



Simply Magnesium

What if you discovered a supplement that could significantly help in the prevention of heart disease, cancer, strokes, osteoporosis and dementia?

A supplement that's a key player in working with depression, fertility, chronic fatigue and adrenal support?

Would you be interested?

And what if that supplement wasn't a hi-tech formula, or an obscure tropical plant extract...

...but simply magnesium.

It's time to remind ourselves of the power of mineral that is essential to every cell in your body.

Magnesium is in practically every multi and formula out there, because it is required for so many fundamental processes, not least the absorption of many other nutrients, the production of enzymes and prostaglandins, and the manufacture of ATP, our energy molecule. But are we taking the right form of magnesium? And are we taking enough?

First, let's remind ourselves of why magnesium is so crucial to every aspect of our wellbeing.

Magnesium and energy

The 8th most abundant element on the planet, magnesium is the brightly burning spark that underpins our energy levels. Magnesium is required for the production and stability of the ATP molecule, which provides energy for basic bodily processes. These range from processing and transporting nutrients, to making enzymes, and activating cellular pumps so that important substances can move in and out of each cell. The sodium-potassium pump, for example, is the mechanism by which nerve cells carry signals, and is also fundamental to maintaining the balance and flow of electrolytes across the cell membrane. Without this electrolyte exchange, which also includes the calcium-magnesium pump, we cannot maintain a sufficient pH, electrical charge or flow of hydration for the many important activities of the cell to function efficiently.

Our detoxification processes also require energy supplied by the adenosine triphosphate (ATP) molecule. So without enough magnesium, toxicity will build up in our cells and deaden their functions still further. We will slowly poison ourselves.

As we are essentially a community of approximately 100 trillion cells (embedded or floating in various types of matrix), if our cells are lacking energy and underperforming, then so are we.

Magnesium and cellular health

A healthy cell is one where the nutrients are able to enter and be utilised, toxins are able to be eliminated, and the environment supports the cell's chemical activities. If the cellular pumps are working well, which requires magnesium for ATP production and also relies on the quality of oils in the cell membrane, then the cell will be able to maintain the correct balance of magnesium, calcium, potassium and sodium within the cell. If they are not, then potassium and magnesium will be lost, and calcium and sodium levels will build up in the cell. Cellular processes reliant on magnesium and potassium, including DNA synthesis, enzyme manufacture and energy production, become sluggish, while processes that utilise calcium, such as muscle contraction and nerve excitability, become overactive.

At the same time, the environment or "test tube conditions" of the cell change, that is, its pH (acid-alkaline balance), temperature, hydration and light availability. This will stultify many other cellular activities, and together with the increased toxic load, will lead to chronic inflammation¹ and impaired function. The cell becomes increasingly stagnant, contracted and disconnected as the cell membrane becomes less able to hear and respond to external information. With the reduced ability to maintain a healthy balance and flow of electrolytes, the charge across the cell membrane changes, which directly affects the cell's ability to hold and produce quantum energy from light particles.²

Magnesium and cancer prevention

The membrane itself will by this stage contain fewer oxygen-attracting phospholipids (made from essential fatty acids), which has huge implications for how we produce ATP during cellular respiration and how the cell behaves. When there is a 40% reduction in oxygen availability for the ATP process, the cell will use up more glucose to make its energy molecules, and the cell will revert to foetal behaviour and start to multiply³. And indeed, the general effects on the body of impaired cell function and detoxification, including the change in pH and the slowing of the metabolic rate, will include a reduced ability to take up oxygen in the lungs and by the blood. Otto Warburg, awarded 2 Nobel prizes for his work on cancer, said that "Cancer has only one prime cause. The prime

cause of cancer is the replacement of normal oxygen respiration of body cells by an anaerobic (oxygen-less) cell respiration.”

