

INTERNATIONAL HEALTH NEWS

Your Gateway to Better Health!

NUMBER 123

MARCH 2002

11th YEAR



Editorial

Diabetes is one of the fastest growing disorders in the world today. It is reaching epidemic proportions among many aboriginal groups and it is estimated that 22 million Americans will be diabetic by the year 2025. Diabetes is largely a lifestyle disease and its growth is closely tied in with the increasing prevalence of obesity. In this issue we discuss what you can do to prevent and treat type 2 diabetes and its precursors, insulin resistance and impaired glucose tolerance.

Also in this issue, vitamin C protects against stomach cancer, a low-calcium diet is exactly wrong if you tend to develop kidney stones, and air pollution is now a prime suspect in some common birth defects.

*Yours in health,
Hans Larsen, Editor*

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LETTERS TO THE EDITOR

I was wondering if there is such a thing as taking too much vitamin C and if there is what is the limit?

AF, USA

Editor: *The official upper safe limit is 2000 mg/day. Healthy people would get all the vitamin C they can absorb by taking 400 to 500 mg three times a day. Sick people may require more. Even large quantities (10 to 20 grams/day) of vitamin C are probably safe, unless you suffer from hemochromatosis (iron overload).*

Which is better for depression, EPA or DHA?

JB, USA

Editor: *Low levels of docosahexaenoic acid (DHA) have been linked to an increased risk of depression and supplementation with fish oils, which contain both EPA (eicosapentaenoic acid) and DHA, has been found effective in alleviating depression. I would put my money on DHA as being the most effective, but it would certainly be easier to take both.*

Thank you for your site! It is very informative and helpful. I wonder if you can comment on taking 1000 mg of vitamin C whilst on Coumadin (a blood thinner).

TH, USA

Editor: *I am not aware of any interaction between vitamin C and warfarin (Coumadin). However, high doses of vitamin E combined with warfarin could increase bleeding tendency.*

Could you please tell me if pollock fish provides a significant amount of omega-3 and is it close to being as good a source as salmon, herring, mackerel, etc.?

KB, USA

Editor: *Pollock is not a terribly good source of EPA. It contains 90 mg/100 grams as compared to 410 mg/100 grams for Atlantic salmon and 500 mg/100 grams for mackerel. It is a somewhat better source of DHA. It contains 450 mg/100 grams as compared to 1430 mg/100 grams for salmon and 700 mg/100 grams for mackerel.*

ABSTRACTS

Sweet potato – new remedy for diabetes?

VIENNA, AUSTRIA. Experiments have shown that caiapo, an extract of white-skinned sweet potato (*Ipomoea batatas*), reduces insulin resistance in laboratory animals (rats). Now researchers at the University of Vienna report that caiapo has a similar effect in type 2 diabetes patients. Their clinical trial involved 18 diabetic men (average age of 58 years) treated by diet alone. The men were randomized to receive either placebo, 2 grams of caiapo or 4 grams of caiapo daily taken in divided doses before breakfast, lunch and dinner. Fasting glucose, insulin and cholesterol levels were measured before the beginning of treatment and after six weeks of treatment. The effect of 2 grams (low dose) of caiapo was not significant, but the men

consuming 4 grams (high dose) of caiapo daily experienced a 13 per cent drop in fasting plasma glucose accompanied by a 30 per cent drop in total cholesterol and a 13 per cent drop in LDL cholesterol.

The researchers conclude that supplementing with 4 grams per day of caiapo decreases insulin resistance and lowers cholesterol levels in type 2 diabetes patients. They suggest that caiapo could potentially play a role in the treatment of type 2 diabetes. NOTE: This study was funded by Fuji Sangyo, the manufacturer of caiapo.

