

NUTRITION

Diabetes: A Public Health Crisis?

With all the medical advancements of the last half of the twentieth century, life can and should be safer, healthier and more comfortable as we enter the next century. Infectious diseases such as tuberculosis (consumption), typhoid fever, deadly influenza and polio have been nearly eradicated. It seems now our enemy has become ourselves. A lifestyle of plenty, abundant and affordable food, and mechanical conveniences have contributed to an increase in chronic illnesses such as diabetes mellitus (DM) that appear to be endangering the health of even the youngest Americans.

A report from the Center for Disease Control and Prevention (CDC) indicated the prevalence of diagnosed cases of DM has increased by one third between the years 1990 and 1998 (4.9%-6.5% resp.). What is most alarming is that the age at which people are being diagnosed with DM is rapidly declining. For people in their forties the incidence of DM increased forty percent in the same eight years while for people in their thirties it increased as much as seventy percent.①

One cause of this metabolic abnormality is now confirmed to be due in part to genetics. Certain populations most prone to developing diabetes are believed to have a "thrifty gene" that conserves energy and was essential for their ancestors when food was scarce. This no longer being the case in the US, the "thrifty gene" has led half the population of Pima Indians in the south western US to develop DM. Interestingly, a closely related tribe of Pima

Indians just over the border in Mexico, where manual labor and a traditional diet is the way of life, has a much lower incidence of DM.

However, genetics is not the only factor. The relationship between type 2 diabetes and obesity is well documented but not well understood. The CDC survey showed that of the patients who were obese, 13.5% had Type 2 diabetes compared with only 3.5% who were of normal weight. This is an even more alarming statistic given the increased rate of obesity among children and adults in the US. According to The American Obesity Association, an estimated 97 million adults in the US are overweight or obese and approximately 25 percent of children are also overweight.

In fact, even maternal diet may play a role in the development of diabetes. As part of a large study of nurses' health, researchers found that the risk of developing Type 2 diabetes mellitus as an adult was greatest in those women who weighed less than 5.5 pounds when born, independent of other risk factors.②

The devastating effects of this disease have now been given many more years to take its toll on more and more people. This affects us all, even if we don't suffer directly from the disease. The cost of treatment for the sixteen million people with diabetes and all its indirect costs is now up to ninety eight billion dollars yearly. The burden of these healthcare costs will be felt by all Americans for some time to come.

This issue of Nutrition Realities focuses on the incidence of diabetes mellitus and its relationship to other chronic disease states including common risk factors, metabolic consequences and dietary management. A cluster of symptoms specific to insulin resistance such as those associated with Metabolic Syndrome or Syndrome X are reviewed and a discussion of acute and chronic complications is also included.

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② Rich-Edwards J., Colditz G., Stampfer M., Willett W., Gillman M., Hennekens C., Speizer E., Manson J. Birthweight and the risk for Type 2 Diabetes Mellitus in Adult Women *Annals of Internal Medicine* 1999 February;130(4):278.]

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Realities

TYPE 1 & TYPE 2 DIABETES

Diabetes mellitus ranks among the leading causes of death and contributes to a variety of other major diseases, including heart disease and stroke. People with diabetes are twice as likely to develop these cardiovascular problems as those without diabetes. However, today people with diabetes can live long and healthy lives.

There are two types of Diabetes, Type 1 and Type 2. Type 1 Diabetes is the less common type accounting for 5 to 10 percent of all diagnosed cases. Type 1 diabetes occurs when the pancreas cannot synthesize the hormone insulin. Without insulin, the body's energy metabolism becomes drastically altered, with severe health consequences. The person with Type 1 diabetes must obtain insulin to assist the cells in taking up blood glucose needed for energy metabolism the needed fuels from the blood; for this reason, type 1 is sometimes called insulin-dependent diabetes mellitus (IDDM). The insulin must be injected; it cannot be taken orally because insulin is a protein and the GI enzymes would digest it.