Other researchers have sought to prove DNA damage as the root cause of cancer⁴. Apte & Sarangarajan explain how the p53 tumour suppressor gene is mutated in over 50% of tumours. The p53 gene is usually activated when oxygen levels are low (hypoxia)⁵, to prevent the cell from multiplying as Kremer describes and to induce cell death (apoptosis) – mutant p53 cells found in these tumours, however, show a resistance to hypoxia-induced apoptosis⁶. The body would usually work hard to repair such damage, or kill off the damaged cell, but in some cases this is not possible, perhaps due to the nature of the damage or the lack of certain resources. Magnesium is one of the nutrients crucial to DNA production and stabilisation⁷, and zinc is also important for DNA repair and p53 expression⁸.

Many other researchers point to the pH disruption in cancer cells⁹, the alterations in cellular communication via light emission¹⁰, and extreme stagnation and toxicity. We have seen the pivotal role magnesium plays with all of these aspects, together with potassium, oils and their supporting nutrients. Magnesium is also essential for the production of glutathione, which is important in our detoxification pathways.

Magnesium relaxes muscles

The same relationship between intracellular magnesium and calcium governs how well our muscles work: calcium helps muscles to contract, and magnesium helps them to relax. Muscle tissue usually contains more magnesium than calcium, and muscles low in calcium are prone to cramps and spasms. Magnesium may therefore be greatly beneficial to conditions such as **chronic back pain, leg cramps** and **IBS**. Indeed, constrictions in the muscle, nerve and connective tissue cells may contribute not only to muscle spasms, but also to poor postural alignment, as the skeletal structure is manipulated out of place. In my opinion, good hydration and nutrition is therefore a useful adjunct to many forms of bodywork.

Low levels of oxygen and an imbalance in intracellular calcium and magnesium levels have also been linked to **fibromyalgia**.

In addition, the importance of magnesium to cellular integrity and function described above shows just how crucial magnesium is to general tissue health in the body, including the tissue lining the bowel. Together with zinc, vitamin C and essential fatty acids, magnesium can help reduce the inflammation and repair damage to the inside of the digestive tract, and so help with **IBS, Crohn's disease, colitis** and many conditions arising from **malabsorption** in the gut. To avoid the occurrence or

reoccurrence of bowel disorders such as **IBS, Crohn's disease and colitis**, we need to ensure that our intestines have the resources they need to stay healthy, and the correct magnesium:calcium ratio to avoid spasms and help the bowel move in a way that helps prevent stagnation and fermentation.

Oestrogen and progesterone levels influence magnesium levels, which explains why the menstrual cycle is often accompanied **abdominal cramping**, including "**Mittelschmerz**" (mid-cycle cramping) where progesterone peaks in week 3.

Magnesium and blood vessels

A lack of magnesium can also cause contractions in the arterial walls, which contain smooth muscle tissue. In some people, this can lead to **headaches and migraines**, where the blood vessels in the head and neck are constricted. In one study, 3000 patients given at least 200mg supplemental magnesium daily reported an 80% reduction in their migraine symptoms.

Reduced levels of magnesium can also contribute to circulatory problems in other parts of the body, such as the extremities in **Raynaud's syndrome**, where the hands, for example, become very cold and pale due to extreme vasoconstriction of the periphery blood vessels.

Magnesium and heart disease

Coronary arteries also contain smooth muscle tissue, and so need calcium to contract and magnesium to dilate. Only 3mm or less in diameter, these arteries depend on magnesium to dilate them so that they can carry oxygen-rich blood from inside the heart to the heart muscle, which also needs a correct balance of magnesium and calcium to regulate our heartbeat. In fact, magnesium expert Mildred Seelig cites several studies that show magnesium to be beneficial in the treatment of **arrhythmia**¹¹ .

Magnesium is not the only nutrient needed to prevent heart disease. We also know the importance of essential fatty acids, vitamin E, vitamin C, Co Q10 and other supplements, but many would cite magnesium as being the most important. A CDCP¹² 19 year test showed that heart disease was a higher risk factor in those with magnesium deficiency, and a 5 year study in Taiwan showed a lower incidence of stroke death in areas where there was more magnesium in the water¹³. Magnesium deficiency has been shown to increase platelet aggregation, which contributes to the kind of clotting seen in **heart attacks, pulmonary embolism and strokes**.

