

LE Magazine July 2005

## REPORT

### High Blood Sugar

#### Integrative Strategies for Supporting Healthy Metabolism

By Bruce Scali



According to the American Diabetes Association, more than 5 million of the 20 million Americans who have diabetes have not yet been diagnosed with the disease. A condition of elevated blood sugar, diabetes is the sixth leading cause of death in the United States. If current trends continue, diabetes and its complications will be America's leading cause of death by 2010, surpassing both cancer and heart disease.

Diabetes is fast becoming a global epidemic. In the US alone, more than 1 million new cases are diagnosed each year, with associated health costs that exceed \$100 billion.<sup>1</sup> Worldwide, diabetes cases are expected to grow from the 135 million people who were diagnosed in 1995 to at least 300 million by 2025, with a 42% increase in industrialized countries and a stunning 170% increase in developing nations.<sup>2,3</sup> Life expectancy is typically four to eight years lower for diabetics than for non-diabetics.<sup>4</sup>

The American Diabetes Association reports that the risk of death for diabetics is two times that for non-diabetics.

#### WHAT IS DIABETES?

After eating carbohydrate-dense foods like white rice, white bread, and potatoes, the body breaks down these starchy foods into the simple sugar, **glucose**. Glucose serves as the primary energy source for the human body. The hormone insulin transports glucose into cells where it can be used as fuel. When the body does not produce enough insulin, or if the cells do not respond to the insulin that the body produces, glucose builds up in the blood, a condition called hyperglycemia, or high blood sugar. This metabolic defect produces free radicals as well as advanced glycation end products,<sup>5</sup> which are formed when a sugar molecule attaches to a free amino acid to create a non-functioning structure in the body. High blood sugar that leads to oxidation and glycation is associated with serious complications such as heart disease, stroke, kidney disease, nerve damage, blindness, and vascular problems that can necessitate an amputation.<sup>5,6</sup>

While a definitive cause for diabetes has not been identified, genetic predisposition, environmental factors such as viruses and chemicals, and nutritional and other lifestyle factors may contribute to its incidence. Sedentary lifestyles and modern diets that are rich in refined starches (white bread, pasta, white rice) and sugars (sodas, breakfast cereals, candy) account for much of the explosive growth in diabetes cases.

#### TYPES OF DIABETES

Diabetes exists in several forms.

- **Type I diabetes** was previously known as insulin-dependent diabetes mellitus or juvenile-onset diabetes. This is an autoimmune condition characterized by the body attacking insulin-producing cells in the pancreas. The result is an inability to produce insulin, necessitating insulin injections. Type I diabetes usually presents in people under the age of 20, and accounts for less than 10% of all diabetes cases.
- **Type II diabetes**, formerly known as non-insulin-dependent diabetes mellitus, usually presents in those older than 40 and is characterized by a metabolic inability of cells to process glucose because of loss of sensitivity to insulin. In response to the buildup of unused glucose, the pancreas produces more insulin. When cells do not get the energy they need, the liver produces more glucose. As this cycle perpetuates, the body is flooded with glucose and insulin. Over time, pancreatic insulin production shuts down, and a type II diabetic could become insulin dependent. Environmental, lifestyle, and genetic factors are strongly associated with type II diabetes.
- Gestational diabetes can occur in women during pregnancy, and usually disappears after childbirth. Secondary diabetes can result from chronic or recurrent conditions such as pancreatitis, or from an adverse effect of some medications, particularly anti-psychotic drugs such as clozapine and olanzapine.<sup>7,8</sup>

## DIAGNOSING DIABETES

Diabetes is definitively confirmed by measuring blood glucose levels after an overnight fast (fasting plasma glucose) and after ingesting a 75-gram glucose load (oral glucose tolerance test, or OGTT). These two tests measure the body's ability to metabolize glucose. The hemo-globin A1C (HbA1c) test measures glycated hemoglobin in red blood cells and is used to measure average glucose levels over a three-month period. Although not a diagnostic test, the hemoglobin A1C measurement assesses the efficacy of treatment methods over an extended period of time. Diabetic laboratory parameters are as follows:

- Fasting glucose: >125 mg/dL (milligrams per deciliter) on at least two occasions.
- Oral glucose tolerance test: >200 mg/dL at two hours.

Common symptoms of diabetes include frequent urination, excessive thirst, extreme hunger, unusual weight loss, increased fatigue, irritability, and blurred vision. Anyone experiencing these symptoms should consult a physician for examination and assessment.

## PRE-DIABETES

Many millions of people are at risk for developing diabetes, and are beginning to experience the changes in physiology that occur with the disease. These individuals display an impaired fasting glucose of 100-125 mg/dL, alone or in combination with an impaired glucose tolerance of 140-199 mg/dL. More than 40 million US adults between the ages of 40 and 74 are pre-diabetic, according to the American Diabetes Association.

A number of risk factors are associated with type II diabetes. These include obesity, physical inactivity, dyslipidemia (elevated triglycerides and low levels of high-density lipoprotein, or HDL), hypertension, low testosterone (in young and middle-aged men), and family history of the disease.<sup>9-12</sup> These risk factors are noteworthy because studies have shown that modifying several of them can help with the management of diabetes.<sup>13,14</sup> For example, one study involving overweight patients concluded, “. . . the risk of type II diabetes could be reduced by 58% . . . with changes in lifestyle of high-risk overweight subjects with impaired glucose tolerance.”<sup>15</sup> Another stated, “All four main studies of lifestyle intervention on diabetes incidence found a direct benefit for diet and exercise intervention compared with usual care.”<sup>16</sup>



## INSULIN RESISTANCE AND SYNDROME X

As noted earlier, cellular resistance to insulin results in increased pancreatic insulin production. Excess insulin in the bloodstream, called hyperinsulinemia, is often a prelude to diabetes.<sup>17</sup> In 1988, Gerald Reaven, MD, an authority on insulin resistance, coined the phrase “Syndrome X,” also known as metabolic syndrome, to identify a cluster of metabolic disorder symptoms that often accompany abnormal blood glucose levels: hyperlipidemia, or elevated low-density lipoprotein (LDL), cholesterol, and triglycerides; abdominal obesity; hypertension; and hyperinsulinemia.