Type 2 diabetes is the predominant form of diabetes, with 90 to 95 percent of all cases, and is often undiagnosed. It develops most often in people over 40 years of age, but is also observed in obese children. Although the exact cause of type 2 diabetes remains unclear, high blood glucose and insulin resistance are the hallmarks of the disorder. In the initial stages, the pancreas produces insulin but the cells become less sensitive to it, they become insulin resistant. As blood glucose rises, the pancreas makes more insulin, and blood insulin rises to abnormally high levels resulting in

hyperinsulinemia. The chronic demand for insulin exhausts the cells, and finally insulin production falters as the diseases progresses. Type 2 diabetes appears to be associated with obesity, often of long duration, abdominal fat deposition, and physical inactivity. As body fat increases, body tissues become less able to respond to insulin.

A person with undetected high blood sugar may still feel just fine. They may also feel exhausted, urinate frequently, and have an insatiable thirst. Even if someone still feels fine they need to do what they can to keep their blood sugar near normal levels because over time high blood sugar can raise the risk of heart attacks or stroke. Plus, type 2 diabetes can also cause damage to the kidneys, nerves, and eyes.

Type 2 diabetes usually develops later in life, for all people, pancreatic insulin-producing cells progressively lose their function with age. Type 2 diabetes is also associated with obesity; about 90 percent of United States adults with type 2 diabetes are obese. One of the many metabolic consequences of obesity is insulin resistance. Compared with normal-weight people, obese people require much more insulin to maintain normal blood glucose levels. More insulin is produced, but as body fat increases, insulin receptors are reduced in number or function; consequently, insulin resistance increases, and adipose and muscle tissues become less and less able to take up blood glucose. At some point, the body cannot produce enough insulin to keep up, and type 2 diabetes develops. Age and obesity alone do not predict the onset of type 2 diabetes; genetics also plays a role.

DIABETIC DIET

The American Diabetes Association (ADA), in 1994, released their generalized version of the diabetic diet. There is no longer a diabetic diet, but rather healthy eating suggestions for people with and without diabetes. They outlined the diabetic diet as a normal healthful style of eating and a way to achieve several desirable goals. These goals consist of: 1) keeping blood glucose levels close to normal and maintaining cholesterol, LDL, HDL, and triglycerides all within normal limits; 2) getting to and keeping a reasonable weight and eating foods in a style which can promote health.

To achieve the first goal, it may be necessary to frequently monitor blood glucose levels, to determine the affects of various influences such as food intake, medication, stress, activity and illness during the day or night. When blood levels vary from the norm, adjustments may then be made to a maintain blood glucose and lipid levels within an acceptable range.

Regarding the second goal, life experience and cultural patterns often affect the way people make food

choices. One diet often does not work for everyone. That is why people often regain weight lost on popular diet programs. Diet programs that assume a one-type-fits-all view, often don't take into account individual differences. After some time, most people tire of rigid eating patterns and go back to their old habits, which are more comfortable and familiar.

The new generalized diet allows for a more personal touch for the diabetic patient. Patients can make their diet healthier in small ways that work better for them, unlike a strict diet pattern. Changes can be made easily, such as eating smaller portions, adding vegetables, or avoiding meal skipping.

A food plan needs to provide the needed calories to maintain a healthy weight. And, perhaps losing extra pounds if desirable. Working with a registered dietitian can be helpful to most patients. A registered dietitian can determine a reasonable goal weight and design a dietary program which can help achieve weight loss and maintain a healthful weight.