Ludvik, Bernhard, H., et al. The effect of Ipomoea batatas (caiapo) on glucose metabolism and serum cholesterol in patients with type 2 diabetes. Diabetes Care, Vol. 25, January 2002, pp. 239-40 (letter)

Vitamin C protects against stomach cancer

MAYWOOD, ILLINOIS. Stomach cancer is now the second most common cancer in the world after non-melanoma skin cancer. A diet rich in salted, pickled or smoked food is associated with an increased risk of stomach cancer as is a low level of stomach acid (hypochlorhydria). Hypochlorhydria can be caused by the long-term use of ulcer drugs such as cimetidine (Tagamet), ranitidine (Zantac) and omeprazole (Losec). It can lead to bacterial overgrowth in which nitrate-reducing bacteria promote the conversion of harmless nitrates to carcinogenic N-nitroso compounds. Infection with the *Helicobacter pylori* bacterium causes inflammatory cells to produce reactive oxygen metabolites that may damage DNA and cause a chronic inflammation leading to stomach cancer. It is estimated that almost 80 per cent of all stomach cancer patients have a *H pylori* infection. It also seems that people with

blood type A are more prone to develop stomach cancer.

Researchers at the Loyola University of Chicago now report that vitamin C may play a vital role in preventing stomach cancer. They believe that vitamin C decreases the risk of *H pylori*-induced cancer by preventing the formation of N-nitroso compounds in the stomach and by limiting free radical damage to the stomach lining. Researchers at the University of Leeds (UK) found that supplementation with 500 mg of vitamin C twice daily for two weeks markedly increased the concentration of ascorbic acid in stomach tissue, blood plasma, and gastric juice. They conclude that vitamin C supplementation may be an important factor, along with *H pylori* eradication, in preventing stomach cancer.

Feiz, Hamid Reza and Mobarhan, Sohrab. Does vitamin C intake slow the progression of gastric cancer in Helicobacter pylori-infected populations? Nutrition Review, Vol. 60, January 2002, pp. 34-36

Atherosclerosis and fatty acids

We do not normally report the results of cell culture experiments, but this one was so intriguing that we decided to make an exception.

LEXINGTON, KENTUCKY. It is well established that an inflammation of the cells (endothelial) that line blood vessels is a precursor to atherosclerosis. Researchers at the University of Kentucky Medical Center now report that linoleic acid, but not oleic acid, induces inflammation in human endothelial cells. The researchers exposed endothelial cells from umbilical veins to linoleic, oleic, and linolenic acids. The concentrations used were similar to those that would be encountered in the blood of people consuming these fatty acids. The researchers observed that linoleic acid caused a strong activation of the genes responsible for initiating

inflammation. Oleic acid, on the other hand, dampened the inflammatory response, and linolenic acid had only a moderate effect. They conclude that linoleic acid can induce profound inflammation in cultured human endothelial cells.

Editor's Note: Most vegetable oils, including safflower, sunflower and corn oil are high in linoleic acid. Olive oil has a high oleic acid content and hardly any linoleic acid while flax oil is high in linolenic acid. Butter contains very little linoleic acid and hardly any linolenic acid.

Toborek, Michael, et al. Unsaturated fatty acids selectively induce an inflammatory environment in human endothelial cells. American Journal of Clinical Nutrition, Vol. 75, January 2002, pp. 119-25

Rutledge, John C. Links between food and vascular disease. American Journal of Clinical Nutrition, Vol. 75, January 2002, p. 4 (editorial)

Grain fortification with vitamin B12?

DUBLIN, IRELAND. Since 1998 it has been mandatory to fortify grain-based foods with folic acid in the United States. Recent reports indicate that this measure has resulted in a 19 per cent decrease in the incidence of neural tube defects. A similar fortification program is being considered in the UK. Irish researchers now suggest that the fortification protocol should include not only folic acid, but also vitamin B12. They point out that folic acid supplementation also lowers the level of homocysteine, a potent risk factor for heart and vascular disease. However, a recent trial carried out by the Dublin researchers clearly showed that as blood levels of folic acid increased through supplementation, blood levels of vitamin B12 became the limiting factor. In other words,

additional folic acid as well as additional vitamin B12 is required in order to attain the maximum reduction in homocysteine levels. Four to five hundred micrograms per day of folic acid were found to increase folic acid levels by 80 to 180 per cent and lower homocysteine levels by about 30 per cent in both men and women. Both folate and homocysteine levels tended to revert to their pre-supplementation levels after 10 weeks of no supplementation; this shows that continuous supplementation is necessary in order to keep homocysteine levels under control.

Quinlivan, E.P., et al. Importance of both folic acid and vitamin B12 in reduction of risk of vascular disease.