An estimated one in four individuals who have hyperinsulinemia will progress to type II diabetes.<sup>18</sup> Considering that other Syndrome X symptoms also have been correlated with diabetes, it is clear that anyone with this metabolic disorder is at high risk for becoming one of the millions of future diabetics.<sup>19</sup>

The common thread in both diabetes and Syndrome X is glucose, both its level and absorption. The key to treatment, then, is how to prevent an overload of glucose in the blood, and how to support insulin's action in the body.

## LIFESTYLE CHANGES

The American Diabetes Association and diabetes specialists agree that the first line of defense against the disease is a lifestyle-modification program. Anyone with high blood sugar can incorporate lifestyle changes, a proper diet, and well-chosen nutritional supplements in a comprehensive program to help control blood sugar and improve health.



Losing weight and eating properly are the first lines of defense against high blood sugar. According to a major study, “Obesity is considered the most important risk factor for type II diabetes.”<sup>20</sup> Studies have shown that losing as little as 1.5% of body weight can improve diabetic parameters, and that those who lost 15% of their body weight were able to discontinue oral medications. The link between obesity and diabetes is irrefutable.<sup>21-23</sup> Other lifestyle factors also have a major impact.

Regular exercise is as important for diabetes management as it is for general health. As little as 30 minutes of walking a day can dramatically improve glucose control.<sup>24-26</sup> Smoking appears to increase the risk of developing type II diabetes.<sup>27,28</sup> Smoking by diabetics also increases their risk of complications affecting the eyes and kidneys.<sup>29</sup> Moderate alcohol consumption can improve insulin sensitivity and also has a positive effect on C-reactive protein, a cardiovascular risk factor.<sup>30-32</sup> Finally, stress contributes to obesity and initiates harmful hormone responses to the body’s

sudden demand for energy: adrenaline breaks down glycogen into glucose, and cortisol inhibits insulin action, exacerbating hyperglycemia. Thus, stress avoidance may help with glucose control.<sup>33</sup>

## PROPER DIET

Carbohydrate-rich food must be digested and converted to the simple sugar glucose for use by the body as energy. The primary components in any diet are carbohydrates, proteins, and fats. The amount, proportion, and sources of each are vitally important. Carbohydrate-containing foods include grains, beans, starchy vegetables (for example, tubers such as potatoes), and fruits.

Some carbohydrates are absorbed very rapidly and can increase blood sugar dramatically. These include white bread, potatoes, candy, corn flakes, and corn syrup. Additionally, these foods tend to be low in vitamins, minerals, and fiber, all of which help promote good health. In contrast, complex carbohydrates such as whole grains, beans, green vegetables, and fruits are broken down more slowly by the digestive system, promoting less dramatic increases in blood sugar. These foods also tend to be good dietary sources of vitamins, minerals, and fiber.

Fresh vegetables contain beneficial antioxidants and phytochemicals that promote health and help prevent disease, and should be consumed in abundance. Fresh fruits are also rich in beneficial phytochemicals, but in some people, they can affect blood glucose levels more significantly than vegetables. A proper diet that is rich in vegetables, nuts, and beans, that includes moderate amounts of whole grains and fruits, and that is low in concentrated starches like bread, potatoes, and refined sugars, can help promote healthy blood sugar levels and reduce obesity.

As shown in Table 1, the glycemic index classifies foods by how fast they raise blood sugar levels compared to pure glucose. Foods with a glycemic index value that is closer to 100 raise blood sugar more quickly, so foods with low indices should be consumed to achieve better blood sugar control.

Baked potato	95
White bread	95
White rice	95
Mashed potatoes	90
Chocolate bar	70
Corn	70
Boiled potatoes	70
Banana	60
White pasta	55
Unsweetened juice	40
Rye bread	40
Lentils	30
Soy	15
Green vegetables	<15
Tomato	<15

## REPORT

### High Blood Sugar

#### Integrative Strategies for Supporting Healthy Metabolism

By Bruce Scali

Although traditional recommendations suggest a diet with 65% of calories supplied by complex carbohydrates, high-carbohydrate diets still increase blood sugar and stimulate insulin production, according to Steven Whiting, PhD. This is likely because complex carbohydrates tend to have a high glycemic load. While the glycemic index indicates how quickly a food raises blood sugar level, the glycemic load is a measure of how much sugar is in a food. Glycemic load is calculated by multiplying the number of grams of carbohydrate in a serving of food by the food's glycemic index. Some foods such as carrots have a high glycemic index but a low glycemic load. Thus, carrots raise blood sugar quickly, but contain relatively few carbohydrates. Whole grains tend to have a lower glycemic index than white bread, but because they are rich in carbohydrates, they have a high glycemic load. Foods with a higher glycemic load are expected to cause a greater increase in blood glucose over time and thus a greater need for insulin. Long-term consumption of foods with high glycemic loads is associated with an increased risk of type II diabetes and coronary heart disease.<sup>34</sup> Thus, both glycemic index and glycemic load are important dietary factors to consider when choosing foods to promote optimal blood sugar.



Dr. Gerald Reaven, head of endocrinology, gerontology, and metabolism at Stanford University, says, "Why trade one insulin-raising nutrient for another? It is far safer, and just as nutritious, to decrease carbohydrates and maintain protein at a reasonable level, while increasing your intake of 'good' unsaturated fats."<sup>35</sup> If fewer carbohydrates are available, the body will convert protein to glucose. This is a much slower process, so shifting the balance between carbohydrates and proteins will reduce the risk of hyperglycemia.<sup>36</sup> Numerous studies confirm the efficacy of substituting more protein for carbohydrates.<sup>37,38</sup> According to a September 2004 study, "increasing the protein content of the diet with a corresponding decrease in the carbohydrate content potentially is a patient-empowering way of reducing the hyperglycemia present with type II diabetes mellitus, independent of the use of pharmaceutical agents."<sup>39</sup>

The common perception of fats is that they do little more than make us fat. The type of dietary fat is critical in determining its effects in the body. Trans fatty acids, found in hydrogenated oils in commercially made cookies, cakes, and processed foods, increase the risk of diabetes, while the polyunsaturated fats in nuts and seeds reduce risk.<sup>40</sup> Replacing foods that are rich in trans fats with those containing polyunsaturated fat could reduce the risk of type II diabetes by nearly 40%.<sup>40</sup> Because "good" fats such as olive oil are high in calories, however, care must be taken when planning a daily menu.

