



A balanced diet is essential for physical well-being and should provide an appropriate number of Calories to meet your energy requirements for the day. In a fit active male doing physical work this could be as many as 3,000 Calories per day. Someone incapacitated by MND may need considerably fewer calories per day. This energy should come from a proper balance of proteins, carbohydrates and fats obtained from balanced sources that include fresh fish, meat, fresh vegetables including greens, and fresh fruit.

In addition to the protein fats and carbohydrates a balanced diet should also provide sufficient minerals, vitamins, roughage and a group of chemicals called "essential amino acids" that the body needs but cannot manufacture. Essential amino acids are usually obtained from meat products.

Vitamin and mineral supplements can be of limited use but they will never totally replace a balanced diet. A balanced healthy diet is essential for maintaining physical fitness. It is as important that people with MND and their carers observe their intake of fats, sugars, fibre, artificial colourings etc as any completely healthy individual. This can be difficult when eating becomes difficult or diet becomes less of a priority. However, recent evidence has suggested that in some cases specific vitamins and minerals may benefit MND patients. Research is ongoing to determine the reasons.

VITAMIN A, Axerophthol

Vitamin A is found in liver, milk egg yolks, butter and fish oils such as halibut- and cod-liver oils. It can also be made in the body from a group of chemicals called carotenoids that are found in plants such as sweet potatoes, carrots, mangoes, spinach, cantaloupe and dried apricots.

Why do you need it?

- for vision
- for healthy skin
- for healthy cells and tissues
- to fight infection
- to aid in bone growth

Carotenoids are a group of chemicals, often reddish in colour, which include beta carotene and lycopene. "Vitamin A" supplements are usually sold in the form of beta carotene and do not include the other carotenoids.

Lycopene, which we obtain from tomatoes, is known to show greater ability to react with peroxynitrite (a damaging compound of Oxygen and Nitrogen) than does beta carotene (research suggests that nitric oxide, and especially peroxynitrite, could be involved in motor neurone death).

VITAMIN B Group

The B Complex Vitamins

Although all B vitamins are of importance for good health, five from this group are of

MND Scotland is the working name of the Scottish Motor Neurone Disease Association, the only charity funding research and providing care and information for those affected by MND in Scotland.

particular importance in balanced nutrition.

- **Vitamin B₁**, also known as Thiamine or Aneurine is found in many foods including peas, beans, lentils, wholemeal bread, yeast cabbage and raw carrots. Thiamine helps enzymes in the cells break down carbohydrates and is also important in the normal functioning of the nervous system, particularly the peripheral nerves.
- **Vitamin B₂**, Riboflavin is found in liver, kidney and milk and when deficient is responsible for sore lips and red eyes.
- **Vitamin B₃**, Nicotinic Acid or Niacin is found in the same foods as Vitamin B₁ and prevents development of a disease called pellagra which causes gastrointestinal disturbances, skin eruptions and mental changes. Vitamin B₃ is a coenzyme assisting in the breakdown and utilisation of protein, fats and carbohydrates. It improves circulation and reduces cholesterol levels in the blood.
- **Vitamin B₆**, Pyridoxine is obtained from foods like banana, salmon, chicken, turkey, sweet potato with skin, vegetable juice, cod, beef, watermelon, and spinach. B₆ helps your body break down and generate amino acids (the building blocks of protein) to create new cells. Helps to help produce haemoglobin, the protein in red blood cells and helps to fight infection
- **Vitamin B₁₂**, Cyanobalamin is obtained from cereals, steak, tuna, fish, turkey, yoghurt, chicken, cheese and liver and is important in red blood cell formation. In

those with the disease Pernicious Anaemia deficiency of B₁₂ may also result in degeneration of the spinal cord. B₁₂ works with folic acid to make healthy red blood cells and is needed for the normal growth of your nerves. It also keeps the protective, outer coating of your nerves healthy

Folic Acid

Folic acid is well known for its protective effects against the development of spina-bifida during in the unborn foetus. It also has a role to play in making new cells in the digestive tract and maintaining healthy blood cells. However, excess folic acid intake through supplements could mask a vitamin B-12 deficiency, paving the way to crippling, irreversible nerve damage.