An early sign of magnesium deficiency is degradation of elastin in the subendothelium of the arteries, the part of the lining which lies next to the smooth muscle. When this happens, the artery walls lose their elasticity, and inflammation occurs. Newer thinking around heart disease proposes that the cholesterol and calcium is sent to areas of damage in the arterial wall as a kind of plaster, presumably until the body had found a way to heal the damage. These plasters are rigid, however, and so not a good longterm solution¹⁴. If we don't have the nutrient stores, ability and energy to bring resources to this area and heal it, then the oxygen and blood rich coronary arteries gradually get weakened and blocked, and are unable to feed the heart muscle, leading initially to **angina** pain.

In up to 30% angina patients, however, the arteries are not badly blocked, and in 40-60% sudden deaths from heart attack, there is no prior artery blockage, no clots and the heartbeat has been normal¹⁵. Could these be caused by muscle spasm due to lack of magnesium?

Magnesium and osteoporosis

Many practitioners reach for the calcium when osteoporosis is diagnosed, perhaps with some vitamin D to aid absorption. But just as important, if not more so, is the actual placement of calcium in the body. Calcium placement is ultimately governed by magnesium.

The body will maintain homeostasis of the blood above everything else. If blood calcium is low, then the parathyroid will pull calcium out of the bones to stabilise blood levels. But if the diet is sufficiently high in calcium-rich vegetables and pulses, then why would the blood calcium levels be so low?

We need to look back to electrolyte exchange at the cell membrane again. If the calcium-magnesium pump isn't working efficiently, due to a lack of magnesium bound ATP and a lack of serum magnesium, then calcium will build up in the cells and have restricted access back into the blood. Magnesium also helps calcium to be laid down in the bone in the form of calcium phosphate crystals. Moreover, magnesium actually helps calcium to be absorbed in the first place. So with osteoporosis, magnesium should really be top of our list of supporting nutrients, and calcium may not be appropriate at all.

Kidney and gallstones

85% of kidney stones are made from calcium phosphate or calcium oxalate, and gallstones are largely calcium bilirubinate or calcium carbonate combined with cholesterol (present in the gallbladder as a component of bile). Ideally we would like calcium to stay in solution rather than be bound up in this way to form stones. It is magnesium that helps calcium to stay in solution in the body. In addition, healthy urine

usually contains levels of citrate that will prevent the formation of oxalates in the kidneys¹⁶.

So taking magnesium citrate would be a logical choice here for the prevention of stones. At the same time you would need to address pH (also assisted by magnesium) and the general health and function of the kidney/ gall bladder tissue cells.

Magnesium and the brain

I have already mentioned the role of magnesium and calcium in sending nerve signals. Neurotransmitters in the brain use magnesium, calcium and zinc to stimulate and regulate electrical activity. Calcium-rich brain cells can fire excessively, which will deplete their energy, and sometimes lead to **seizures**, or even cell death. Magnesium will lower the threshold for those seizures, and so reduce the likelihood that they will happen.

Dr Carolyn Dean tells of a Florida high school football team ill-advisedly given calcium supplements to help with leg cramps before a game. Remember that calcium competes with magnesium for absorption, and also acts antagonistically to magnesium in the body. After playing strenuously on a hot day, 8 members of the team suffered full blown seizures, and 2 had repeated seizures. Others reported symptoms including disorientation, blurred vision, problems walking, muscle twitching, nausea and weakness. The worst affected had also had magnesium depleting fizzy drinks and fast food before the game¹⁷.

Brain cells damaged by toxicity, trauma or stress will also fire inappropriately. Chemicals such as food additives, pesticides, herbicides, solvents and cleaning products can all cross the blood-brain barrier and poison brain cells. Magnesium can help to protect the brain from the toxic effect of these chemicals.

Heavy metals compete with magnesium in the small intestine and brain, and so as well as depleting magnesium, they will be depleted by magnesium if there is enough there. Magnesium also plays an important role in detoxifying our cells from heavy metals, not least through production of detoxifying glutathione. Studies have shown that magnesium will in fact protect the whole body from heavy metals¹⁸. With the increase in links between heavy metals and conditions such as **Parkinson's**¹⁹, **Alzheimer's**²⁰, **dementia**, **MS**, **ME**, **autism**²¹, **ADHD** etc., magnesium would be a strong contender for consideration when looking at supplementation for brain health, alongside essential fatty acids and zinc.

