

Millions of people worldwide suffer from diabetes – most develop it in middle age

The warning signs of diabetes are found in 25-30 per cent of adults – due to our high Glycemic Load and low micro-nutrient diet and inactive lifestyle

The cow's milk in baby formula has been linked to Type 1 diabetes. Breast-fed children have the least risk

Diabetes can lead to blindness, kidney failure, gangrene and heart disease

Diabetes attacks our anti-oxidant defences – boosting your anti-oxidant intake provides a shield

Vitamin E and PUFAs could repair some of the damage done to nerves and other tissues

Flavonoids and Vitamin C can strengthen typically weakened blood vessels

Red wine, or half an aspirin, daily protects against glycosylation

Athletes, dieters, the overweight, new mothers and the elderly should consider a specific anti-diabetic supplement

Chapter 16

How you can avoid and treat diabetes

Juvenile diabetes

When you understand how complex and sophisticated breast milk is, even the best infant formulae look primitive – and potentially hazardous. There is growing evidence that infant formulae based on cow's milk may be an important risk factor for Type 1 diabetes, also known as juvenile or insulin-dependent diabetes⁽¹⁾.

One of the proteins in cow's milk, Bovine Serum Albumen (BSA), is found in most infant milk-based formulae⁽⁷⁾. Many insulin-dependent diabetics have raised levels of antibodies against BSA in their blood^(1, 2).

When adults eat protein foods, the molecules are broken up in the gut and do not normally enter the blood and trigger antibodies. Infants are less well protected: they produce fewer digestive enzymes and their guts appear to let more protein molecules, like BSA, enter the bloodstream. Once there, they are recognised as foreign molecules and the immune system begins to produce antibodies against them.

By an unfortunate coincidence, part of the BSA molecule bears a strong resemblance

to molecules on the membranes of the beta cells in the pancreas which produce insulin^(1, 6). Hence, it is believed that antibodies raised against BSA molecules can also attack the beta cells, leading to their eventual destruction, and therefore diabetes. (Beta casein and bovine insulin, two proteins found in cow's milk, have also been implicated^(117, 137, 138).) Cow's milk has been found to trigger diabetes in animals too^(3, 4).

AUTO-IMMUNE DISEASE?

Scientists have long suspected that insulin-dependent diabetes might be an auto-immune disease – that is, one caused by the immune system attacking its owner. And the evidence is getting stronger.

A recent Finnish study showed that babies who were older than four months when first given formula milk had lower rates of diabetes than babies who received formula from an earlier age⁽⁶⁾.

In children who were exclusively breast-fed, the risk of diabetes was the lowest of all⁽⁸⁾.



In babies, cow's milk may trigger antibodies that attack insulin-producing cells. Wheat and soy are also under suspicion⁽¹¹⁵⁾.

Breast-feeding reduces risk of diabetes

Children who are exclusively breast-fed have the lowest rate of Type 1 diabetes.

Adult-onset diabetes

The majority of diabetics (143 million worldwide, rising to 250 million by 2010) develop the disease later in life, typically in middle age. This form of diabetes is called Type 2, adult-onset or non-insulin-dependent diabetes, and the risk of developing this condition is increased by obesity, inactivity, high saturated fat intake, alcohol consumption, smoking and a poor anti-oxidant intake^(98, 109, 110). Conversely improved diet and exercise reduce the risk of developing diabetes by more than 50%⁽¹³⁹⁾.

Insufficient insulin (Type 1) or insulin resistance (Type 2) both lead to excessive blood sugar levels (hyperglycaemia). The long-term complications of hyperglycaemia are potentially very serious⁽¹⁸⁾. Intensive treatment to normalise blood sugar (in Type 1 diabetes) slows the onset of these problems, but does not avoid them completely^(19, 26, 27).