Foods rich in folic acid include:

Cereals, lentils, spinach, asparagus, orange, chickpeas, kidney beans, fortified pasta, rice and bread.

Use of B vitamins is a complex issue and not entirely clear. Frequently people with MND are found to be low in B₁ and B₆ but supplemental B₁ and B₆ only provide temporary improvement. Recent evidence suggests that B₃/niacin may play an important role in the treatment of ALS/MND. Simple supplementation with B₃ is ineffective in re-establishing levels of B₃ in the body and central nervous system. Zinc, vitamin C, magnesium, manganese, B₁, B₂ and B₆ must exist in adequate quantities for B₃ to be metabolised and made available for the body. This example is true of many supplements.

VITAMIN C Ascorbic acid or Ascorbate

Probably the best known sources of vitamin C are citrus fruits, tomatoes and fresh vegetables. Deficiency causes scurvy, a disease characterised by bleeding into the tissues, under the skin and from the gums. Vitamin C taken by mouth is absorbed from the intestines, but the amounts allowed to pass from the intestines into the more general blood stream are closely regulated by the liver. For this reason large dose vitamin C tablets such as 1000mg tablets are unlikely to deliver to the body the doses they appear to promise. Recent research has shown that large doses of vitamin C injected into the bloodstream may be useful in shrinking certain kinds of tumours.

Vitamin C does the following:

- Helps your body absorb iron
- For healthy gums, teeth, bones, and muscles
- To help heal wounds
- To fight infection
- As a powerful antioxidant protecting the cells of your body.

Vitamin C may be important in the treatment of ALS because ascorbate slows down glutathione loss and vice versa. Glutathione is thought to be important for motor neurone function. And can effectively neutralise some destructive cell free radicals

The SOD1 enzyme, which can be defective in some cases of ALS/MND, exists to remove the superoxide free radical before it can cause cellular damage. While neurones have lots of SOD1 enzyme, they may be unique among cells (with the possible exception of white blood and adrenal gland cells) in having extremely high ascorbate levels. Some evidence suggests that ascorbate levels may be close to 10,000 times than

for SOD, a level that would allow them to compete with that enzyme for superoxide radical removal in the neuronal cell's cytoplasm (fluid). Japanese research showed that SOD1 could only account for a portion of superoxide removal in brain preparations, offering indirect evidence for this relationship.

Body tissue and the brain are both resistant to taking up ascorbate and, as noted earlier; most of a large vitamin C dose will be quickly eliminated from the body. Vitamin C supplements should be spread throughout the day or use a 'slow release' form of vitamin C. Vitamin C uses the same transporter that removes glucose (blood sugar) from the blood, therefore it should only be taken between meals (or at night) and especially never in association with sugary foods or drinks.

VITAMIN D, Calciferol.

Vitamin D is manufactured by the body when our skin is in the sunlight - approximately 15 minutes exposure of arms to sunlight supplies our daily vitamin D requirements, but it is also found in cod liver oil, butter, cereal, salmon with bones and eggs.

Lack of vitamin D causes rickets since vitamin D plays a role in calcium absorption and metabolism, both of which are essential to build healthy bones. You need vitamin D to help your body absorb bone-strengthening calcium and phosphorus from your gastrointestinal tract and signal to your kidneys to retain calcium so that it won't be lost from your body.

Drug research to help ALS sufferers is often based on the theory of a toxic build up of glutamic acid in the brain. Glutamic acid needs vitamin B₆ in order for it to be metabolised. Vitamin B₆ needs

phosphorus to be absorbed by the body. Phosphorus needs Vitamin D or it can't be absorbed by the body. Therefore a deficiency of vitamin D could cause lack of phosphorous, which can lead to B₆ deficiency which in turn leads to a build up of glutamate.