High-fiber diets are particularly helpful in promoting healthy blood sugar levels. Numerous studies confirm the importance of fiber.<sup>41-43</sup> One study concluded, "A high level of dietary fiber . . . above the level recommended by the [American Diabetes Association], improves glycemic control, decreases hyperinsulinemia, and lowers plasma lipid concentrations in patients with type II diabetes."<sup>44</sup> Dietary fiber works by at least two mechanisms. Fiber-rich foods such as vegetables, beans, fruits, and whole grains take longer to chew and digest than refined foods such as white bread and sugar. Also, fiber slows the emptying of the stomach contents, promoting a feeling of fullness and balanced blood sugar levels.

Fiber should be introduced gradually into the diet because it may affect insulin and other diabetic medications, and because it takes some time for the digestive system to adjust to added fiber. The two types of fiber are soluble and insoluble. Soluble fiber slows gastric emptying and glucose release in the bloodstream. Insoluble fiber promotes bowel regularity and slows the breakdown of starch, which also has the effect of reducing blood glucose. Soluble fibers include pectin, gums, mucilages, and some hemicelluloses. Insoluble fibers include cellulose and many hemicelluloses. People commonly associate fiber with bran products, but as shown in Table 2, fiber-rich foods also include whole grains, fruits, vegetables, dried beans and peas, and nuts and seeds. Optimal daily fiber intake should include a total of 25-30 grams of soluble and insoluble fiber.

Many other foods can be helpful for controlling blood sugar. Onions and garlic are particularly beneficial foods for those with high blood sugar, and consuming 1-6 grams daily of the spice cinnamon has been shown to help reduce glucose and lipid levels.<sup>45-47</sup>

While it is important to be checked by a physician, studies have shown that diligent self-monitoring of blood sugar using currently available kits is extremely helpful for glucose management.<sup>48,49</sup> Self-monitoring of blood glucose is an effective way to gauge your response to different foods and supplements. Using this tool, patients can play an active role in helping to optimize their blood glucose levels.

Table 2: Fiber Sources\*

Food Selection	Portion Size	Soluble Fiber	Insoluble Fiber
<b>Grains and Pasta</b>			
Bran cereal	1/2 cup	0.3	9.7
Rolled oats	3/4 cup (cooked)	1.3	1.7
Whole oats	1/2 cup (cooked)	0.5	1.1
Rye bread	1 slice	0.8	1.9
Whole-grain bread	1 slice	0.1	2.8
Brown rice	1/2 cup (cooked)	1.3	0.0
Graham crackers	2	0.04	1.4
Rye wafers	3	0.06	2.2
Popcorn	3 cups	0.8	2.0
<b>Vegetables</b>			
Broccoli	1 stalk	1.3	1.4
Carrot	1 large	1.3	1.6
Parsnips	1/2 cup (cooked)	0.4	4.0
Lettuce	1 cup (raw)	0.2	0.3
Summer squash	1/2 cup (cooked)	1.1	1.2
Tomato	1 small	0.1	0.7
Zucchini	1/2 cup (cooked)	1.1	1.4
<b>Legumes</b>			
Peas	2/3 cup (cooked)	0.6	3.3
Kidney beans	1/2 cup (cooked)	0.5	1.0
Lentils	2/3 cup (cooked)	0.6	3.9
Lima beans	1/2 cup (cooked)	0.2	1.2
Pinto beans	1/2 cup (cooked)	2.2	0.7
White beans	1/2 cup (cooked)	0.4	3.8
<b>Fruit</b>			
Apple	1 small	2.3	1.6
Apricot	1 medium	0.5	0.2
Banana	1 small	0.6	0.7
Blackberries	1/2 cup	0.7	3.0
Cherries	10	0.3	0.6
Grapefruit	1/2 fruit	0.9	0.4
Orange	1 medium	1.3	0.7
Peach	1 medium	0.5	0.5
Pear	1 small	0.6	1.9
Plum	1 medium	0.7	0.5
Strawberries	3/4 cup	0.9	1.5
Tangerine	1 medium	1.4	0.4

\* Source: [www.fatfreekitchen.com](http://www.fatfreekitchen.com).

As Table 2 suggests, it is very difficult to obtain optimal daily intake (25-30 grams) of fiber from dietary sources. This is why

health-conscious people increasingly are turning to low-cost fiber supplements.

## REPORT

### High Blood Sugar

#### Integrative Strategies for Supporting Healthy Metabolism

By Bruce Scali

#### CONTROLLING BLOOD SUGAR: AN INTEGRATED APPROACH

Eric Braverman, MD, is an integrative medicine specialist and director of the Place for Achieving Total Health (PATH Medical) in New York City. Dr. Braverman reports tremendous success in working with patients with high blood sugar. By integrating supplements, diet, medication, and lifestyle changes, his patients have achieved better health and relief from the ravages of diabetes and high blood sugar.

Dietary modification is a crucial part of Dr. Braverman's approach. "Sugar, white flour, and soft drinks today are what tobacco was 50 years ago," he says. "We're seeing the result of long-term consumption of junk food, despite warnings about its consequences. This simple rule of thumb for general health is especially important for diabetics: eliminate processed foods such as white sugar, white rice, and white flour from your diet."

Dr. Braverman is also a strong advocate of diabetes screening. "Considering the looming diabetes epidemic, everyone should insist on a glucose test," he adds. "Those with risk factors should monitor their blood sugar every three months, and those who enjoy good health should request a hemoglobin A1C (HbA1c) test at their annual physical. It's as important as a Pap smear, cardiogram, PSA, or breast exam."

Using his integrative approach, Dr. Braverman has seen significant improvement in the laboratory parameters of his patients. "Diabetics often have HbA1c levels over 12%," he explains. "Standard therapies typically lower that by one or two points. The Life Extension protocol can cut it in half. I have used Life Extension techniques to lower HbA1c levels of 14% down to 8%, and a level of 13% was returned to normal (below 6%). Diabetics who have triglyceride levels of 1500 mg/dL are frequently reversed to normal, cholesterol levels of 373 mg/dL are reversed to normal, and even signs of kidney failure with a blood creatinine level of 2.1-2.2 mg/dL have been reversed. Diabetics are at a high risk of developing Alzheimer's and early memory loss 30 years before developing dementia. We've been able to reverse this memory problem as well."