One of the ways in which hyperglycaemia causes disease is because of the high oxidative load it imposes on the body^(20, 21, 99, 100). To make matters worse, copper and zinc levels are usually low in diabetics^(22, 23, 103), probably because of increased urinary losses.

The results of diabetes:

- **Increased free radical load**
- **Damaged anti-oxidant defences^(22,23,29,103,125)**
- **25 times the risk of blindness**
- **20 times the risk of kidney failure**
- **20 times the risk of gangrene**
- **Up to six times the risk of heart disease**

DIETS WHICH FIGHT DISEASE : **Diabetes**

This is damaging, because the important anti-oxidant and anti-ageing enzyme, Superoxide Dismutase (SOD), needs both copper and zinc to function properly.

Double Whammy

Diabetes increases free radicals in the body, and at the same time damages our anti-oxidant defences^(22, 23, 29, 103, 125).

DIABETES AND AGEING

When a molecule of glucose ('blood sugar') bonds to another molecule such as a protein, this is termed 'glycosylation'. As blood sugar levels increase, this increases the rate of glycosylation. Excessive glycosylation of proteins is another cause of accelerated ageing in diabetes⁽²⁹⁾.

Glycosylation of crystallins (proteins in the eye) leads to cataract. Glycosylation of elastin and collagen in the blood vessels can cause hardening of the arteries and kidney damage. Glycosylation of insulin renders it ineffective, contributing to insulin resistance and making matters worse.

Vitamin E

In human diabetics 900mg Vitamin E a day significantly improved peripheral nerve function⁽¹²⁸⁾, while alpha lipoic acid (600-1200mg a day) improved blood sugar control⁽⁷⁴⁾.

Oxidation and anti-oxidants

Hyperglycaemia also damages tissues directly. Excess glucose molecules bond directly to proteins, damaging them and impairing their normal function. The destructive combination of oxidation and glycosylation causes the accelerated ageing that occurs in diabetic arteries, kidneys, blood vessels and other tissues

Prime targets for free radicals in the body are the poly-unsaturated fatty acids (PUFAs) in cell membranes. The body finds it hard to replace PUFAs which have been oxidised. If the oxidised PUFAs are not replaced with fresh PUFAs, cell membranes begin to deteriorate and this impairs their normal functions.

In addition, when PUFAs are oxidised, they form lipid peroxides. In diabetics and pre-diabetics, levels of peroxides in the blood are abnormally high^(17, 30, 39). These peroxides cause serious damage to the lining of blood vessels^(31, 32). At the same time, high blood glucose levels block Vitamin C uptake into vessel walls, causing further local breakdown of the extra-cellular matrix and tissue damage^(76, 77, 123, 131-133). This explains why the course of diabetes can be modified by high-dose anti-oxidants and other supplements⁽¹²⁸⁾.

Anti-oxidants & prevention

Diabetes during pregnancy increases the risk of birth defects. High-dose Vitamin E may give some protection against this⁽⁷²⁾.

Lipid peroxidation in diabetics is reduced by high-dose Vitamin E^(12, 81, 101, 108, 112). In diabetes-prone rats, anti-oxidant therapy delays the onset and reduces the incidence of diabetes^(24, 25). Even more excitingly, some (perhaps most) of the complications of diabetes,

such as the nerve damage and atheroma that cause loss of sensation and impotence in male diabetics, can be reversed with high-dose Vitamins E and C, and other anti-oxidants such as alpha lipoic acid^(74, 116, 127, 128).

ANTI-OXIDANTS AND PREVENTION

High-dose anti-oxidants such as Vitamin E reduce the rate of PUFA oxidation, and the levels of peroxides in diabetics^(12, 81, 101, 108, 112) and protect against blood clots⁽⁷¹⁾.

More surprising are studies which show that high doses of Vitamin E (900 mg/day) improve blood sugar control and reduce platelet stickiness and ‘bad’ LDL cholesterol levels in Type 2 diabetics^(34, 35, 108), a combination which should be highly cardio-protective. Vitamin C appears to offer different, but equally significant, benefits^(97, 111, 113).