Magnesium is also required for the production of serotonin, making it a useful nutrient for those with **depression**, and also for the production of dopamine, low levels of which are associated with **Parkinson's disease**.

Magnesium and anxiety

Magnesium deficiency has been related to **anxiety**²², **panic attacks**²³ and **palpitations**²⁴. We have already looked at magnesium and heart health, but we must also look at the role of the adrenals here too.

What I often refer to as an "adrenal lifestyle", i.e. with stressful jobs, repeated heavy exercise or adrenaline sports, burning the candle at both ends, running on empty – all of these deplete magnesium levels by putting a strain on the adrenals. Adrenal stress will lead to increased loss of magnesium and potassium via the kidneys, as aldosterone signals that they should hold onto fluids via sodium retention – thus also contributing to high blood pressure.

Additionally, magnesium is a co-factor for the hormones, prostaglandins and enzymes required to service the adrenals (alongside zinc, essential fatty acids, vitamin C, vitamin E, a variety of B vitamins and amino acids – B5 is a particularly good adrenal support, as are B6 and vitamin C). Adrenal depletion will also put a strain on thyroid, and indeed the rest of the endocrine system.

Stress in itself will have a contracting effect on the whole body, and **chronic stress** will lead to the kind of stagnating effect discussed earlier. The cells respond to stress by restricting the flow across the cell membrane. The purpose of this seems to be to hold onto water by impeding the flow of water (each molecule of sodium will have 28 molecules of water following it), so the cell membrane alters in a way that inhibits the action of the pumps. This will reduce intracellular magnesium and potassium levels and increase calcium and sodium levels, with all of the potential ramifications already discussed and more. So when we talk about stress-related illness, we are referring to specific biochemical processes that can be assisted by the addition of magnesium.

Blood sugar, diabetes and insulin

One of the roles of calcium in the blood is to regulate blood sugar²⁵. We have already seen how magnesium deficiency can lead to calcium misplacement, and this will impact on how well we can hold our blood sugar levels. Magnesium supplementation has also been shown to improve insulin response and glucose tolerance.

Refined sugar has 95% less magnesium and so uses up our own magnesium reserves to help digest it. If we don't have enough magnesium to do this, we form pyruvic acid and abnormal sugars that

impede ATP production in the brain and nervous system. So we would certainly be advised to avoid refined sugar, and where blood sugar is a more pronounced issue, magnesium would be part of a team of nutrients that would need to be looked at, including chromium, cobalt, copper, zinc, iodine and oils.

Magnesium and women

We have already seen how oestrogen and progesterone affect magnesium levels, and this is relevant for both menstruating women and women going through **menopause**. There have been a number of studies showing magnesium to be therapeutic due to its ability to relax muscles and blood vessel walls, and also to reduce PGF2 alpha, a prostaglandin which stimulates contraction of the uterine muscle.

In one study, 192 women took 400mg magnesium daily for **PMS** with the following results: 95% reported reduced breast pain and weight gain, 89% had a decrease in nervous tension and 43% experienced fewer headaches. Pre-menstrual mood swings have also been shown to benefit from magnesium supplementation, perhaps because of its effect on serotonin levels²⁶.

Women with **Polycystic Ovary Syndrome** (PCOS) have lower magnesium levels and higher calcium levels, and magnesium is a useful supplement for all areas of fertility work, particularly in providing raw materials for prostaglandin production, which regulates menstrual activity, and in maintaining healthy tissue cells.

Pregnancy

Magnesium requirements increase during **pregnancy, labour and breastfeeding**. The developing baby requires magnesium for its own ATP production, manufacture of enzymes and hormones, prostaglandins and to maintain its own electrolyte balance during the production of its own healthy cells. The mother needs increased magnesium intake to provide for all of this, and also to service her own increased levels of hormones, prostaglandins, enzymes and ATP, as well as increased uterine and breast tissue. In terms of labour, if magnesium is deficient, then the cervix may have a hard time dilating and the pelvis may find it difficult to relax and widen. Seelig also links magnesium deficiency with many conditions relating to pregnancy, including spontaneous abortion, preeclampsia, postpartum uterine cramps, placenta abnormalities in eclampsia, intrauterine growth retardation and foetal hypoxia²⁷.