Dr. Braverman's advice is simple and direct: "Maintain a healthy weight, eat properly, balance your hormones, and take the right supplements."



#### HORMONE BALANCE AND DIABETES

Hormone balancing is a critical yet often overlooked element in a program of diabetes management, according to Dr. Braverman. He believes that declining hormone levels result in diminished blood sugar control, since hormone deficiencies can decrease the effectiveness of insulin. One theory of aging suggests that we are only as young as our oldest part. If we do not address the diminished hormone levels that accompany normal aging, then therapies will be only marginally effective. High blood sugar may represent only the tip of the iceberg, or the visible manifestation of a greater problem, which is an underlying hormone imbalance.



In order to balance hormone levels, it is first necessary to assess the levels of several hormones in the body. Blood testing provides an accurate way to assess hormone status. Typically, hormone testing for men will assess levels of DHEA, testosterone, and estrogen. Hormone testing for women assesses DHEA, estrogen, progesterone, and testosterone.

Testosterone supplementation for men reduces insulin resistance, raises beneficial HDL, lowers blood pressure and triglycerides, and helps to reduce excess weight while building muscle.<sup>50,51</sup> "I've had patients reduce their insulin from 100 units to 50 by balancing their testosterone," says Dr. Braverman.

Women tend to gain weight easily from age 35 on due to decreasing levels of estrogen, progesterone, and testosterone. Data suggest that correcting these hormone imbalances in women improves glucose control and may alleviate the tendency to gain weight.<sup>52</sup> Additionally, many women anecdotally report improved mood, energy, and libido following hormone balancing.

A proper level of DHEA (dehydroepiandrosterone) should be maintained in both men and women to support insulin's action on glucose.<sup>53</sup> Women typically need up to 100 mg of DHEA daily, while men typically require up to 200 mg.

Dr. Braverman recommends bioidentical hormones rather than synthetic hormones such as Premarin®. He notes that men and women must be screened thoroughly for cancer before taking any sex hormones. Nutritional and herbal supplements, such as Life Extension's Super MiraForte and Natural Estrogen, help balance hormone levels in men and women, respectively.

### BENEFICIAL EFFECTS OF FIBER

In addition to recommending abundant dietary fiber to his patients, Dr. Braverman advocates the use of fiber supplements. Supplemental sources of fiber include psyllium husk, guar gum, and a dietary fiber blend called PGX™. Psyllium husk can be used in capsule or powder form, and has been reported to decrease glucose absorption and reduce total cholesterol and LDL in type II diabetics.<sup>54</sup> Guar gum is another beneficial fiber for controlling blood sugar because it slows gastric emptying and thus the absorption of glucose.<sup>55</sup> PGX™ is a fiber supplement that binds to many times its weight in water, helping to slow carbohydrate absorption and promote a feeling of fullness. Clinical trials support its application in improving glycemic control in diabetes and in enhancing lipid profiles.<sup>56,57</sup> (See "Novel Fiber Limits Sugar Absorption, *Life Extension*, September 2004.)

**Table 3: Supplements for Normalizing Blood Sugar**

SUPPLEMENTS	PURPOSE
Psyllium, guar gum, PGX™, bilberry leaf extract	Slows glucose absorption; prevents blood sugar spikes.
Chromium, lipoic acid, fish oil, DHEA, testosterone, estrogen	Improves insulin sensitivity; optimizes blood lipids.
Lipoic acid	Supports healthy nerve function.
Bilberry fruit extract	Protects eyes; provides antioxidant and circulatory support.
Multi-vitamin/mineral	Supports immune and connective tissue health.

### THE IMPORTANCE OF SUPPLEMENTS

Nutritional supplements are powerful tools in supporting healthy metabolism and normalizing blood sugar. High blood sugar is marked by many complications, including increased risk for heart disease, kidney and nerve damage, visual deterioration, and vascular problems.

As shown in Tables 3 and 4, proper supplementation can help reduce blood glucose levels, improve insulin action, increase cellular metabolism, and correct the damage of glycation.

Chromium is a trace mineral with numerous beneficial actions for supporting healthy blood sugar. Chromium appears to promote insulin sensitivity and improve glycemic control in many individuals.<sup>58</sup> Additionally, chromium has been found to lower blood glucose levels, both at fasting and at two hours following a glucose challenge.<sup>59</sup> Chromium also has been demonstrated to lower triglyceride levels and boost levels of HDL in patients with type II diabetes.<sup>59</sup> Chromium thus helps to optimize both blood sugar levels and blood lipid profiles.

Essential fatty acids such as EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) are crucial nutrients for people with high blood sugar. In mammal studies, EPA supplementation helps to prevent insulin resistance and improve glucose tolerance test parameters.<sup>60</sup> Human studies have demonstrated that EPA and DHA together help lower serum triglycerides and raise HDL in non-insulin-dependent diabetic patients.<sup>61</sup> Additionally, EPA and DHA supplements decreased rates of lipid peroxidation and

**Table 4: Recommended Supplements for Supporting Healthy Blood Sugar Levels**

Supplements	
Lipoic acid	300-600 mg/day
Bilberry leaf	100-200 mg 3x/day
Chromium	400-1000 mcg/day
DHA	1000-1750 mg/day
DHEA	50-100 mg/day (females) 100-200 mg/day (males)
EPA	1400-2400 mg/day
<b>Fiber supplements</b>	

raised levels of glutathione peroxidase, an antioxidant enzyme.<sup>61</sup> Omega-3 fatty acids therefore may help to improve the dyslipidemia that often occurs with hyperglycemia and may decrease the rate of vascular complications.