The Lancet, Vol. 359, January 19, 2002, pp. 227-28 (research letter)

Air pollution and birth defects

LOS ANGELES, CALIFORNIA. Studies carried out in China, Brazil and Mexico have found a significant association between air pollution and low birth weight, preterm birth, and fetal mortality. Researchers at the University of California now report a strong correlation between exposure to carbon monoxide and ozone and defects in the hearts of newborn babies. Carbon monoxide and ozone are major pollutants generated by automobile traffic. The researchers correlated the

levels of pollutants with birth outcome for almost 10,000 women living within 10 miles of an air monitoring station in Los Angeles. They found that women exposed to high levels of carbon monoxide and ozone in their second month of pregnancy were almost three times more likely to give birth to a child with certain heart anomalies (pulmonary artery and valve anomalies and ventricular septal defects) than were women who had been exposed to lower levels of the two

pollutants. The researchers point out that the heart of the fetus develops during the second month of pregnancy and conclude that air

pollution in southern California may contribute to heart-related birth defects.

Ritz, Beate, et al. Ambient air pollution and risk of birth defects in southern California. American Journal of Epidemiology, Vol. 155, January 1, 2002, pp. 17-25

Fish consumption and pregnancy outcome

COPENHAGEN, DENMARK. Danish researchers report that women who consume fish or seafood once a week during the first 16 weeks of pregnancy have a 3.6 times lower risk of giving birth to a low birth weight (less than 2500 grams) or premature (born before 259 days) baby than do women who never consume fish or seafood. The study involved almost 9000 women who completed a food frequency questionnaire. The researchers found that women whose daily intake of fish was less than 15 grams, corresponding to

a fish oil intake of 150 mg/day, were significantly more likely to give birth to a preterm or underweight baby than were women with higher intakes. They suggest that small amounts of fish oil may confer protection against preterm delivery and low birth weight.

Olsen, Sjurour Frooi and Secher, Niels Jorgen. Low consumption of seafood in early pregnancy as a risk factor for preterm delivery: prospective cohort study. British Medical Journal, Vol. 324, February 23, 2002, pp. 1-5

Risk factors for stomach ulcers

HAMILTON, CANADA AND HONG KONG. The use of non-steroidal anti-inflammatory drugs (NSAIDs) and the presence of a *Helicobacter pylori* infection have both been linked to an increased risk of stomach ulcers. What is not known is whether the two risk factors are additive. Researchers at McMaster University and the Prince of Wales Hospital in Hong Kong have just released two studies that provide the answers. The Canadian researchers reviewed 25 studies involving NSAID-users and found that their risk of stomach ulcers was significantly higher (35.8 versus 8.3 per cent) than the risk among non-users irrespective of *H pylori* status. Patients with *H pylori* infection were twice as likely to have ulcers than patients without an infection.

People taking NSAIDs who also had *H pylori* infection were 61 times more likely to have an ulcer than were people who did not have an infection and did not use NSAIDs. The Canadian researchers conclude that both NSAIDs and *H pylori* increase the risk of stomach ulcers individually and, even more so, when combined.

The Hong Kong research team studied the effect of eradicating *H pylori* before starting long-term NSAID therapy. They found that ulcer probability after six months treatment with diclofenac was 12.1 per cent in the group where the *H pylori* infection had been eliminated as compared to 34.4 per cent in the control group. The risk of complicated (bleeding) ulcers was 4.2 and 27.1 per cent respectively. The researchers conclude that eradication of *H pylori* before the commencement of long-term NSAID therapy can markedly reduce the risk of stomach ulcers.