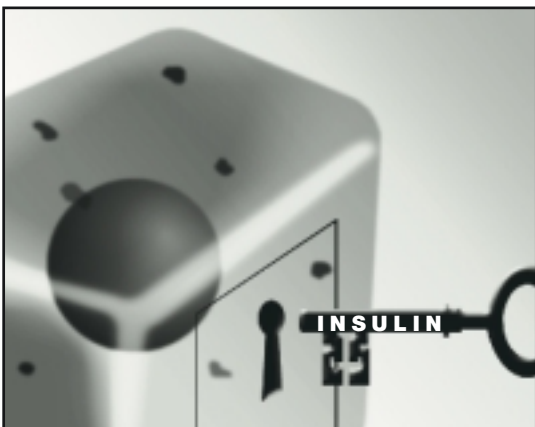
QUESTIONS FROM

t h e C l i n i c

Q: What is the difference between a glycated hemoglobin HbA1c test and a blood sugar test?

a: The hemoglobin HbA1c test is a blood test that tells how much sugar has been in a patient's blood for the past 2 to 4 months. Hemoglobin is what makes red blood cells red and these cells circulate in the blood for about four months. During the four-month lifespan, the glucose in the blood enters the red blood cells, and when this happens in excess the hemoglobin becomes glycated. This HbA1c test is able to detect whether high levels of blood glucose have occurred over the past few months. This test is usually done during doctor visits every three to six months.

Blood sugar tests can be done by the diabetic patient several times a day at their home. Blood sugar tests give the patient their blood sugar level at the time the test is taken. Both types of tests are important for keeping blood sugar levels under control and near the target range to prevent the many complications of diabetes.



Nutrition Realities welcomes your Questions from the Clinic. If you have questions or comments, please send them by mail, FAX, or e-mail to:

Questions from the Clinic

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Q: Can a diet for someone with type 2 diabetes include foods like cake and cookies?

a: A diet that controls glucose fluctuations benefits those with type 2 diabetes the most. Many type 2 diabetics find that a consistent carbohydrate intake spaced throughout the day helps them maintain appropriate blood glucose levels and maximize the effectiveness of drug therapy. Eating too much carbohydrate at one time can raise blood glucose too high, stressing the already-compromised insulin-producing cells. And, eating too little carbohydrate can result in hypoglycemia, especially for those taking oral glycemic medication or insulin. The amount of carbohydrate, not the source, affects glucose levels the most. People with type 2 diabetes need to pay attention to their carbohydrate intake, and they can eat sweets and sugars, like cake and cookies, if they can afford the calories.

Q: What does glycemic effect mean?

a: The term glycemic effect describes the effect of food on blood glucose levels. Basically, how quickly glucose is absorbed after a person eats, how high blood glucose rises, and how quickly it returns to normal. Slow absorption, a modest rise in blood glucose levels, and a smooth return to normal are considered desirable. Different foods have different effects on blood glucose depending on a number of factors working together, and the effect is not always what one might expect. For example, ice cream, a high-sugar food, produces less of a response than a baked potato, a high-starch food.

A food's glycemic effect differs depending on whether it is eaten alone or as part of a mixed meal. And, eating small meals frequently throughout the day spreads glucose absorption evenly across the day and offers the same metabolic advantages as do foods with a low glycemic effect.

Major Risk Factors for Type 2 Diabetes

- **Obesity.**
- **Family History.**
- **High-risk ethnic background.**
- **Gestational diabetes or mother who gives birth to a baby weighing over 9 pounds.**

Dietary Risk Factors AND CHRONIC DISEASES

Most of today's life-threatening diseases develop and become chronic as a result of physiological deterioration of the body induced by factors such as age, gender, lifestyle, and environment. Diet is one of many lifestyle factors that influences the risk of developing chronic diseases. Several risk factors may be associated with a particular disease, and several chronic diseases may have similar risk factors as illustrated by the table below.