Lipoic acid, a potent antioxidant and coenzyme, is one of the most critical nutrients for people with high blood sugar. Clinical and animal studies have shown that lipoic acid stimulates insulin-mediated glucose uptake.<sup>62</sup> In rats fed a high-sugar diet, lipoic acid improved insulin sensitivity and glucose tolerance.<sup>62</sup> In a study of type II diabetics, three months of supplementation with lipoic acid helped to improve painful neuropathy symptoms in 77% and eliminated symptoms in 19% of participants.<sup>63</sup> Lipoic acid also improved nerve-conduction velocity, which is often compromised in diabetic patients suffering from neuropathy.<sup>63</sup> Lipoic acid therefore acts by several mechanisms to improve insulin sensitivity as well as help support healthy nerve function.

Bilberry, a close relative of the blueberry, has been eaten and used medicinally for centuries because of its high nutritive value. Bilberry leaf decoctions administered orally have been shown to lower blood glucose levels.<sup>64</sup> Bilberry exhibits an affinity for the tissues of the eye, improving the delivery of oxygen and blood to the eye tissues and scavenging free radicals that can contribute to conditions such as cataracts and macular degeneration.<sup>64</sup> Anthocyanosides present in bilberry have been found to retard the development of cataracts in animals and humans.<sup>64</sup> European studies have shown that bilberry anthocyanosides are highly effective in preventing diabetic retinopathy.<sup>64</sup> Additionally, bilberry extracts improve microcirculation, enhance collagen integrity, and exert anti-inflammatory properties.<sup>64</sup> Bilberry is thus a powerful tool in protecting the eyes against the secondary effects of high blood sugar.

A multi-vitamin/mineral helps form the foundation of a healthy lifestyle for all adults, and is especially important for those with hyperglycemia. Diabetic patients are susceptible to infections and delayed wound healing. An important study showed that diabetics who supplemented with a multi-vitamin/mineral formula for one year experienced a decreased rate of illness, infection, and missed time from work compared to study subjects who took a placebo.<sup>65</sup> Thus, a multi-vitamin/mineral supplement may help patients with high blood sugar to optimize health and prevent illness.

Guar gum	250-500 mg 3x/day
(or)	
P G X™	1-3 grams 3x/day
(or)	
Psyllium	2-5 grams 3x/day

---

## References

---

1. Killilea T. Long-term consequences of type 2 diabetes mellitus: economic impact on society and managed care. *Am J Manag Care*. 2002 Oct;8(16 Suppl):S441-9.
2. Narayan KM, Gregg EW, Fagot-Campagna A, Engelgau MM, Vinicor F. Diabetes—a common, growing, serious, costly, and potentially preventable public health problem. *Diabetes Res Clin Pract*. 2000 Oct;50 Suppl 2S77-84.
3. Osei K. Global epidemic of type 2 diabetes: implications for developing countries. *Ethn Dis*. 2003;13(2 Suppl 2):S102-6.
4. Gu K, Cowie CC, Harris MI. Mortality in adults with and without diabetes in a national cohort of the US population, 1971-1993. *Diabetes Care*. 1998 Jul;21(7):1138-45.
5. Ahmed N. Advanced glycation endproducts—role in pathology of diabetic complications. *Diabetes Res Clin Pract*. 2005 Jan;67(1):3-21.
6. Bonnefont-Rousselot D, Beaudoux JL, Therond P, Peynet J, Legrand A, Delattre J. Diabetes mellitus, oxidative stress and advanced glycation endproducts. *Ann Pharm Fr*. 2004 May;62(3):147-57.
7. Leslie DL, Rosenheck RA. Incidence of newly diagnosed diabetes attributable to atypical antipsychotic medications. *Am J Psychiatry*. 2004 Sep;161(9):1709-11.
8. Kropp S, Grohmann R, Hauser U, Ruther E, Degner D. Hyperglycemia associated with antipsychotic treatment in a multicenter drug safety project. *Pharmacopsychiatry*. 2004 Mar;37 Suppl 1S79-83.
9. Fletcher B, Gulanick M, Lamendola C. Risk factors for type 2 diabetes mellitus. *J Cardiovasc Nurs*. 2002 Jan;16(2):17-23.
10. Trevisan R, Vedovato M, Tiengo A. The epidemiology of diabetes mellitus. *Nephrol Dial Transplant*. 1998;13 Suppl 82-5.
11. Meigs JB. Epidemiology of the insulin resistance syndrome. *Curr Diab Rep*. 2003 Feb;3(1):73-9.