Huang, Jia-Qing, et al. Role of Helicobacter pylori infection and non-steroidal anti-inflammatory drugs in peptic-ulcer disease: a meta-analysis. The Lancet, Vol. 359, January 5, 2002, pp. 14-22

Chan, Francis K.L., et al. Eradication of Helicobacter pylori and risk of peptic ulcers in patients starting long-term treatment with non-steroidal anti-inflammatory drugs: a randomised trial. The Lancet, Vol. 359, January 5, 2002, pp. 9-13

Pounder, Roy E. Helicobacter pylori and NSAIDs – the end of the debate? The Lancet, Vol. 359, January 5, 2002, p. 3 (commentary)

Calcium and kidney stones

PARMA, ITALY. Kidney stones, in at least 70 per cent of all cases, consist of calcium oxalate crystals, often mixed with calcium phosphate or sodium urate. The prevailing medical practice is

to prescribe a low-calcium diet in order to prevent recurrence of stones. Italian researchers now question this approach. Their randomized clinical trial included 120 men with a history of kidney

stones (idiopathic hypercalciuria). Sixty of the men were assigned to a low-calcium diet (avoidance of milk, yogurt and cheese) while the other sixty were assigned to a normal calcium diet that was low in animal protein (52 grams/day max.) and salt.

After five years 23 of the men in the low-calcium diet group had experienced a recurrence of kidney stones as compared to only 12 men in the normal calcium diet group. Thus the men in the low-calcium group had twice the risk of recurrence than did the men in the normal calcium, low protein and low salt group. Says Dr.

David Bushinsky of the University of Rochester, "Physicians should no longer prescribe a low-calcium diet to prevent recurrent nephrolithiasis in patients with idiopathic hypercalciuria".

Borghgi, Loris, et al. Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. New England Journal of Medicine, Vol. 346, January 10, 2002, pp. 77-84

Bushinsky, David A. Recurrent hypercalciuric nephrolithiasis – does diet help? New England Journal of Medicine, Vol. 346, January 10, 2002, pp. 124-25 (editorial)

NEWSBRIEFS

Alternative treatments and cancer. It is estimated that over 40 per cent of adult Americans use complementary and alternative therapies such as acupuncture, biofeedback, vitamin therapy, herbal medicine, and hypnosis. Researchers at the Fred Hutchinson Cancer Research Center in Seattle now report that 73 per cent of all children diagnosed with cancer in the State of Washington use some form of alternative treatment. The alternative therapies were used in conjunction with, rather than instead of, conventional treatments and were more prevalent in cases where parents were dissatisfied with the conventional medical care their child was receiving. Treatment by an alternative health care provider, herbal medicine and vitamin therapy, especially with vitamin C, were the most commonly used modalities.

Preventive Medicine, Vol. 33, November 2001, pp. 347-54

Advertising pays – for the drug companies. New Zealand and the United States are the only countries that allow drug companies to advertise directly to consumers. A recent study concludes that this practice is highly effective in getting patients to ask their physicians for advertised drugs. When asking the doctor if he or she would have prescribed the drug if the patient had not asked for it the answer was ambivalent ("possibly" or "unlikely") in half the cases. The Canadian researchers performing the study conclude that patients' requests for medicines are a powerful driver of prescribing decisions.

British Medical Journal, Vol. 324, February 2, 2002, p. 278-79

Chewing gum could be bad for your health.

Periodontitis (gum disease) is a potential risk factor for heart disease. It is believed that bacteria living in periodontal pockets can release pro-inflammatory breakdown products (endotoxins) into the blood stream. Belgian researchers now report that the release of endotoxins is vastly accelerated by chewing and is higher with more severe periodontal disease. Just chewing gum 50 times on each side of the mouth caused a significant release of endotoxins. The researchers conclude that gum disease can be a major source of the release of inflammatory components into the blood stream.

Journal of Periodontology, Vol. 73, January 2002, pp. 73-8

Rheumatoid arthritis not inherited. Danish researchers have concluded that environmental effects are far more important than genetic effects in the development of rheumatoid arthritis. Their study involved 37,338 twins including 5194 pairs of identical (monozygotic) twins. The study participants were checked for monozygosity by blood group and DNA analysis and for the presence of rheumatoid factor. The researchers found that pairs of identical twins were no more likely to have arthritis than were pairs of fraternal (dizygotic) twins.

British Medical Journal, Vol. 323, December 22-29, 2001, pp. 1-5

BotanicLab recalls PC SPES. BotanicLab (www.botaniclab.com) has issued a voluntary recall notice for its PC SPES product. It has been found highly effective in the treatment of prostate cancer. The recall notice was prompted by a test carried out by the California Department of Health

that revealed the presence of a small amount of a warfarin-like compound. Further testing is underway to determine if the compound is actually warfarin or a natural component of the eight herbs contained in PC SPES.