Each of the chronic diseases develops in response to multiple interactive factors, including many non-dietary factors such as age, lack of physical activity, and smoking. Hypertension, obesity, high blood lipids, atherosclerosis, diabetes, and some types of cancer are also common in families due to heredity factors. Just as people's genetic susceptibility to disease varies, so do their responses to dietary measures. Logically, preventive efforts may be most beneficial for persons with strong family histories of

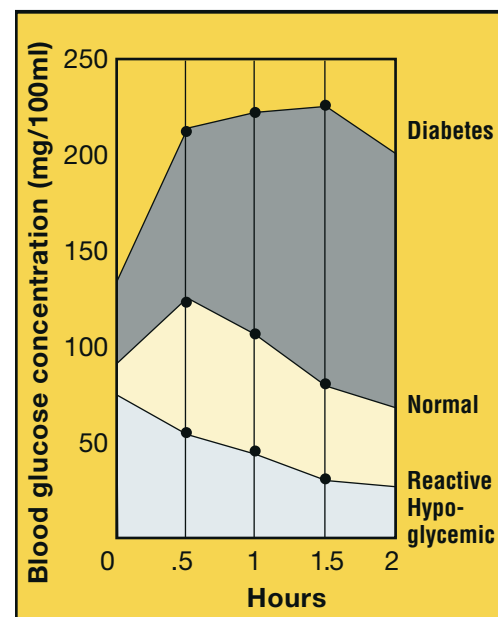
disease, and health care professionals should make a concerted effort to identify those people for intervention and treatment.

Dietary excesses, particularly excess food energy and fat intakes, increase the likelihood for most of today's major chronic diseases. Several of the dietary recommendations are aimed at weight control, reducing dietary fat especially saturated fat, adding complex carbohydrates, and balancing food intake with activity and energy expenditure. The problems of overweight people multiply when medical problems develop. Overweight people with diabetes usually have hypertension and high blood lipids as well. Such a combination of problems may require only one primary treatment plan, losing the excess weight by adopting a healthful diet combined with regular physical activity. All adults have a great opportunity to enjoy the benefits of dietary moderation to help preserve their health into their later years.

CHRONIC CO

Heart and blood vessel problems are the main causes of sickness and death among people with diabetes. Having diabetes triples the chances of serious heart disease for people over the age of 45. Atherosclerosis tends to develop early, progress quickly, and be more severe in diabetics. Their blood becomes thickened with glucose and causes the heart to pump harder to push nutrients and oxygen through the bloodstream. Blood cells stick together and clog the arteries and if these clogged arteries are in the heart, the result is a heart attack. If the clogged arteries are in the brain, a stroke will occur.

Heart and blood vessel problems can



Diet Risk Factors	Chronic Diseases					
	Cancers	Type 2 Diabetes	Obesity	Atherosclerosis	Stroke	Hyper-tension
High-fat Diet	X	X	X	X	X	X
Excessive Alcohol Intake	X		X	X	X	X
Low fiber	X	X	X	X	X	
Low vitamin and/or mineral	X			X		X
High salt or pickled food intake	X					X
Other Risk Factors						
Genetics	X	X	X	X	X	X
Age	X	X		X	X	X
Sedentary lifestyle	X	X	X	X	X	X
Smoking	X			X	X	X
Stress	X			X	X	X
Environmental contaminates	X					

IMPLICATIONS OF TYPE 2 DIABETES

also cause poor blood flow with poor circulation in the legs and feet. Elevated blood glucose levels can damage the structure of the blood vessels and nerves, which can lead to loss of circulation and nerve function. Infections are also likely to occur due to poor circulation along with glucose-rich blood and urine. Patients with diabetes need to pay special attention to hygiene and to watch for early signs of infection.

Nerve damage is a problem for many diabetics because nerve tissues can deteriorate. Patients at first experience symptoms of painful prickling sensation, often in the arms and legs. Later, the person loses sensation in the hands and

feet. Injuries to these areas may go unnoticed and infections can progress quickly. With loss of both circulation and nerve function, undetected injury and infection may lead to gangrene resulting in amputation of the limbs, usually the legs or feet. Diabetics are advised to take conscientious care of their feet and visit a podiatrist regularly.

Disorders of the small blood vessels, capillaries, may also develop and result in loss of kidney function known as diabetic kidney disease, also called diabetic neuropathy. Diabetes can cause kidney disease by damaging the parts of the kidneys that filter out wastes. When the kidneys fail, the

patient will have to have their blood filtered through a dialysis machine or get a kidney transplant. Controlling blood glucose and blood pressure can prevent or delay the onset of kidney disease.