Even more surprisingly, recent work suggests that E depletion may be a risk factor for developing diabetes^(68, 98). Low carotenoid status is another⁽⁶⁹⁾.

This implies that oxidative stress, and lipid peroxidation, may be causes of diabetes, as well as important exacerbating factors.

Glycosylation and anti-glycosylants

High blood sugar levels increase the glycosylation of proteins, changing their structure and impairing their function. This type of protein damage contributes to diabetic retinopathy, cataract, renal disease and colorectal cancer⁽¹⁶¹⁾. It can be reduced by high dose Vitamins C and E^(113, 114), but flavonoids are the supreme anti-glycosylants^(101,130). Long used to stabilise diabetic retinopathy (by normalising capillary function^(43,44,74)), these nutrients are strongly recommended for all diabetics.

The flavonoids in red wine protect cholesterol and other lipids from oxidation and increase levels of ‘good’ HDL cholesterol⁽³⁶⁾. But the salicylates and flavonoids in red wine also prevent glycosylation, as does curcumin, the flavonoid in turmeric^(101,130).

Critically, glycosylated insulin is inactive, and contributes to insulin resistance⁽¹⁴⁰⁾. A low Glycemic Load diet combined with a high flavonoid intake can largely normalise this.

It is no coincidence that the sweetest natural foods – the berries – contain the highest levels of protective flavonoids. Most processed foods have high sugar levels and no flavonoids.

Glycosylants

All sugars cause glycosylation. Glucose is fairly inactive – that’s why we use it as fuel. Fructose (fruit sugar) is more damaging; galactose even worse. [Lactose (milk sugar) is broken down in the body into glucose and galactose.]

Anti-glycosylants

- 1 Flavonoids in red wine, pine bark extract or turmeric.
- 2 Salicylates, including aspirin.
- 3 Low Glycemic Load diet (see page 273).

Red wine and grape juice

Red wine and grape juice combine flavonoids with alcohol and sugar respectively. Red wine or grape seed extract are therefore preferred.

Fat factors

The dietary content of fats and oils is important, and can be manipulated to produce health benefits.

As well as having excessive levels of sugar in the blood (hyperglycaemia), diabetics also have abnormally high levels of triglycerides.

Post-prandial hypertriglyceridaemia (having very high levels of triglycerides – or fats – in the blood vessels after a meal) is inevitably found in diabetics. This is also found in many of the (apparently) healthy relatives of diabetics, which has led some scientists to conclude that this may be the forerunner of hyperglycaemia⁽⁴⁰⁾.

As levels of triglycerides increase, they begin to interact with LDL and HDL cholesterol. Cholesterol enters the triglyceride particles, making them more likely to cause coronary artery disease; and the LDL/HDL ratio increases, which has a similar effect.

Diabetics have excessive levels of triglycerides because, although triglycerides are normally removed from the blood by an enzyme called LPL, LPL depends on normal levels of insulin, and the LPL enzyme is therefore generally defective in diabetics.

A diet rich in fat, and especially saturated animal fats, decreases the activity of LPL, leading to an increase in triglycerides, and an increase in the risk of coronary artery disease.

Regular exercise, on the other hand, makes LPL in the muscles more active, and so lowers triglycerides, and reduces the risk of heart disease.

Although this is an oversimplification, it helps to explain why our lack of exercise and undue fondness for junk foods high in saturated fats and low in anti-oxidants and micro-nutrients has led to insulin resistance and hypertriglyceridaemia in 25-30 per cent of middle-aged adults.

Regular exercise, plus lower calorie, predominantly vegetarian diet can often help reduce the severity of Type 2 diabetes – and may even bring it under complete control.

Omega 3 fish oil or hemp or flaxseed oil and Vitamin E, and a glass of red wine! PUFA supplements, together with anti-oxidant support (such as evening primrose oil and high-dose Vitamin E) restore nerve function in animal models of diabetes⁽³³⁾.