California Department of Health Services, Office of Public Affairs, Press Release 02-03, February 7, 2002

Arsenic in drinking water. Taiwanese researchers have found that men exposed to high levels of inorganic arsenic in their drinking water have a 29 times increased risk of developing bladder cancer. Studies in Chile, Argentina,

Japan and the UK have shown similar results. The World Health Organization and the European Union have recognized the danger of arsenic contamination and have recently set the maximum acceptable level of arsenic in drinking water at 10 ppb (parts per billion). The current maximum allowable level in the USA is 50 ppb and the Canadian level is 25 ppb. Health Canada admits that this has more to do with the ability of current water treatment facilities to reduce arsenic contamination than with the actual science of health effects.

Canadian Medical Association Journal, Vol. 166, January 8, 2002, p. 69

RESEARCH REPORT

Insulin Resistance and Diabetes

Diabetes mellitus is the most common endocrine disorder in the world today. It is estimated that over 16 million American suffer from the disease[1]. Diabetes manifests itself through abnormally high blood glucose levels and comes in two major forms – insulin-dependent (type 1) and non-insulin-dependent (type 2). Type 1 diabetes most often occurs before the age of 20 years and involves progressive destruction of insulin-producing cells in the pancreas. Type 2 diabetes is usually diagnosed after the age of 40 years and is primarily caused by a defect in the mechanism that governs the uptake of glucose by individual cells. The treatment of type 1 involves daily insulin injections while type 2 can often be managed by diet and exercise.

Type 2 diabetes is, by far, the most common and accounts for approximately 90% of all cases. It has a fairly strong genetic component and should always be suspected in obese individuals since about 90% of all diabetics are obese. Fatigue, frequent urination, abnormal thirst, increased appetite, blurred vision, and slow healing of skin, gum and urinary infections are common symptoms of type 2 diabetes.

Diagnosis

Prior to 1997 diabetes was suspected if an individual had a least two fasting glucose readings of 140 mg/dL (7.8 mmol/L) on two separate occasions. In 1997 the American Diabetes Association lowered the diabetes cut-off point to 126 mg/dL (7 mmol/L) on two separate occasions. So now the “rules” are[2]:

- Fasting glucose level less than 110 mg/dL is considered normal
- Fasting glucose level between 110 and 126 mg/dL indicates impaired glucose tolerance (insulin resistance)
- Fasting glucose level at or above 126 mg/dL indicates diabetes.

The World Health Organization (WHO) recommends the 2-hour oral glucose tolerance test. The interpretation of its results is[2]:

- 2-hour reading of less than 140 mg/dL (7.8 mmol/L) is normal
- 2-hour reading of between 140 and 200 mg/dL is indicative of impaired glucose tolerance
- 2-hour reading of 200 mg/dL or greater is indicative of diabetes.

The National Institutes of Health recommends that diabetes should be suspected only if at least two readings in the 2-hour period are equal to or greater than 200 mg/dL.

There is evidence that food intake during the two days prior to the glucose tolerance test can materially affect the results. It is best to eat a diet rich in complex carbohydrates and avoid an excessive intake of protein and fats[3].

Epidemiological studies have found that an elevated level of glycosylated hemoglobin (HbA_{1c}) is a strong indicator of an increased risk for vascular disease. Glucose binds to the pigment in red blood cells (hemoglobin) whenever new cells are generated. The proportion of hemoglobin molecules that contains glucose can be used as a measure of the average blood sugar level over the past four months (the average lifetime of a red blood cell). Unfortunately, the test for HbA_{1c} is not very reproducible between individual testing laboratories so a good deal of interpretation is required on the part of the physician. The current recommendation is that glycosylated hemoglobin should be below 7%[2,4].

The R-R interval study is another important test used in the investigation of diabetes. It evaluates the functioning of the vagus nerve and is very similar to a standard electrocardiogram (ECG). The R-R interval is the difference in heart rate between a deep inhalation and a deep exhalation. A healthy young person may have as much as a 75% drop in heart rate when going from inhaling to exhaling while a diabetic may show little or no difference. Little or no difference indicates that the vagus nerve may have been damaged by long-term exposure to high glucose levels. This damage plays a major role in a number of diabetes complications such as digestive problems, arrhythmias, erectile dysfunction (impotence), and delayed stomach-emptying[4].