Magnesium and ME

A double blind placebo controlled test of randomly chosen chronic fatigue patients showed a significant increase in energy levels and emotion handling after 6 weeks of intramuscular magnesium sulphate.

In my own practice, I have repeatedly found magnesium to be a crucial factor within the various programmes I have put together for individual ME/chronic fatigue patients. I believe this works on the following levels:

- Increasing ATP production helps provide energy and shift sluggishness on all levels
- Regulating blood sugar levels also helps with energy levels throughout the day
- Releasing the vasodilation and muscle restriction on the neck so common with ME patients relieves headaches and migraines
- Clearing the toxic load has beneficial consequences for whole body; magnesium particularly helps protect the brain and kidneys from the effects of toxic damage
- Magnesium strongly supports the integrity of muscle and nerve tissue, which is often a problematic area with ME.
- Restoring the magnesium/calcium balance in nerves can also help to redress problems of heightened sensitivity to noise and light
- Restoring the balance and flow of electrolytes across the cell membrane allows clearer communication within the body and with its environment, and helps bring more oxygen and light into the body²⁸.

Sources of magnesium

Shellfish have the highest levels of magnesium, followed by nuts and seeds. Dark green leafy vegetables are also good sources of magnesium, as are pulses, cauliflower and avocado. Wholegrains contain useful amounts, but processing will reduce their levels, for example 80-85% of their magnesium is lost during milling of wheat into flour, and white rice contains 83% less magnesium than brown rice. The process of freezing vegetables will often reduce their magnesium content too. It is also worth noting that minerals will leach into the water when boiling vegetables, so it is good practice to use the water to make gravy and sauces.

In addition, soil levels of magnesium have fallen, leading to reduced uptake by plants and animals through the food chain. McCance and Widdowson show a 24% drop in vegetable magnesium levels, a 16% reduction in fruit, and a 10% drop in meat, between 1940 and 1991²⁹. In fact the soil loss is probably greater than these statistics suggest, as the vegetables in the 1940 study were boiled for much longer times. Broccoli, for example, was boiled for 45 minutes in the 1940 study, but for only 15 minutes in the 1991 study.

Magnesium absorption and uptake

Magnesium needs a high level of acidity in the stomach to convert it into a usable form. Approx 50% (in some cases up to 75%, but in others much lower) is absorbed in the small intestine, providing there is adequate

hydration (magnesium is water soluble) and enough functioning protein transport molecules in the GI wall. Magnesium absorption is inhibited by calcium, phosphorous, potassium, sodium, lactose, supplemental iron, high doses of supplemental zinc, phosphates (for example in fizzy drinks), caffeine, alcohol, oxalic acid and phytic acid. Free fatty acids can also reduce absorption, as can high protein levels; however many of the protein rich foods are also high in magnesium. Magnesium is also inhibited or depleted by diuretics, the contraceptive pill, insulin, digitalis, some antibiotics such as tetracycline, cortisone and cardiac glycosides³⁰. Magnesium is excreted largely by the kidneys, but also in the gut, and as we have seen, stress will increase magnesium loss.

For best uptake by the cells, magnesium requires an alkaline environment and good levels of vitamin B6.

Magnesium supplementation – dosage and form

So now we come to the big question: how much to take, and what is the best form?

How much to take varies hugely from person to person. Factors include age, the person's current magnesium status, diet, soil magnesium levels, the health of the small intestines and kidneys in particular, and all the other factors for absorption discussed above. In addition, higher levels are needed by pregnant and lactating women. The Reference Nutrient Intake (RNI) recommended by the government is 300mg for men and 270mg for women, but many would agree that this falls far short of actual requirements. Elson Haas estimates that an average diet usually supplies around 120mg³¹, and many practitioners have found it appropriate in some cases to supplement up to 600-800mg on top of this. Toxicity is rare, as excess magnesium is usually excreted. A B6 supplement is often prescribed alongside magnesium to improve uptake by the cells.