Another disorder of the capillaries is diabetic eye disease, also called diabetic retinopathy, which can lead to blindness. Diabetic eye disease can develop even when sight is good, so regular eye exams are encouraged. Keeping blood glucose and blood pressure within normal limits can prevent or delay the onset of diabetic eye disease. Diabetes is a leading cause of both kidney failure and blindness.



ACUTE COMPLICATIONS OF TYPE 2 DIABETES

Acute complications of Type 2 diabetes are experienced frequently among patients. When insufficient insulin is not being produced blood glucose fails to enter into the cells, and glucose accumulates in the blood often leading to the following complications.

Hyperglycemia

Insufficient insulin can cause blood glucose to rise and hyperglycemia can result. Hyperglycemia is when there is too much glucose in the blood and this can occur when someone is sick, under a large amount of stress, and by certain medications, especially if their diabetes medicine dose is too small. High blood glucose creates an osmotic effect, and water is taken from tissues into the blood. At this point blood glucose concentration is so high it interferes with the kidneys' ability to reabsorb glucose. The excess glucose spills into the urine along with fluid and electrolytes, causing glycosuria. Glycosuria generally occurs when blood glucose exceeds 180 milligrams per 100 milliliters. As a result of hyperglycemia, both the intracellular and the extracellular fluid compartments become depleted, leading to severe dehydration. This explains why people with uncontrolled diabetes produce excessive urine, polyuria, and exhibit excessive thirst, polydipsia.

Many times people with Type 2 diabetes do not have any symptoms that their blood sugar is high. It is often difficult to know if blood sugar is too high just from the way a person feels. It is best to encourage regular blood sugar tests a few times a day

just to be sure. Patients should not let high blood sugar go untreated, even if they feel fine. If it is left untreated for too long, it can lead to other health problems.

Symptoms of Hyperglycemia:

Intense thirst and hunger.

Increased urination.

Weight loss.

Blurred vision.

Fatigue.

Acetone breath.

Glycosuria.

Labored breathing.

Nonketotic Coma

People with Type 2 diabetes can go into a coma caused by extremely high blood glucose. This problem is common in the elderly because they may not recognize thirst and drink enough water to compensate for high blood glucose levels. This type of coma is called hyperosmolar hyperglycemic nonketotic coma.

Weight Gain in Type 2 diabetes

Type 2 diabetes also deprives cells of the energy they need. When the cells are unable to attain adequate nourishment, a sense of hunger is stimulated. As a result, people with Type 2 diabetes often overeat. Then the insulin they do have slowly takes effect, and the body ends up storing fat from the excess energy consumed. This is why people with Type 2 diabetes are likely to remain overweight.

Hypoglycemia

Hypoglycemia is when blood sugar goes too low, below 70 mg/dl. It is a

consequence, not of untreated diabetes, but of inappropriate management. It can result from too much glucose-lowering drug, strenuous physical activity, skipped meals, delayed meals, inadequate food intake, vomiting, or severe diarrhea.

Severe hypoglycemia can lead to loss of consciousness, brain damage, and even death if left untreated. Repeated episodes of hypoglycemia might permanently impair cognitive function.

Symptoms of Hypoglycemia:

Hunger.

Headache.

Sweating.

Shakiness.

Nervousness.

Confusion.

Disorientation.

Slurred speech.

Many of the symptoms of hypoglycemia are the same as that of alcohol intoxication and make it difficult for the person to take corrective measures. Adults who have had diabetes for a long time risk severe hypoglycemia because the warning signs become less noticeable over time. And, those who tightly manage their blood glucose levels are more likely to develop hypoglycemia than others with diabetes. Symptoms can also occur while the person is sleeping making hypoglycemia difficult to detect. If hypoglycemia goes unrecognized, that person may pass out, or even die if a glucagon shot is not given immediately.