People with type 2 diabetes may have developed impaired kidney function so it is important to have a through evaluation of kidney function. Creatinine clearance and microalbuminuria are the two tests most frequently used here. It is also advisable to have homocysteine levels checked. High levels are a potent risk factor for heart disease, stroke and many other conditions[4].

Mechanism of insulin resistance and type 2 diabetes

Insulin is released by the pancreas in response to the presence of sugar (glucose) in the blood stream. Glucose gets into the blood through consumption of sugar or sugar-containing foods or via the breakdown of carbohydrates into simple sugars. Insulin is a chemical messenger that acts on the walls of the cells to cause the release, from within the cell, of special protein molecules – the so-called GLUT-4 transporters. The GLUT-4 transporters rise to the cells' outer membranes where they grab hold of the glucose molecule and transport it into the interior of the cell. Here the glucose is used to produce energy and any excess is converted into fat[5].

This process functions flawlessly in non-diabetic persons resulting in a steady glucose level in the blood stream usually between 60 and 115 mg/dL with an average of 85 mg/dL.

In diabetics glucose levels are not under control and can reach levels of 250 mg/dL or higher. Patients with type 1 (insulin-dependent) diabetes produce little or no insulin because the beta-cells in the pancreas, which normally produce the hormone, have been destroyed. Patients with type 2 (non-insulin-dependent) diabetes, on the other hand, usually produce an adequate amount of insulin, but for some reason the mechanism whereby the insulin summons the GLUT-4 transporters does not function. The result is that both glucose and insulin levels in the blood remain high. The same problem is experienced by persons with insulin resistance (impaired glucose tolerance), but to a lesser degree.

Complications in diabetes

The most serious problem with high glucose levels is that the excess glucose tends to bind to proteins and cause them to become "sticky". This process is called glycosylation and is a major factor in atherosclerosis and other diabetes complications. The higher than normal insulin levels (hyperinsulinemia) experienced by people with insulin resistance or type 2 diabetes are also highly detrimental. They interfere with the normal metabolism of fats and cause an increase in the production of very-low-density cholesterol, a potent risk factor for heart disease. High insulin levels also encourage the formation of blood clots and thereby increase the risk of heart attacks. Finally, high insulin levels can lead to hypoglycemia (low blood sugar levels)[5].

Long-term, uncontrolled high blood sugar levels can lead to a number of serious complications, among them kidney failure, hypertension, diabetic retinopathy (eye disease), neuropathy (nerve disease), heart disease, peripheral vascular disease (intermittent claudication), stroke, diabetic foot disease, and erectile dysfunction[5].

Prevention of type 2 diabetes

It is estimated that 35% of all cases of impaired glucose tolerance eventually progress to full-blown diabetes. Researchers at the Finnish National Public Health Institute believe that this progression can be halted by fairly simple lifestyle modifications. Their study involved 522 middle-aged, overweight men and women with a mean age of 55 years. The members of the intervention group were given individualized goals on how to reduce weight (by 5% or more), how to decrease total fat intake and saturated fat intake (to 30% and 10% of energy consumed respectively), how to increase fiber intake, and how to exercise effectively for at least 30 minutes a day. The control group was given some general advice, but no personalized attention. After four years 11% of the members of the intervention group had developed diabetes as compared to 23% in the control group. None of the 49 members in the intervention group or the 15 members of the control group who reached four out of the five goals developed diabetes. On the other hand, diabetes did develop in the 48 subjects in the control group and the 13 in the intervention group who did not achieve any of the five goals. The researchers conclude that type 2 diabetes can be prevented by changes in lifestyle among people with impaired glucose tolerance[6].