12. Laaksonen DE, Niskanen L, Punnonen K, et al. Testosterone and sex hormone-binding globulin predict the metabolic syndrome and diabetes in middle-aged men. *Diabetes Care*. 2004 May;27(5):1036-41.
13. Boule NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA*. 2001 Sep 12;286(10):1218-27.
14. Kelly JM, Marrero DG, Gallivan J, Leontos C, Perry S. Diabetes prevention. A GAMEPLAN for success. *Geriatrics*. 2004 Jul;59(7):26-31.
15. Scheen AJ. Clinical study of the month. Prevention of type 2 diabetes in overweight patients with impaired glucose tolerance: efficiency of lifestyle changes. *Rev Med Liege*. 2001 Jun;56(6):463-5.
16. Kanaya AM, Narayan KM. Prevention of type 2 diabetes: data from recent trials. *Prim Care*. 2003 Sep;30(3):511-26.
17. Goldstein BJ. Insulin resistance as the core defect in type 2 diabetes mellitus. *Am J Cardiol*. 2002 Sep 5;90(5A):3G-10G.
18. Chisholm DJ, Campbell LV, Kraegen EW. Pathogenesis of the insulin resistance syndrome (syndrome X). *Clin Exp Pharmacol Physiol*. 1997 Sep;24(9-10):782-4.
19. Lorenzo C, Okoloise M, Williams K, Stern MP, Haffner SM. The metabolic syndrome as predictor of type 2 diabetes: the San Antonio heart study. *Diabetes Care*. 2003 Nov;26(11):3153-9.
20. Scheen AJ. From obesity to diabetes: why, when and who? *Acta Clin Belg*. 2000 Jan;55(1):9-15.
21. Resnick HE, Valsania P, Halter JB, Lin X. Relation of weight gain and weight loss on subsequent diabetes risk in overweight adults. *J Epidemiol Community Health*. 2000 Aug;54(8):596-602.
22. Wannamethee SG, Shaper AG. Weight change and duration of overweight and obesity in the incidence of type 2 diabetes. *Diabetes Care*. 1999 Aug;22(8):1266-72.
23. Moore LL, Visoni AJ, Wilson PW, et al. Can sustained weight loss in overweight individuals reduce the risk of diabetes mellitus? *Epidemiology*. 2000 May;11(3):269-73.
24. Ryan DH. Diet and exercise in the prevention of diabetes. *Int J Clin Pract Suppl*. 2003 Mar;(134):28-35.
25. Ivy JL. Role of exercise training in the prevention and treatment of insulin resistance and non-insulin-dependent diabetes mellitus. *Sports Med*. 1997 Nov;24(5):321-36.
26. Schulze MB, Hu FB. Primary prevention of diabetes: what can be done and how much can be prevented? *Annu Rev Public Health*. 2004 Oct 26.
27. Eyre H, Kahn R, Robertson RM, et al. Preventing cancer, cardiovascular disease, and diabetes: a common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association. *Stroke*. 2004 Aug;35(8):1999-2010.
28. Manson JE, Ajani UA, Liu S, Nathan DM, Hennekens CH. A prospective study of cigarette smoking and the incidence of diabetes mellitus among US male physicians. *Am J Med*. 2000 Nov;109(7):538-42.
29. Jenkins AJ, Rowley KG, Lyons TJ, et al. Lipoproteins and diabetic microvascular complications. *Curr Pharm Des*. 2004;10(27):3395-418.
30. Greenfield JR, Samaras K, Hayward CS, Chisholm DJ, Campbell LV. Beneficial postprandial effect of a small amount of alcohol on diabetes and cardiovascular risk factor. Modification by insulin resistance. *J Clin Endocrinol Metab*. 2005 Feb;90(2):661-72.
31. Avogaro A, Watanabe RM, Dall'Arche A, et al. Acute alcohol consumption improves insulin action without affecting insulin secretion in type 2 diabetic subjects. *Diabetes Care*. 2004 Jun;27(6):1369-74.
32. Shai I, Rimm EB, Schulze MB, et al. Moderate alcohol intake and markers of inflammation and endothelial dysfunction among diabetic men. *Diabetologia*. 2004 Oct;47(10):1760-7.

33. Riazi A, Pickup J, Bradley C. Daily stress and glycaemic control in Type 1 diabetes: individual differences in magnitude, direction, and timing of stress-reactivity. *Diabetes Res Clin Pract.* 2004 Dec;66(3):237-44.
34. Foster-Powell K, Holt SHA, Brand-Miller JC. International table of glycemic index and glycemic load values: 2002. *Am J Clin Nutr.* 2002 July;76(1):5-56.
35. Reaven GM. Diet and Syndrome X. *Curr Atheroscler Rep.* 2000 Nov;2(6):503-7.
36. Gannon MC, Nuttall FQ, Saeed A, Jordan K, Hoover H. An increase in dietary protein improves the blood glucose response in persons with type 2 diabetes. *Am J Clin Nutr.* 2003 Oct;78(4):734-41.
37. Nuttall FQ, Gannon MC, Saeed A, Jordan K, Hoover H. The metabolic response of subjects with type 2 diabetes to a high-protein, weight-maintenance diet. *J Clin Endocrinol Metab.* 2003 Aug;88(8):3577-83.
38. Brinkworth GD, Noakes M, Parker B, Foster P, Clifton PM. Long-term effects of advice to consume a high-protein, low-fat diet, rather than a conventional weight-loss diet, in obese adults with type 2 diabetes: one-year follow-up of a randomised trial. *Diabetologia.* 2004 Oct;47(10):1677-86.
39. Nuttall FQ, Gannon MC. Metabolic response of people with type 2 diabetes to a high protein diet. *Nutr Metab (Lond).* 2004 Sep 13;1(1):6.
40. Salmeron J, Hu FB, Manson JE, et al. Dietary fat intake and risk of type 2 diabetes in women. *Am J Clin Nutr.* 2001 Jun;73(6):1019-26.
41. McKeown NM. Whole grain intake and insulin sensitivity: evidence from observational studies. *Nutr Rev.* 2004 Jul;62(7 Pt 1):286-91.
42. Schulze MB, Liu S, Rimm EB, et al. Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *Am J Clin Nutr.* 2004 Aug;80(2):348-56.
43. Hodge AM, English DR, O'Dea K, Giles GG. Glycemic index and dietary fiber and the risk of type 2 diabetes. *Diabetes Care.* 2004 Nov;27(11):2701-6.
44. Chandalia M, Garg A, Lutjohann D, et al. Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. *N Engl J Med.* 2000 May 11;342(19):1392-8.
45. Campos KE, Diniz YS, Cataneo AC, et al. Hypoglycaemic and antioxidant effects of onion, *Allium cepa*: dietary onion addition, antioxidant activity and hypoglycaemic effects on diabetic rats. *Int J Food Sci Nutr.* 2003 May;54(3):241-6.
46. Kumar GR, Reddy KP. Reduced nociceptive responses in mice with alloxan induced hyperglycemia after garlic (*Allium sativum* Linn.) treatment. *Indian J Exp Biol.* 1999 Jul;37(7):662-6.
47. Khan A, Safdar M, Ali Khan MM, Khattak KN, Anderson RA. Cinnamon improves glucose and lipids of people with type 2 diabetes. *Diabetes Care.* 2003 Dec;26(12):3215-8.
48. Guerci B, Drouin P, Grange V, et al. Self-monitoring of blood glucose significantly improves metabolic control in patients with type 2 diabetes mellitus: the Auto-Surveillance Intervention Active (ASIA) study. *Diabetes Metab.* 2003 Dec;29(6):587-94.
49. Schwedes U, Siebolds M, Mertes G. Meal-related structured self-monitoring of blood glucose: effect on diabetes control in non-insulin-treated type 2 diabetic patients. *Diabetes Care.* 2002 Nov;25(11):1928-32.
50. Mayes JS, Watson GH. Direct effects of sex steroid hormones on adipose tissues and obesity. *Obes Rev.* 2004 Nov;5(4):197-216.
51. Tsai EC, Matsumoto AM, Fujimoto WY, Boyko EJ. Association of bioavailable, free, and total testosterone with insulin resistance: influence of sex hormone-binding globulin and body fat. *Diabetes Care.* 2004 Apr;27(4):861-8.
52. Ferrara A, Karter AJ, Ackerson LM, Liu JY, Selby JV. Hormone replacement therapy is associated with better glycemic control in women with type 2 diabetes: The Northern California Kaiser Permanente Diabetes Registry. *Diabetes Care.* 2001 Jul;24

