

Special Needs for Special Problems:

Diabetes in Women, Children, the Elderly, and Minority Populations

The DRWG recognized the disproportionate burden, unique impact, and special needs diabetes confers on particular populations. The DRWG Strategic Plan addressed the special issues related to diabetes in women, children, the elderly, and minority groups. Many of the research accomplishments and initiatives detailed in prior sections of this report directly relate to our understanding of the prevention and treatment of diabetes in these special populations. Certain of these are mentioned briefly here.



Photos: National Diabetes Education Program.

Diabetes in Women

Diabetes affects 9.1 million women (8.9 percent of all women over age 20) and this number is expected to increase dramatically as the population ages and becomes increasingly sedentary and overweight. Several aspects of diabetes that are unique to women are discussed below.

▶ ASSESSING THE RELATIONSHIP OF BLOOD GLUCOSE LEVELS IN PREGNANCY TO ADVERSE OUTCOMES

It has long been known that women with diabetes who become pregnant and women who develop gestational diabetes during pregnancy are at increased risk for delivery of a child with congenital anomalies. However, it was widely believed that gestational diabetes was more benign in this regard than other forms of diabetes. In a recent study, researchers compared the incidence of congenital anomalies according to the mother's blood glucose level. They found that congenital anomalies in offspring of women with gestational and type 2 diabetes affect the same organ systems that have been previously described in pregnancies complicated by type 1 diabetes. High blood glucose levels were associated with an increasing risk of anomalies in general and with anomalies involving multiple organ systems, without a preferential increase in involvement of a specific organ system. To further delineate the level of glycemia at which adverse outcomes develop during pregnancy and to address a wide range of other clinical issues related to the mother and fetus during diabetic and gestational diabetic pregnancies, the NIH has established the "Cooperative Multicenter Maternal-Fetal Medicine Units Network." Also

investigating levels of glucose during pregnancy that place the mother, fetus, and neonate at increased risk of adverse outcomes is the "Hyperglycemia and Adverse Pregnancy Outcomes Study," a cooperative, international research endeavor involving 16 field centers and approximately 25,000 pregnant women.

▶ EXPOSURE TO DIABETES IN THE WOMB INCREASES THE OFFSPRING'S RISK OF DIABETES AND OBESITY

Babies born to mothers with diabetes have an increased risk of becoming diabetic and obese. However, it is not clear whether this is solely due to the genes inherited by the children, or whether the diabetic condition of the mother also plays a role. In a recent study, children born after their mothers had developed diabetes were found to be more likely to be diabetic and obese compared with children born before their mothers developed diabetes. Thus, the diabetic condition of the mother during pregnancy affects a child's risk of diabetes and obesity. Because type 2 diabetes is increasingly occurring in younger women, preventing or delaying diabetes in these women may improve not only the health of the mother but also the health of the offspring.

IDENTIFYING PREDICTORS OF DIABETES IN WOMEN WITH PRIOR GESTATIONAL DIABETES

Many, but not all, women with gestational diabetes develop type 2 diabetes later in life. In a recent study, investigators sought to identify characteristics before delivery that predict the development of diabetes after a pregnancy with gestational diabetes. The major predictors were post-glucose challenge hyperglycemia, poor pancreatic beta cell compensation for insulin resistance, and elevated endogenous glucose production during pregnancy. This knowledge may lead to strategies to target these factors to prevent later development of type 2 diabetes. Already, one study to prevent subsequent diabetes in women with a history of gestational diabetes has shown promising results. This trial targeted the insulin resistance that places these women at high risk for developing type 2 diabetes. In these women, treatment with an insulin-sensitizing medication resulted in a significant increase in insulin sensitivity and decreased risk of progression to type 2 diabetes. These results, together with findings from the medication arm of the Diabetes Prevention Program (DPP) clinical trial, indicate that medications that increase insulin sensitivity may be effective in preventing or delaying type 2 diabetes in women with a history of gestational diabetes who are at high risk for developing type 2 diabetes.

REDUCING THE RISK OF DIABETES IN WOMEN WITH LIFESTYLE CHANGE

In a large epidemiological study of risk factors for type 2 diabetes in women, researchers found that a healthy diet and lifestyle are associated with a markedly reduced risk of developing type 2

diabetes. Excess body fat was the single most important risk factor and lack of exercise, poor diet, and smoking were also associated with development of diabetes. Both moderate forms of exercise, such as walking, and vigorous forms of activity, such as aerobics, were associated with a substantial reduction in risk of type 2 diabetes in women. Another intriguing recent finding from a small clinical trial found that moderate alcohol consumption reduces insulin resistance in postmenopausal women. These findings from epidemiological studies, together with the results of the DPP (described previously) provide a practical approach to prevention of diabetes in women through achievable lifestyle change.

REDUCING THE RISK OF HEART DISEASE IN WOMEN WITH DIABETES

Cardiovascular disease is the leading cause of death among American women. Women with diabetes have an increased risk of heart disease, which is two- to six-times more common in diabetic than in non-diabetic women. Understanding the factors that contribute to excess heart disease in diabetic women is of critical importance, especially because data indicate that these women have not experienced the decline in heart disease mortality that has been described for the general population. In recent studies, researchers found that exercise can markedly reduce the risk of cardiovascular disease in women with diabetes. In a non-randomized epidemiological study, diabetic women who spent at least four hours per week performing moderate or vigorous exercise had an approximately 40 percent lower risk for cardiovascular disease than those who exercised less.

Diabetes in Children

Among children, type 1 diabetes is one of the most common and serious diseases of childhood. It requires chronic care, and conveys risk for severe complications. Once a disease of older Americans, type 2 diabetes in children has now emerged as a growing clinical problem.