Researchers at the National Center for Chronic Disease Prevention and Health Promotion in the USA report that vitamin supplementation helps prevent diabetes. Their study, which involved 9573 men and women between the ages of 25 and 74 years, began in 1971-1975 and was continued for 20 years. At the end of the study 1010 (11%) of the participants had developed diabetes. All the participants were asked if they used supplements (vitamins, minerals, and other supplements) at the beginning of the study and again 10 years into the study. Regular vitamin users were found to have a 24% lower risk of developing diabetes than did non-users even when adjusted for the effects of age, race, education, smoking, blood pressure, cholesterol, body mass index, exercise, alcohol consumption, fruit and vegetable intake, fat intake and total energy intake. The risk reduction was somewhat smaller for women (16%) than for men (30%). The risk reduction for the participants who supplemented with both vitamins and minerals was even more impressive at 33%. The researchers speculate that vitamin E, chromium, and magnesium may be particularly effective in preventing diabetes. They modestly conclude "the judicious use of vitamins may play a role in the prevention of diabetes"[7].

Researchers at Kuopio University in Finland report that a low intake of vitamin E is a significant risk factor for the development of type 2 diabetes. Their study involved 944 Finnish men aged 42 to 60 years who were free of diabetes when tested between March 1984 and December 1989. Four years later 45 of the men had developed clinically confirmed diabetes. The researchers found that men with a below average intake of vitamin E had an almost four times greater risk of developing diabetes than did men with a higher than average intake. They conclude that oxidative stress (free radical attacks) plays an important role in the development of diabetes and suggest that vitamin E supplementation may be useful in the primary prevention of the disease[8].

Researchers at the Harvard School of Public Health have found that a high intake of trans-fatty acids (hydrogenated oils, margarine) markedly increases the risk of developing diabetes. They believe that replacing trans-fatty acids in the diet with non-hydrogenated, polyunsaturated fatty acids would substantially reduce the incidence of type 2 diabetes, perhaps by as much as 40%[9,10].

Researchers at the Harvard Medical School believe that regular exercise is an important tool in both the prevention and treatment of type 2 diabetes. They cite a study involving 87,253 nurses that found women who exercised vigorously once a week had a 37% lower risk of developing diabetes than did women who exercised less than once a week. A 16% lower risk persisted even after adjusting for degree of obesity (BMI), family history of diabetes, and other variables. Similarly, a study of over 21,000 male physicians found that men who exercised vigorously once a week had a 30% lower risk of developing type 2 diabetes than men who exercised less than once a week; this correlation held even after adjustment for age, smoking, hypertension, high cholesterol levels, and obesity (BMI). A recently published Swedish study

found that men with impaired glucose tolerance (a forerunner for diabetes) could cut their risk of developing full-blown diabetes by two thirds by following a diet and exercise program. The researchers conclude that people can reduce their risk of developing diabetes by anywhere from 30 to 50% merely by following a regular, moderate or vigorous exercise program[11].

It is clear that the development of type 2 diabetes is, to a large extent, preventable if concerted, timely action is taken.

For those who already have the disease treatment aimed at maintaining blood glucose levels within normal or near-normal levels is a must. The treatment involves frequent monitoring of glucose levels combined with a special diet and the use of pharmaceutical drugs or supplements. Glucose levels should be measured at least twice a day – before breakfast and before dinner. Until a glucose profile is established it may also be advisable to measure it 2 hours after meals and at bedtime. The measurements can be done at home using a computerized glucose meter or the newly developed GlucoWatch[12].

A. Conventional treatment

Diet, exercise, and oral hypoglycemic agents are the mainstay of conventional treatment of insulin resistance and type 2 diabetes. The diet emphasizes the avoidance of simple sugars and an increased intake of fiber. There is no agreement on the preferred proportion of carbohydrates, proteins and fat. Some experts believe that a diet deriving 40% of energy from carbohydrates, 30% from protein, and 30% from fat is optimum while others advocate 60% carbohydrates, 20% protein, and 20% fat[13-15].

Exercise at the recommended heart rate for aerobic exercise is very important. Exercise helps to reduce insulin levels and lowers cholesterol and triglyceride levels as well as blood pressure[11,16,17]. Many patients with insulin resistance or type 2 diabetes can actually revert to a non-diabetic state just by exercising and following a proper diet. For those who cannot oral hypoglycemic agents are prescribed.