The form of magnesium you take is also important. Many supplements contain carbonates and oxides, as these are cheaper forms. However, these forms will also reduce the stomach acidity, and therefore how well absorbed the magnesium is. The Nutrigold Newsletter "The Truth About Mineral Supplementation" cites a 1990 study by Lindberg et al where magnesium citrate was shown to be 4-4.5 times more absorbable than magnesium oxide. Using Lindberg's data it can be calculated that yeast-enriched supplements marketed as "like the form in which they are present in foods" are only a tenth of the value for money compared to magnesium citrate supplements³². Magnesium oxide is also a laxative, and so I would not recommend its use in therapeutic doses.

Magnesium sulphate is the form of magnesium in Epsom salts, and enough is absorbed transdermally to help relax the muscles wonderfully in a warm bath. Its absorption in the gut, however, is so poor that it will instead attract water into the colon, and so like magnesium oxide, has a laxative effect.

Magnesium chloride is widely available for internal and transdermal use, and is the form that the stomach converts magnesium into, so is useful where stomach acids levels are lower. The body then needs to convert magnesium into citrate form for use in the Krebs cycle. In fact the body creates 1.5kg of citrates daily, so supplementing magnesium in citrate form would not significantly upset the balance of citrates. The body's own aspartate pool is much smaller, however, and so supplementing with magnesium aspartate may have a more unbalancing effect.

Finally it's worth noting a 2005 study comparing absorption of organic and inorganic forms of magnesium, where the organic forms (including citrate, gluconate and aspartate) were shown to be better absorbed³³. Overall, magnesium citrate would seem to be the most beneficial form to take that is readily available³⁴.

Magnesium supplementation should be increased gradually and mindfully. As magnesium will increase the detoxification pathways in the body³⁵, we need to make sure that the routes of elimination can cope with the extra workload. This may require additional support for the lymphatic system, blood, liver, kidneys, lungs, skin and/or colon. A good practitioner will be able to look at the whole picture in this way, and provide assistance on all levels to help you take appropriate levels of magnesium in a way that your body work best with it.

To find a practitioner, contact the Federation of Nutritional Therapy Practitioners on 0870 3120042 / www.fntp.org.uk

Kirsten Chick B.A. (Hons), DNN is a lecturer at the College of Natural Nutrition and at Sussex Downs College. She practises in Brighton & Hove, and gives talks and workshops around the country. For more information see www.connectwithnutrition.co.uk

¹ Mark Sircus tells of a Medical University of South Carolina study of blood inflammation levels, using C-reactive protein as a marker, in 3800 men and women, which showed that those who got consumed than 50% of the RDA for magnesium (310-420mg) were almost 3 times more likely to have dangerously high CRP levels. ("Inflammation and Systemic Stress" 2008)

² *Johanna Budwig and Mae Wan Ho have shown how the electrons in the cell membrane capture and hold quantum energy from light; FA Popp has shown how the body can produce its own light; Vladimir Voeikov has shown how free radicals, including oxygen ions, come together to produce light.*

J Budwig "Flax oil as a true aid against heart infarction, cancer and other diseases" 3rd edition Apple Publishing 1994; MW Ho "The Rainbow and the Worm" World Scientific Publishing 1998; M Rattemeyer, FA Popp, and W Nagl, Naturwissenschaften 68 (1981): VL Voeikov "Reactive oxygen species (ROS): pathogens or sources of vital energy? Part 2. Bioenergetic and bioinformational functions of ROS" Journal of alternative and complementary medicine 2006

³ *H Kremer "The Silent Revolution in Cancer and AIDS Therapy" Xlibris 2009*

⁴ *Links between DNA damage and cancer have been explored by Link & Poulsen ("Cancer risk and oxidative DNA damage in man" Journal of Molecular Medicine 1996) and Wiseman & Halliwell ("Damage to DNA by reactive oxygen and nitrogen species" Biochem Journal 1996)*

⁵ *or during DNA damage, the expression of certain oncogenes or cytotoxic stimulus*