The right combination

PUFA supplements should always be combined with anti-oxidants^(10, 124), particularly Vitamins E and C, and Co-enzyme Q10⁽²⁴⁾.

... And exercise too

Weight loss and exercise are essential elements in any self-help programme for Type 2 diabetes.

Family matters

One study of diabetics and their non-diabetic relatives may eventually change the way we think about coronary artery disease.

Among the non-diabetic relatives, there were two distinct types. One group, who were probably not prone to diabetes, had normal insulin, normal triglycerides, and normal LPL activity. The other group, who were likely to develop diabetes, had high insulin, high triglycerides (especially post-prandial triglycerides), and grossly sub-normal LPL activity. This pre-diabetic combination is termed ALP and is probably genetically determined^(63, 64).

ALP types can benefit from losing weight and taking more exercise. Additionally, they should eat more oily fish, because the Omega 3 PUFAs in fish oil increase LPL activity, and bring the triglycerides down^(9, 41, 42, 65-68). They also lower insulin levels in healthy subjects and in Type 2 diabetics: and improve the HDL/ LDL ratio⁽⁹⁾.

ALP types should definitely increase their intake of Vitamins E and C. Chromium supplements are also strongly recommended. Not only do they reduce triglyceride levels in Type 2 patients⁽⁴⁵⁾, they can also improve many ALP symptoms such as sugar craving^(55, 62) and excess insulin levels⁽⁸²⁾.

Mineral deposits

A survey carried out in 1993 by the US Department of Agriculture showed that the average diet is very low in chromium. Chromium supplements may therefore be a good idea, especially for dieters, athletes, the elderly, the overweight and diabetics.

Some scientists believe that chromium depletion can lead to insulin resistance⁽¹⁰⁵⁾, the primary symptom of Type 2 diabetes. Chromium is probably part of the Glucose Tolerance Factor (GTF), which is needed for the normal metabolism of sugar and other carbohydrates^(46, 47), although not everyone agrees^(84-87, 89).

Chromium and/or GTF deficiency is thought to occur particularly after pregnancy^(48, 49), and in the elderly⁽⁵⁰⁾, but chromium depletion is probably much more widespread^(16, 37, 57, 59-62).

Are you an ALP?

Early warning signals for diabetes

- **Weight gain**
- **Cravings for sweet foods**
- **Spells of cold, tiredness and irritability**
- **Raised levels of insulin and serum triglycerides**

Preventative chromium

Hexavalent chromium compounds are toxic and should be avoided. Go for the organic trivalent chromium – about 120mcg a day.

TOP CHROMIUM FOODS

Apples, eggs, nuts, mushrooms, broccoli, tomatoes.

DIETS WHICH FIGHT DISEASE : **Diabetes**

Have your oats

Diabetics and pre-diabetics should try eating oat-based foods. Beta glucans in oats reduce the absorption of sugar and fats from the gut, and as a result lower levels of blood glucose, LDL cholesterol and triglycerides.

They have extra benefits for blood sugar and lipid levels. Even a slight reduction in post-prandial glucose may have significant benefits⁽¹⁰²⁾.

Beta glucans are technically pre-biotics, like inulin or FOS (see Chapter 7, Pre-biotic fibre). These compounds will likely have similar benefits in diabetes.

Diet or Drugs

Anti-diabetic nutrition programmes also reduce the risk of heart disease. Oral anti-diabetic drugs (sulphonurea, tolbutamide, etc) are linked to an increased risk of heart attacks⁽¹⁰⁷⁾.

So what are the likely benefits of chromium supplements?

- There are reports that the glucose tolerance curve, which often deteriorates with old age, can be normalised by chromium-containing yeast supplements^(51-54, 90, 107). Even a slight improvement should confer considerable health benefits⁽¹⁰⁷⁾.
- Transient hypoglycaemia, a condition characterised by erratic glucose tolerance, mood swings, sugar craving and weight gain, and which may be a form of latent diabetes (see ALP above), may respond well to chromium supplements^(55, 62).

