein meals are satiating, delay hunger & sustain energy.

Choline

Choline is needed for the proper functioning of brain, nerves, muscle, and liver as well as energy production and metabolism. Deficiency signs include fatty liver disease, impaired energy, and impaired mood & cognition. From choline the body derives phosphatidylcholine (a critical cell membrane component in all cells, including the brain), betaine (involved in important methylation reactions), sphingomyelin (in the myelin sheath around nerves) and acetylcholine (a neurotransmitter). It is especially an at-risk nutrient during pregnancy and breastfeeding. The developing foetus requires plentiful amounts for neurodevelopment and will deplete the maternal stores if intake is inadequate. Therefore, the availability of adequate choline has a large impact on foetal and maternal health outcomes and has lasting effects on cognitive function, memory & attention in offspring. Animal foods such as liver, salmon and eggs provide rich sources. There are plant sources such as chickpeas, navy beans and cauliflower though in much smaller amounts and deficiencies are common. People with MTHFR genetic variations can use up choline for methylation reactions. Lecithin is phosphatidylcholine, so is a good source. Lecithin is made from sunflower or soy – if using it check that the soy source is organic & not genetically modified. The best form of choline in supplements is Alpha GPC or CDP (Citicoline) because they are most effectively used by the body.

Taurine

Not available from plant foods, taurine is a sulphur containing amino acid found in meat, chicken, fish & dairy. The body can make it from other amino acids (methionine and cysteine), so it's called 'semi-essential', however this can be inadequate to meet demand. Taurine acts as a calming brain chemical (like GABA & Glycine). By binding to GABA receptors, it helps sleep, mood, & anxiety and helps to prevent migraine headaches. It brings fatty acids into the mitochondria to produce energy and so helps the body burn fats, while improving insulin levels and blood sugar control. It is needed to produce bile in the liver and helps the liver's detoxification processes. It also helps prevent gallstones developing and helps prevent fatty liver disease which is epidemic in modern society. It is important in cardiac health and in the retina. Supplements are available.

Zinc

Zinc is needed in hundreds of enzyme reactions in the body, it is very important for immune function, wound healing and cell signalling amongst other. The best food sources include meat, fish, and shellfish (oysters are the highest source). Legumes, nuts, seeds, and grains contain zinc, but the bioavailability is limited by the presence of phytates in these foods. Soaking these foods in water for several

hours before cooking them, and fermented foods might increase zinc absorption. Vs should be aware of possible deficiency and blood tests can evaluate Zinc status. Deficiency can affect many systems, and may present as lowered immunity, mood symptoms, cognitive function (attention & memory), poor wound healing & reproductive system symptoms (& other). Supplements may be of benefit.

Iron

Iron deficiency is the most frequently detected deficiency. Heme iron found in meat is highly bioavailable, i.e., the body can absorb and use it readily. This is not the case for plant sources of iron which are lower in content and are bound up with plant constituents like phytates and tannins that hinder absorption. Growing children, menstruating women, and pregnant and breastfeeding women are particularly at risk of anaemia. Checking blood levels via iron studies are good lab tests to have performed, especially if feeling tired or fatigued, experiencing low attention span, headaches, pale skin, feeling out of breath, or racing heart. V sources of iron include chickpeas, lentils & tofu and deep green leafies like spinach & kale which should be eaten with vitamin C sources such as lemon to improve bioavailability.

Vitamin B12

The only source of Vitamin B12 in the diet are animal foods, if these are not eaten, or otherwise supplements not taken, deficiency will ensue. B12 is needed as a cofactor for the synthesis of DNA, myelin, and fatty acids. Deficiency will cause problems with red blood cell formation leading to anaemia, and problems in the brain and nervous system, as myelination of nerve cells is B12 dependent (along with numerous other important actions). Babies and children can be majorly impacted by this too. These changes can be irreversible. In babies & infants failure to thrive, anaemia, lethargy, irritability & failure to meet developmental milestones can all occur. In adults deficiency symptoms include numbness & tingling in the extremities, low appetite, irritability & fatigue, depression, memory & cognitive impairment, balance problems, paleness & yellowing of skin. Deficiency signs might take a while to develop in Vs as liver stores are used up & depleted over time without replenishment from the diet (e.g., it might take up to 3-years to deplete liver stores). Lab tests can determine Vitamin B12 status – low serum B12, elevated methylmalonic acid and elevated serum homocysteine levels are markers of deficiency. Supplements are necessary in vegans.