53. Ishizuka T, Kajita K, Miura A, et al. DHEA improves glucose uptake via activations of protein kinase C and phosphatidylinositol 3-kinase. *Am J Physiol.* 1999 Jan;276(1 Pt 1):E196-204.
54. Sierra M, Garcia JJ, Fernandez N, Diez MJ, Calle AP. Therapeutic effects of psyllium in type 2 diabetic patients. *Eur J Clin Nutr.* 2002 Sep;56(9):830-42.
55. Russo A, Stevens JE, Wilson T, et al. Guar attenuates fall in postprandial blood pressure and slows gastric emptying of oral glucose in type 2 diabetes. *Dig Dis Sci.* 2003 Jul;48(7):1221-9.
56. Vuksan V, Sievenpiper JL, Owen R, et al. Beneficial effects of viscous dietary fiber from Konjac-mannan in subjects with the insulin resistance syndrome: results of a controlled metabolic trial. *Diabetes Care.* 2000 Jan;23(1):9-14.
57. Vuksan V, Jenkins DJ, Spadafora P, et al. Konjac-mannan (glucomannan) improves glycemia and other associated risk factors for coronary heart disease in type 2 diabetes. A randomized controlled metabolic trial. *Diabetes Care.* 1999 Jun;22(6):913-9.
58. McCarty MF. Nutraceutical resources for diabetes prevention—an update. *Med Hypotheses.* 2005;64(1):151-8.
59. Bahijiri SM, Mira SA, Mufti AM, Ajabnoor MA. The effects of inorganic chromium and brewer's yeast supplementation on glucose tolerance, serum lipids and drug dosage in individuals with type 2 diabetes. *Saudi Med J.* 2000 Sep;21(9):831-7.
60. Minami A, Ishimura N, Sakamoto S, et al. Effect of eicosapentaenoic acid ethyl ester v. oleic acid-rich safflower oil on insulin resistance in type 2 diabetic model rats with hypertriacylglycerolaemia. *Br J Nutr.* 2002 Feb;87(2):157-62.
61. Kesavulu MM, Kameswararao B, Apparao C, Kumar EG, Harinarayan CV. Effect of omega-3 fatty acids on lipid peroxidation and antioxidant enzyme status in type 2 diabetic patients. *Diabetes Metab.* 2002 Feb;28(1):20-6.
62. Thirunavukkarasu V, Anitha Nandhini AT, Anuradha CV. Lipoic acid attenuates hypertension and improves insulin sensitivity, kallikrein activity and nitrite levels in high fructose-fed rats. *J Comp Physiol [B].* 2004 Nov;174(8):587-92.
63. Negrisanu G, Rosu M, Bolte B, Lefter D, Dabelea D. Effects of 3-month treatment with the antioxidant alpha-lipoic acid in diabetic peripheral neuropathy. *Rom J Intern Med.* 1999 Jul;37(3):297-306.
64. Anon. Monograph. *Vaccinium myrtillus* (bilberry). *Altern Med Rev.* 2001 Oct;6(5):500-4.
65. Barringer TA, Kirk JK, Santaniello AC, Foley KL, Michielutte R. Effect of a multivitamin and mineral supplement on infection and quality of life. A randomized, double-blind, placebo-controlled trial. *Ann Intern Med.* 2003 Mar 4;138(5):365-71.

## REPORT

### Integrative Diabetes Management: A Case History

By Eric Braverman, MD



Edgar was a 51-year-old diabetic with multiple complaints when I first saw him five years ago. He had been using injectable insulin for several years to manage his blood sugar, but this married computer analyst and father of three could not remember when he was not 40 pounds overweight and suffering from fatigue and hypertension. His latest problem, periodic erectile dysfunction, led him to my office.

Edgar was taking blood pressure and cholesterol medications, but had not seen much improvement in his health with conventional care. He wanted to know whether an integrative medical approach might help him. I assured him that many well-researched strategies were available, and that he would feel much better soon.

Elevated blood sugar (hyperglycemia) starts a cascade of health problems. I suspected that his examination would confirm that Edgar had a metabolic disorder with vascular and diabetic complications. Left unchecked, Edgar's condition could deteriorate into heart attack, stroke, blindness, amputations, or dementia. Although there was little likelihood of getting him off insulin, much could be done to improve his condition and enhance the quality and span of his life.

I explained that we would formulate a comprehensive lifestyle, diet, supplement, and hormone program to revive Edgar's metabolism, help him lose weight permanently, restore his sexual function, and avoid the dire consequences of diabetes. Before any specific treatment recommendations were made, the PATH Medical staff would administer a head-to-toe examination under my direction, including a physical examination, standard blood testing and blood sugar assessment, testing for hormone levels, prostate cancer screening, and multiple ultrasound reviews. With this wealth of information, we would get to the source of his complaints, and go beneath the iceberg, so to speak, to avoid Edgar's impending "shipwreck."

His test results, shown above along with desirable ranges, had implications for all of his complaints.

In addition, Edgar's creatinine was 2.3 mg/dL (normal range is 0.4-1.2 mg/dL), indicating impaired kidney function, and his liver enzymes and platelets were elevated, indicating liver disease and blood flow restriction.

Although he was on insulin, Edgar's blood sugar was not sufficiently under control. His fasting glucose indicated that his body was not able to fully metabolize food in the short term, and his HbA1c level was exceptionally high. Most diabetics present with HbA1c levels between 7% and 8.5%. While HbA1c represents average glucose level in the hemoglobin over three months, Edgar's metabolism was functioning poorly over an extended period. When an HbA1c level consistently exceeds 10%, patients are at high risk for blindness and amputations.

To constructively address all of his complaints, it was imperative for Edgar to lose weight and lower his blood glucose. To accomplish this, we formulated an aggressive plan to dramatically alter his metabolism.