In healthy but possibly pre-diabetic subjects with raised insulin levels, there is evidence that chromium supplements can lead to a normalisation of insulin levels⁽⁸²⁾.

- Finally, in diabetic animals, chromium supplements reduce blood sugar, water consumption and weight loss^(56, 58). Human diabetics seem to respond equally well. Work carried out at London's King's College has shown that chromium supplements improve the condition of many Type 2 diabetics, and enable some diabetics to come off their medication altogether^(38, 104, 123).

There may be other reasons to take chromium, as some studies find that long-term chromium supplementation increases levels of HDL (the 'good' cholesterol) in the blood^(13, 14), and reduces levels of triglycerides⁽⁴⁵⁾, which would reduce the risk of heart attacks.

It must be said that not all trials have found such positive results⁽⁸⁸⁾. Nevertheless, the trivalent chromium compounds have little toxicity, and worth trying if you suffer from adult-onset diabetes, hypoglycemic episodes, sugar cravings and weight gain.

Chromium-enriched yeast or chromium polynicotinate may be better than chromium picolinate, which has been linked with psychiatric problems⁽¹⁰⁶⁾ and possible cancer risks.

Magnesium

Low magnesium levels in diabetes are associated with insulin resistance and an increased risk of late complications of the disease. Magnesium supplements have been used with good results in diabetic patients^(75, 91, 92), and it has been suggested that they might help to minimise the late complications of diabetes^(11, 93).

The evidence for this is not very extensive, but magnesium supplements do have an effect on improving plasma lipid levels⁽⁹³⁾, and reducing platelet stickiness⁽³⁹⁾ – which would help reduce circulatory and heart problems. Accordingly, a multi-mineral product combining magnesium (50mg) with chromium (120mg), together with zinc (10mg) and copper (2mg), which are also low in diabetics, should help to reduce the risk of late complications. Chitosan, a lipid-absorbing fibre, may also be helpful⁽¹¹⁸⁻¹²²⁾.

Herbs

Herbal medicine may also have much to offer the diabetic. How they work isn't known, but there is some clinical and traditional evidence for bitter aloes⁽⁹⁴⁾, bitter melon⁽⁹⁵⁾ and fenugreek⁽⁹⁶⁾ as potentially safe anti-diabetic agents.

Glycemic Load (GL)

When carbohydrate foods are eaten they increase blood sugar levels. Refined carbohydrates cause large increases (they are high GL foods), while unrefined carbohydrates (whole grain products, pulses, legumes) cause smaller increases (they are low GL foods). Reducing the GL of your diet significantly improves many aspects of Type 2 diabetes, reduces the risk of developing the condition and is strongly recommended.

Cutting out just 30g carbohydrates a day (eg one potato) has been calculated to reduce the risk of diabetes and cardiovascular disease by 30 per cent^(156,157, 165-168). The GI table on page 358 of the Appendices gives the GI of common foods.

Vanadium?

This trace element may have a therapeutic role⁽⁷⁰⁾ – not proven yet.

Slow cooking

Foods cooked at high temperatures contain glycation end products (AGEs), which exacerbate inflammation in the arteries and elsewhere in the body, and raise LDL cholesterol levels⁽¹⁶⁴⁾. Diabetics should switch to low temperature cooking – ie no fast foods.

GI/GL

Glycemic Index = blood glucose response to a food that contains 50g carbohydrate.

Glycemic Load uses the GI of each food, the carbohydrate content per serving and the number of food servings per day to calculate the total glucose response.