Syndrom e

Insulin resistance, and the resultant hyperinsulinemia, are often associated with a blood lipid profile that places a person at high risk for heart disease. Associated parameters include: glucose intolerance often leading to non-insulin dependent diabetes mellitus, high blood pressure, elevated plasma triglycerides, high levels of circulating low density lipoprotein (LDL), elevated uric acid levels and low levels of high density lipoprotein (HDL).

Insulin resistance and hyperinsulinemia have been linked to an increased risk of coronary heart disease, a leading cause of death in the U.S. Of great concern is the appearance of a small, dense form of LDL that seems to be converted from a larger more buoyant LDL in the presence of hepatic triglyceride lipase. These smaller, denser LDLs are believed to be highly atherogenic leading to plaque formation in the blood vessels. Additionally, new research from the Framingham Offspring Study indicates that high levels, of insulin in the blood associated with glucose intolerance, are also associated with other factors in the blood that make it difficult to break up blood clots and can increase risk of cardiovascular disease.^{①②}

This cluster of metabolic abnormalities has been termed Syndrome X or the Metabolic Syndrome. This syndrome is often associated with specific lifestyle characteristics such as being sedentary, smoking, obesity and visceral adiposity. Genetic factors are also involved and interact with lifestyle factors contributing to the presentation of metabolic abnormalities.

The mechanisms involved in Metabolic Syndrome or Syndrome X involve the

inability of the insulin receptors on the cell surface to bind insulin. This encourages greater pancreatic production of insulin in an effort to reduce elevated blood glucose levels. When the pancreas cannot produce sufficient amounts of insulin to compensate for the reduced insulin sensitivity, impaired glucose tolerance develops often leading to non-insulin dependent diabetes mellitus.

There are no outward symptoms of insulin resistance. The determining factor is an elevated insulin level and, in 25% of the cases, an impaired glucose tolerance. These can be measured by a simple glucose tolerance test. Characteristics of those at highest risk for developing Syndrome X include:

- **BMI over 25 with fat distribution centered above the waist**
- **Parent or sibling with diabetes mellitus**
- **Non Caucasian**
- **Had a baby weighing more than 9 pounds or had gestational diabetes**
- **Have an HDL cholesterol level of 35 mg/dl or less or a triglyceride level of 250 mg/dl or more**
- **Have hypertension (high blood pressure) or take antihypertensive drugs**
- **Have had a minimally elevated glucose level on a previous test**

Dietary considerations should address the greatest need, maintaining a BMI below 25. Losing weight seems to increase insulin sensitivity and decreases blood insulin and triglyceride levels. Many theories of just what the correct dietary composition should be are available. Dr. Gerald Reaven, a leading researcher in the field of Syndrome X, recommends a diet higher in fat (45% of calories mostly from monounsaturated and polyunsaturated fatty acids) and lower in carbohydrates (40% of calories) than that recommended by the US Dept of Health and Human Services, Healthy People 2000 Nutrition Objectives. Dr. Reaven believes that a moderate carbohydrate intake will

blunt the insulin resistant metabolic response to a high carbohydrate intake. Preferred carbohydrate choices are nutrient rich complex carbohydrate sources also high in fiber such as whole grains, fruits and vegetables.^③

There is almost universal agreement that increased physical activity can reduce insulin resistance and help maintain a lower body weight. A recent study of 5,159 men over a 16.8 year period found that physical activity was inversely related to coronary artery disease rates and the risk of Type 2 diabetes mellitus decreased progressively with increased physical activity. Physical activity was significantly related to improved HDL, triglyceride, insulin and urate levels.^④ It is thought that physical activity increases the ability of insulin to bring glucose into muscle cells and use it more efficiently for energy. Findings from the Insulin Resistance Atherosclerosis Study show that both vigorous and nonvigorous activities are associated with significantly improved insulin sensitivity. The benefits provided by increased physical activity include increased muscle mass and decreased visceral fat deposition which contribute to a reduction in insulin resistance.^⑤

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