Cod-liver oil, as a source of vitamin D, is inexpensive and can be purchased in peppermint and other flavours and also tasteless capsules. Please note that vitamin D like Vitamin A can be toxic if taken in excessive doses but this does not mean that these vitamin supplements should be totally avoided. Toxic dose levels are unclear in the case of ALS/MND.

VITAMIN E Tocopheryl Acetate

This is obtained from sunflower seeds, peanut butter, almonds, dry roasted, anola or corn oil, salmon, tinned (with bones) tuna, lobster, olive oil and wheat-germ. The full role of vitamin E in the body is not fully understood, but it is thought to be important in the development and repair of the nervous system, as a powerful antioxidant protecting the cells of your body, including red blood cells and to help protect unsaturated fat from the destructive damage of oxygen.

Vitamin E occurs in food in several forms - alpha, beta, delta, and gamma-tocopherols and alpha, beta, delta and gamma tocotrienols. Most vitamin E supplements contain only the alpha tocopherol form because it is believed to have the greatest biological activity. Gamma-tocopherol is able to quench certain free radicals that alpha-tocopherol does not.

Of the E vitamins it has been stated that only gamma-tocopherol gets rid of

peroxynitrite, a highly destructive nitric oxide radical. ALS researchers suggest that nitric oxide, and especially peroxynitrite, could be involved in the oxidative-stress chain of events leading to motor neuron death.

It is not suggested that gamma-tocopherol is a cure for ALS, but ALS patients who want to take vitamin E should take supplements that contain the mixed forms of the vitamin rather than simple alpha-tocopherol. It has been suggested that high levels of alpha-tocopherol in the blood can reduce the level of the gamma form. Different tocopherol forms appear to have complementary but not identical functions.

The researchers, from the University Medical Centre, Utrecht, investigated the diets of 132 people with a form of MND called amyotrophic lateral sclerosis (ALS). Their dietary habits were compared to 220 control subjects who did not have the disease. Dietary habits were evaluated using a validated 104-item food frequency questionnaire.

While energy intake and supplement intake was similar between the groups, the researchers found that intake of vitamin E and polyunsaturated fatty acids (PUFAs) was noticeably lower in the ALS cases, which agreed with the original hypothesis.

Lead author of the study, Jan Veldink wrote. "This study shows that higher premorbid dietary intake of PUFAs and vitamin E was associated with a 50 to 60 per cent decreased risk of developing ALS,"

The researchers believe vitamin E inhibits lipid peroxidation which leads to oxidative stress.

The nutrients' protective activity, says Veldink, is a case of the sum greater than the parts.

"The combined analysis, including the interaction term, indicates that vitamin E and PUFAs increase their separate protective effects. Vitamin E may act directly to reduce the risk of ALS as a known inhibitor of lipid peroxidation, but it could also act indirectly through inhibition of peroxidation of PUFAs. As a result, a higher level of PUFAs will be available biologically," said Veldink. Although further research is clearly needed, the results do fit with reports on the benefits of this nutrient combination for cognitive diseases.

According to other studies, the risk of Alzheimer's disease could be reduced by a diet rich in plant lipids, fish, or by eating a Mediterranean-style diet, rich in both PUFAs and vitamin E.

The mechanism, say the researchers, is more than just the nutrients' individual benefits. The omega-3 fatty acid, alpha-linolenic acid, for example, has been reported to protect neurones.

Docosahexaenoic acid (DHA) is involved in the membrane of ion channels in the brain, making it easier for them to change shape and transmit electrical signals.

Vitamin K, Menaphthone

Vitamin K is obtained from liver, spinach, cabbage and other green vegetables and is essential for normal blood clotting.

Vitamin P, Hesperidin

Normal permeability of the capillaries depends on an adequate supply of vitamin P in the diet.

Taking huge doses of any medication/supplement is often pointless or even harmful if the medications/supplements are not supported with the other substances required to metabolise them. *Combined* supplementation is essential.