Why diabetes is increasing: The Tri-cameral Model

1 Too much glucose pouring into our bloodstream

When carbohydrates are eaten, they increase blood sugar levels. Unrefined carbohydrates such as whole grains, pulses and legumes (low GI foods) cause small increases; refined carbohydrates (high GI foods) cause surges in blood sugar, lipids and insulin which are all substantial risk factors for diabetes and coronary artery disease^(102, 153-160). The GI of our diet jumped when fine milling techniques and the potato were introduced in the 17th century⁽¹⁴¹⁻¹⁴³⁾ and this is when diabetes really began to take off⁽¹⁴⁴⁾.

2 Too little storage

Most blood glucose is taken up into skeletal muscle – but our sedentary lifestyles mean we are less muscled than our ancestors, and what muscle we have is less effective. So there is less storage space than before into which to clear glucose from the blood⁽¹⁴⁵⁻¹⁴⁸⁾. The other potential storage tissue, brown adipose tissue, is similarly compromised.

3 Insulin mechanisms are impaired

When insulin targets insulin receptors on skeletal muscle, these activate the glucose uptake pump. The pump requires chromium, manganese and inositol to work correctly⁽¹⁴⁹⁻¹⁵²⁾, but the modern diet is depleted in all these elements. Finally, insulin is normally protected from oxidation and glycosylation damage by flavonoids; these too are at an historic low, so our insulin is more dysfunctional than ever.

The cure?

- 1 Eat a reduced GI diet
 - 2 Take more exercise
 - 3 Use a comprehensive supplement with chromium, manganese, copper, zinc and selenium, plus the elements needed for the body to make inositol, together with anti-oxidants and flavonoids.
- } which should lead to weight loss.

Anti-diabetic diet

Reduce the amount of sweets, sugary drinks, white flour products and potatoes eaten, and increase the consumption of wholemeal foods, particularly oat-based foods, pulses and legumes.

This lowers the surges in blood sugar, lipids and insulin which occur after meals and which are substantial risk factors for coronary artery disease⁽¹⁰²⁾.

Switch from snacks to regular meals⁽¹³⁶⁾.

The anti-diabetic diet should also include:

- Up to three glasses of red wine or black grape juice every day – or grapeseed extract, or other source of flavonoids, such as turmeric
- Olive oil, which helps the circulation⁽⁸⁰⁾
- More Omega 3 and 6 fatty acids (oily fish and grains/nuts respectively)

- Vitamins E and C (high-dose)
- More vegetables
- Avoid soft drinks and foods containing high fructose corn syrup⁽¹³⁵⁾