	Edgar's Level	Desirable Range
<b>Blood Sugar</b>		
Fasting glucose	362 mg/dL	<100 mg/dL
HbA1c	14.4%	<6%
<b>Metabolism</b>		
Cholesterol	295 mg/dL	<200 mg/dL
HDL	30 mg/dL	>35mg/dL
LDL	227 mg/dL	<100 mg/dL
Triglycerides	976 mg/dL	<151 mg/dL

## Hormones

Testosterone (total)	220 ng/dL	280-800 ng/dL
Testosterone (free)	6.8 pg/mL	7.2-23.0 pg/mL
DHEA-S	85 ug/dL	70-310 ug/dL*

- Vascular studies: carotid stenosis.
- Ultrasound: slightly enlarged heart and prostate; fatty liver; restricted penile and peripheral vascular blood flow.
- Prostate-specific antigen (PSA) (marker for prostate enlargement and cancer): normal.

\* Editor's note: Life Extension recommends an optimal range of DHEA-S of 400-500 ug/dL.

Edgar's diet contained too high a percentage of refined carbohydrates and not enough fiber and other beneficial nutrients. We recommended the rainbow diet plan, a program that includes vegetables and fruits from the entire color spectrum, substitutes protein for some carbohydrates, emphasizes unsaturated fats, and ensures adequate fiber. This diet promotes weight loss and provides powerful antioxidants to offset the damage caused by elevated blood sugar.

Edgar was given information about the best protein sources, the best fats (walnuts and oily fish), and making "colorful" food choices: tomatoes, pink grapefruit, cherries, and watermelon for a touch of red; spinach, kale, broccoli, and zucchini for green; carrots, squash, oranges, and cantaloupe for yellow and orange; blueberries, plums, and blackberries for purple and blue; and onions, white beans, garlic, and leeks for white.

To complement his diet, Edgar was instructed to exercise moderately every day, which has been found to help control glucose. He agreed to walk in the park near his home daily for at least 30 minutes.

Supplements lower blood sugar by slowing the digestive process or by increasing cellular use of glucose. We recommended guar gum (1.5 grams daily) and PGX™ (9 grams daily) to Edgar for additional fiber, and added chromium (1000 mcg daily) to enhance his metabolism of glucose.

Additional supplements that may help slow the rise in blood sugar were added to Edgar's program. These included bilberry leaf (600 mg daily), lipoic acid (600 mg daily), EPA (2400 mg daily), and DHA (1800 mg daily).

Hormone deficiencies can play a role in excess weight, metabolic imbalance, and erectile dysfunction. Edgar's lab results were low-normal for DHEA and below normal for both testosterone tests. Ranges are established and used by conventional doctors because they represent the levels of hormones found in the general aging population. Life Extension practitioners like myself believe that "normal" ranges are actually well below what should be maintained for optimal health and quality of life. By any measure, however, Edgar required hormone supplementation. Because his PSA test was normal, we could include this therapy in his protocol.

DHEA (200 mg daily) and testosterone gel (1%) were included to boost Edgar's metabolism. Testosterone injections using a bioidentical rather than a very potent synthetic formulation may have helped Edgar lose weight. Testosterone can also help alleviate erectile dysfunction.

As is often the case, Edgar's diabetes was co-morbid with his Syndrome X/metabolic syndrome, and his fatigue and sexual dysfunction were also related. It is no coincidence that parts of his program for controlling blood sugar—including diet, exercise, and fish oil supplements—would also benefit his lipid and vascular profiles. In addition, the supplemental testosterone, exercise, chromium, fish oils, and lipoic acid for improved insulin action would also improve his energy level and libido. While Edgar's treatment included many components, all were necessary in order to address his overall health. Edgar said he would do anything to feel better.

Edgar's compliance with treatment was exceptional, and he looked and felt incrementally better each time I saw him. As he lost weight, he gained physical and mental energy, and his confidence in his program grew. After six months, he no longer experienced erectile dysfunction, and at 18 months, he had lost 36 pounds.

His cholesterol at 18 months had dropped to 177 mg/dL, while his HDL had risen to 55 mg/dL and his LDL had fallen to 117 mg/dL. His triglycerides had been lowered dramatically to 115 mg/dL, and his hormone levels were in the high-normal range. Ultrasound re-tests did not show marked improvement, which was expected. It would take more time to reverse damage that had developed over years.

Edgar's improvement in blood sugar parameters was remarkable. His fasting glucose was down to 154 mg/dL, and his HbA1c

was lowered from 14.4% to 8.2% (still high, but out of the critical zone). Edgar still needed his insulin, but if he stayed on his path, the likelihood of heart attack, stroke, dementia, or severe diabetic complications would be reduced tremendously. His creatinine level had dropped to 1.6 mg/dL, indicating that reducing blood glucose had improved Edgar's kidney function.

## DISCUSSION

Edgar's case illustrates the complex effects of diabetes on the body and the need for a comprehensive treatment strategy. When Edgar came to my office, his diabetes was poorly controlled, his energy level was poor, and his aberrant laboratory measures placed him at risk for further disease and accelerated aging. A comprehensive treatment strategy using dietary and lifestyle interventions, nutritional remedies, hormone balancing, and doctor-patient collaboration helped Edgar to improve his health and energy level dramatically, while reducing his risk for diabetic complications and other age-related diseases.

Integrative care for patients with diabetes and high blood sugar requires a thorough and multifaceted approach. While the results may not appear overnight, dramatic and life-enhancing improvements will reward the proactive patient.

All Contents Copyright © 1995-2009 Life Extension Foundation All rights reserved.

**LifeExtension®**

These statements have not been evaluated by the FDA. These products are not intended to diagnose, treat, cure or prevent any disease. The information provided on this site is for informational purposes only and is not intended as a substitute for advice from your physician or other health care professional or any information contained on or in any product label or packaging. You should not use the information on this site for diagnosis or treatment of any health problem or for prescription of any medication or other treatment. You should consult with a healthcare professional before starting any diet, exercise or supplementation program, before taking any medication, or if you have or suspect you might have a health problem. You should not stop taking any medication without first consulting your physician.