Omega-3 fatty acids: EPA/DHA

Essential fatty acids must be eaten because we can't make them -these are omega-6 fatty acids and omega-3 fatty acids. There are 3 major omega-3 fatty acids: ALA (plant-derived), EPA & DHA. EPA & DHA can be converted from ALA sources (e.g., chia, hempseed, linseed, flaxseed & walnuts) or directly obtained from some foods (notably fish, krill & algae). These are polyunsaturated fats that are critical to good health. They produce anti-inflammatory chemicals in the body and are critical to healthy brain function and cardiovascular health and stop excessive blood clotting. Conversely, Omega-6 fatty acids, found abundantly in vegetable oils, are proinflammatory. Experts believe that we evolved on a diet which provided an omega-6 to omega-3 ratio of approximately 2 to 1. In modern

society however, the ratios are typically much greater - often higher than 20 to 1! This in part explains why there is so much chronic inflammatory illness in society today. Vs can easily be deficient in DHA & EPA as the conversion of the ALA is very inefficient and variable, with studies suggesting less than 5% gets converted. There are vegan sources in the form of algae supplements but it's important to note that the dose compared to that in fish is quite low. It is possible to test for EPA and DHA in the red blood cell membranes in a lab test called The Omega-3 Index test which will indicate whether and to what degree deficiency exists. Vegetable oils (Omega-6) should be avoided (read labels). It is advisable for Vs to eat ALA sources and supplement with Algae oils daily.

Vitamin A

Vitamin A (retinol) is found in liver, eggs, cheese, and animal sources. It is an essential nutrient – it functions in the retina to enable night vision, it is crucial to mucous membrane health and integrity (all the linings of the body), it is important to skin integrity and is a fat-soluble antioxidant. Vitamin A deficiency signs include ongoing dry skin, dry eyes, and poor night vision (xerophthalmia is a classic advanced deficiency sign), lowered immunity, susceptibility to infections and poor growth. There is no retinol in plant foods. Beta-carotene however is abundant in plant foods such as spinach and carrots, and it is converted in the body to Vitamin A, using an enzyme called beta-carotene oxygenase 1 (BC01). There are genetic variations that can greatly reduce the activity of this enzyme and hence the ability to perform this conversion, and so if animal dietary sources are lacking, people with the genetic variation may experience Vitamin A deficiency signs. If the conversion is inefficient people may show yellow/orange discolouration of skin as beta carotene builds up in the blood instead of becoming active Vitamin A (via a second enzyme, BCO2, gene variation). Vs with the risk-alleles of the BCO1 gene should consider Vitamin A supplementation.

Iodine

A critical nutrient due to its important role in fetal and infant development and thyroid hormone production. Thyroid hormones regulate the metabolism of every cell. Seafood, eggs, and dairy products are among the best sources of iodine, so vegans are at risk of deficiency. Iodine-deficient soils are common and produce food crops with low iodine levels. Iodine has been added to commercial salt (labelled as iodized salt) to help counteract widespread deficiencies. An early deficiency sign is the development of a goiter (i.e., enlarged thyroid gland = swelling in the front of the neck). A further issue for vegans is that some foods block the uptake of iodine into the thyroid gland, so worsening iodine deficiency- these are called goitrogens and are found in cruciferous vegetables (e.g., cabbage, broccoli, kale, bok choy and cauliflower), legumes such as soy and some grains such as millet. Luckily one of the richest sources of iodine is seaweed, and vegans should consider including it in their diet.