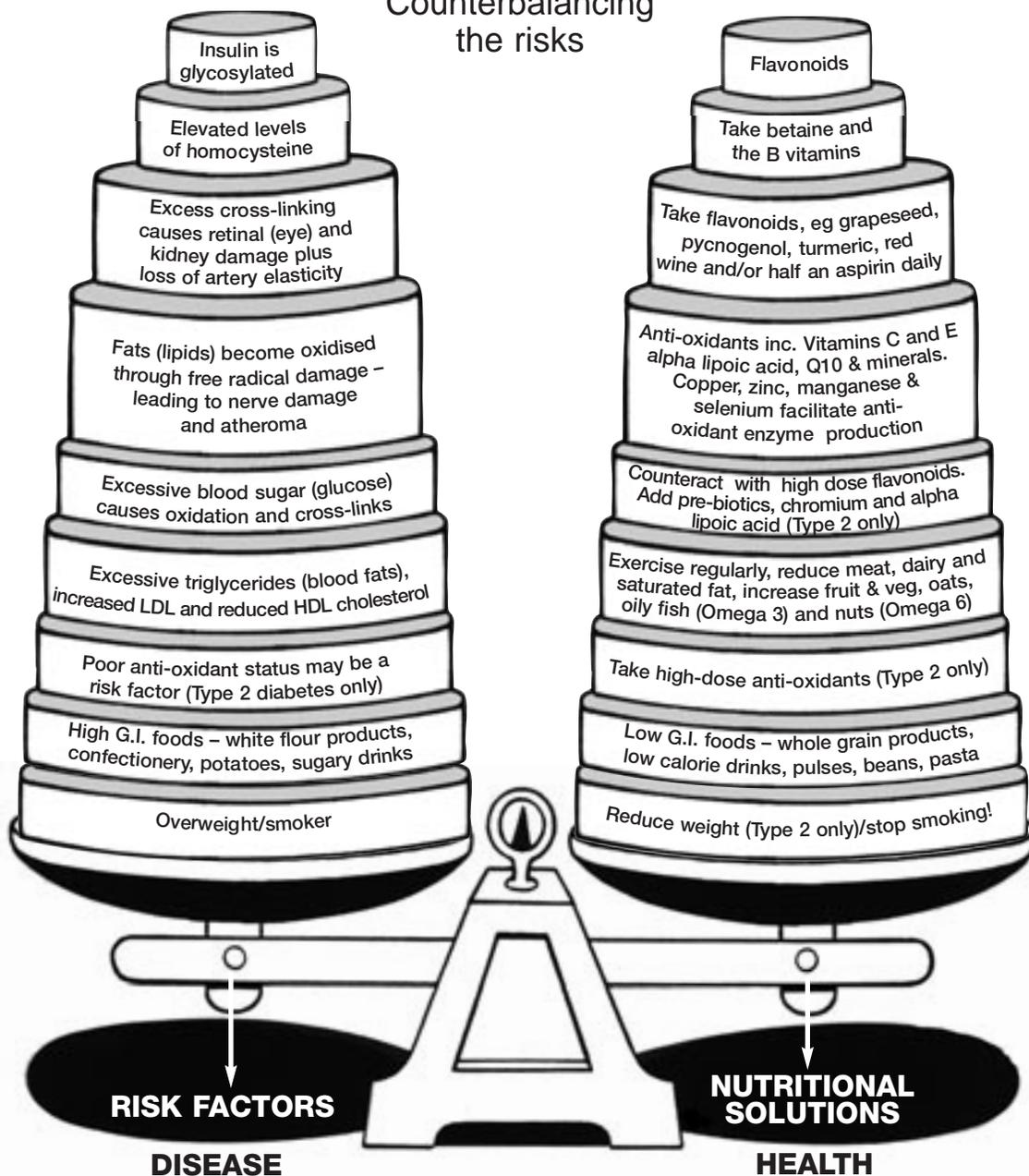
For best results add Co-enzyme Q10 and an organic chromium supplement, which many people say they find helpful in reducing their cravings for sweet foods. Magnesium, copper and zinc should also be considered.

This diet should help to ensure a degree of weight loss, which is in itself a good thing. It should ideally be combined with an exercise programme of at least 20 minutes brisk walking, three times a week.

And please stop smoking!

Preventing diabetes

Counterbalancing the risks



SUMMARY

Avoiding and treating diabetes

- **Anti-oxidants:**
 Vitamins E and C, Q10, alpha lipoic acid, copper, zinc, selenium and manganese
- **Anti-glycosylants:**
 Flavonoids: grapeseed extract, a tablespoon of turmeric or 2-3 glasses of red wine a day – choose the deepest red in colour with good tannic structure (see The Wine List on page 235).
 Also half an aspirin.
- **Minerals:**
 Magnesium, chromium, copper and zinc supplements.
- **PUFAs:**
 Omega 3 and 6 PUFAs, but only when combined with anti-oxidants.
- Lose weight, if overweight, and take more exercise.
- Switch from snacks to regular meals.
- Avoid fats, particularly saturated, which raise triglycerides – whereas exercise reduces them.
- Switch to low G.I. foods, ie oat-based products, whole grain foods, pulses, legumes, pasta.
- Avoid soft drinks and foods containing high fructose corn syrup.
- If you can, breast-feed your babies to give them the best chance of avoiding juvenile diabetes.