⁶ *S Apte & R Sarangarajan "Cellular Respiration and Carcinogenesis" (Humana Press 2009)*

⁷ *J Anastassopoulos & T Theophanides "Magnesium-DNA interactions and the possible relation of magnesium to carcinogenesis. Irradiation and free radicals" Oncology Hematology April 2002*

⁸ *E Ho, C Courtemanche & BNAMES "Zinc Deficiency Induces Oxidative DNA Damage and Increases P53 Expression in Human Lung Fibroblasts" J. Nutr. Aug 2003*

⁹ *Such as Drs Gerson and Simoncini*

¹⁰ *See Budwig above, and Mae Wan Ho's "The Rainbow and the Worm" World Scientific Publishing 1998*

¹¹ *MS Seelig "Magnesium Deficiency in the Pathogenesis of Disease" Goldwater Memorial Hospital 1980*

¹² *Centers For Disease Control and Prevention in the US*

¹³ *Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003*

¹⁴ *85% of such plaques form near junctions in the arteries, where there is more need for protection against overstretching, and they never occur where arteries pass through bony structures that already prevent overstretching*

¹⁵ *Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003*

¹⁶ *Ettinger et al "Potassium-magnesium citrate is an effective prophylaxis against recurrent calcium oxalate nephrolithiasis" J. Urology Dec 1997*

¹⁷ *Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003*

¹⁸ *M Speich et al "Correlations between magnesium and heavy metals in blood and sixteen tissues of rabbits." Magnes Res. Sep 1989*

¹⁹ *EB Montgomery "Heavy metals and the etiology of Parkinson's disease and other movement disorders" 1994*

²⁰ *The occupational histories of 185 people with Alzheimer's disease were compared to 303 people without the disease. Results showed that individuals were up to 3.4 times more likely to develop Alzheimer's if they had worked in jobs exposing them to high levels of lead - either by breathing lead dust or from direct skin contact.*

An Ontario study involving 668 autopsy-verified Alzheimer's brains showed an increased risk by a factor of 2.5 in people drinking water with more than 100 micrograms of aluminium.

²¹ *SJ James et al "Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism" Amer J Clin Nutr 80 2004*

²² *MS Seelig MS, et al "Latent tetany and anxiety, marginal magnesium deficit, and normocalcemia." Dis Nerv Syst. Aug 1975*

²³ *Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003*

²⁴ *EM Haas "Staying Healthy With Nutrition" Celestial Arts 1992*

²⁵ *Martin L Budd "Low Blood Sugar" Thorsons 1984*

²⁶ *Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003*

²⁷ MS Seelig "Magnesium Deficiency in the Pathogenesis of Disease"
Goldwater Memorial Hospital 1980

²⁸ Drs Johanna Budwig and Mae Wan Ho have shown how the electrons in the cell membrane capture and hold quantum energy from light; FA Popp has shown how the body can produce its own light; V Voeikov has shown how free radicals, including oxygen ions, come together to produce light.

²⁹ D Thomas "A study on the mineral depletion of the foods available to us as a nation" 2003

³⁰ Dr Carolyn Dean "The Miracle of Magnesium" Ballantine Books 2003

³¹ EM Haas "Staying Healthy With Nutrition" Celestial Arts 1992

³² LG Plaskett, "The Truth About Mineral Supplementation" Nutrigold 2000

³³ C Coudray et al "Study of magnesium bioavailability from ten organic and inorganic Mg salts in Mg-depleted rats using a stable isotope approach" Magnesium Research vol 18 December 2005

³⁴ magnesium acetate is also a cheap, readily absorbed form, but has a rather unpleasant taste.

³⁵ by increasing glutathione levels, aiding in the production of ATP and helping to drive electrolyte exchange at the cell membrane

The image shows a tilted, black and white version of a periodic table of elements. The title at the top reads "PERIODIC TABLE of the Elements". The table is organized into groups and periods, with elements labeled by their chemical symbols and atomic numbers. The elements shown include Zr, Nb, Mo, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Kr, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Po, At, Rn, Db, Sg, Bh, Hs, Mt, Uun, Uub, Uuq, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, and Lr. The table is tilted at an angle, making the text slanted.