The oldest and most commonly prescribed drugs are the sulfonylureas (Micronase, Diabinese, Tolinase, Orinase, etc.). The primary effect of these drugs is to increase insulin secretion; they also slightly enhance the cells' ability to take in glucose. Obviously, as a deficiency in insulin is rarely a problem for type 2 diabetics the effectiveness of these drugs is somewhat limited. Sulfonylureas also have the potential for many quite serious side effects. Among the more common are hypoglycemia, weight gain, gastrointestinal problems, hypothyroidism, and skin rashes. They also increase the risk of heart disease and circulatory problems and are a definitely not for people with congestive heart failure[18].

Newer drugs such as metformin (Glucophage) and the thiazolidinediones (Avandia, Actos, Rezulin) aim to increase the cells' sensitivity to insulin and thereby facilitate the removal of glucose from the blood stream. Unfortunately, these drugs also have the potential for some very serious side effects such as an increase in blood pressure, increase in death from heart disease, lactic acidosis, weight gain, increase in low-density cholesterol (thiazolidinediones) and liver damage[18].

The potentially devastating side effects of these drugs can, of course, be completely avoided by replacing them with natural supplements as is done in alternative treatment of insulin sensitivity and type 2 diabetes.

B. Alternative treatment

The diet recommended by alternative practitioners is generally higher in complex carbohydrates, about 60% of total energy intake, than is the diet recommended in conventional medicine. Legumes, oat bran, nuts, seeds, pears, apples, and vegetables are particularly important because of their high fiber content. It is also important to emphasize foods with a low glycemic index as these release insulin more slowly and therefore tend to avoid hyperinsulinemia. Dr. Julian Whitaker's book "Reversing Diabetes" contains detailed diet instruction and numerous recipes for diabetes-friendly meals[13].

Several supplements have been found highly useful in the treatment of insulin resistance and type 2 diabetes. An adequate intake of vitamins and minerals is essential for diabetes patients.

Vitamin C is particularly important. Many diabetics are deficient in this important vitamin. Vitamin C helps prevent glycosylation of proteins and the accumulation of damaging sorbitol. An intake of 2000 mg/day is recommended either in divided doses or in time-release capsules[16,19,20,21].

Vitamin E improves glucose metabolism and insulin sensitivity in doses from 800 to 1200 IU/day[16,21,22].

Chromium lowers glucose levels and helps prevent glycosylation; it also lowers cholesterol levels. Recommended dose is 200 micrograms twice a day. Chromium picolinate is the preferred form[16,21,23-25].

The B vitamins, especially vitamin B6 and vitamin B12, are important in preventing diabetes complications as is folic acid[16,21].

Diabetics do not absorb magnesium well so supplementation with 200 mg three times a day may be required to avoid deficiency. Magnesium citrate and maleate are the preferred forms[16,21,26].

Lipoic acid is a powerful antioxidant and also improves insulin sensitivity by increasing the activity of the GLUT-4 transporters. The recommended dosage is 100 mg three times a day[21,27].

Vanadium may well be the most important supplement for diabetics and people with impaired insulin resistance. It is able to activate GLUT-4 transporters just like insulin. Doses of 50-100 mg per day of vanadyl sulfate have been found very effective in lowering glucose levels. However, supplementation with these relatively high doses of vanadium can result in a rapid drop in blood glucose, so should only be undertaken under the supervision of a knowledgeable physician[21,28].

Recent work carried out at the University of Toronto has shown that American ginseng (*Panax quinquefolius*) is able to prevent the spike in blood sugar that follows a meal. A daily dosage of 500 mg (taken with breakfast) should be sufficient[29,30].

Many diabetics are deficient in the hormone DHEA (dehydroepiandrosterone) and may benefit significantly from supplementation. Evening primrose oil, fish oil, flax oil, onions and garlic, and several herbal supplements have also been found useful in blood sugar control[16,31,32].

A regular exercise program, proper diet, and the judicious use of natural supplements can be highly effective in keeping blood glucose levels under control and thus prevent the long-term complications accompanying uncontrolled diabetes.

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INTERNATIONAL HEALTH NEWS is published monthly by:
 Hans R. Larsen MSc ChE, 1320 Point Street, Victoria, BC, Canada, V8S 1A5
 E-mail: health@pinc.com World Wide Web: <http://www.yourhealthbase.com>
 ISSN 1203-1933 Copyright 2002 by Hans R. Larsen

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