Many new initiatives focused on children have been described more fully in other sections, including:

▶ TYPE 1 DIABETES TRIALNET

This multi-center clinical trial network will provide the research infrastructure needed to foster the design and execution of pilot studies, expanded clinical research, and more rapid clinical testing of novel approaches to prevent type 1 diabetes and to preserve beta cell function in patients with recent onset type 1 diabetes.

▶ ENVIRONMENTAL TRIGGERS OF TYPE 1 DIABETES

Based on recommendations from a conference to explore new methods to identify environmental triggers of diabetes, a new research consortium will seek to identify infectious agents, dietary factors, and other potential environmental contributors to the development of type 1 diabetes in newborns with high genetic susceptibility to the disease.

▶ DAISY AND PANDA

Two regional studies, the Diabetes Autoimmunity Study in the Young (DAISY) and the Prospective Assessment in Newborns for Diabetes Autoimmunity (PANDA), are attempting to define the interactions of genes and environmental factors that initiate or protect children from type 1 diabetes. Building upon what is known about the genetic predisposition to diabetes, newborns at high genetic risk are being followed prospectively to identify dietary factors, infectious agents or other environmental factors that may trigger autoimmunity. A new nationwide consortium will extend and coordinate these small regional efforts and increase their power to identify environmental factors that may trigger autoimmune destruction of the beta cells.

▶ TYPE 1 DIABETES GENETICS CONSORTIUM

The NIH-sponsored “International Type 1 Diabetes Genetics Consortium” is striving to identify type 1 diabetes susceptibility genes through the scanning of human genome sequences in families from the U.S., Europe, and Australia.

▶ GLUCOSE SENSORS IN CHILDREN WITH TYPE 1 DIABETES

This multi-center study will determine if using continuous glucose monitoring systems will permit improved control of blood glucose in children with type 1 diabetes while reducing the risk of hypoglycemia.



Photo: Weight-control Information Network.

▶ FACTORS CONTRIBUTING TO TYPE 2 DIABETES IN THE PEDIATRIC POPULATION

This initiative is investigating the causes and extent of the increase in type 2 diabetes in children, particularly in minority populations. It will focus on environmental factors responsible for the increase in type 2 diabetes in children and ways to modify them and will foster new approaches to prevent and treat type 2 diabetes in children who are at risk.

▶ PREVENTION AND TREATMENT OF TYPE 2 DIABETES IN CHILDREN AND ADOLESCENTS

This initiative will support two trials focused on minority populations. One clinical trial will test the ability of a school-based intervention to prevent pre-diabetes, which is prevalent in obese children; a second multi-center trial will compare different treatment strategies for type 2 diabetes in the pediatric population.

Diabetes in the Elderly

Diabetes has become a common disease in elderly people, with almost 20 percent of individuals age 65 years or older affected. Pre-diabetes affects almost 30 percent of this same age group.

These rates are even higher among African Americans, Hispanic Americans, and Native Americans. Data from the National Center for Health Statistics surveys, the Baltimore Longitudinal Study of Aging, the Cardiovascular Health Study, and investigator-initiated grants have indicated that diabetes is an important contributor to cardiovascular disease (heart disease, stroke and peripheral

vascular disease, including amputations) in the elderly. Diabetes in the elderly is similar in many ways to diabetes found in younger persons, but some aspects of its natural history remain to be clarified. This may enable more effective programs to prevent or at least postpone the glucose intolerance that often develops with aging.

BENEFITS OF WEIGHT LOSS AND INCREASED PHYSICAL ACTIVITY IN PREVENTING THE DEVELOPMENT OF TYPE 2 DIABETES IN THE ELDERLY

The first major primary prevention trial for type 2 diabetes in the U.S., the Diabetes Prevention Program (DPP), has yielded important results for the elderly. The DPP has shown that diet and exercise can effectively delay diabetes in a diverse American population of overweight people with impaired glucose tolerance, a condition in which blood glucose levels are higher than normal but not yet diabetic (now, more commonly termed “pre-diabetes”). For individuals on the diet and exercise regimen, the risk of developing type 2 diabetes was reduced by 58 percent. However, the greatest effect was seen in those age 60 years or older, who comprised 20 percent of the study population. In this older group the reduction was 71 percent. Because the risk of type 2 diabetes increases with age, the finding that modest dietary and physical activity changes can markedly prevent type 2 diabetes can have a major impact on this disease in the elderly.

UNDERSTANDING THE RELATIONSHIP BETWEEN METABOLIC REGULATION AND AGING

Insulin resistance is a metabolic disorder that can occur with advancing age and usually precedes the development of type 2 diabetes in older adults. Data from animal models suggest that caloric restriction can prevent and/or delay the onset of age-related disease processes, including insulin resistance, and significantly enhance life span. Based on recommendations from a conference that addressed the implications for people of these findings from animal studies, the NIH solicited applications for cooperative, exploratory clinical studies of the effects of caloric restriction interventions on physiology, body composition, and risk factors for age-related diseases, including diabetes, in non-obese persons. These cooperative projects will be known as CALERIE (Comprehensive Assessment of Long-Term Effects of Reducing Intake of Energy). They will focus on understanding how basic metabolism and insulin sensitivity change with age and with caloric restriction, and the interaction between caloric restriction and physical activity.

▶ **UNDERSTANDING THE MECHANISM(S)
UNDERLYING THE METABOLIC BENEFITS
OF EXERCISE WITH AGE**

Increasing overall levels of physical activity and participation in specific types of exercise (e.g., weight bearing exercises versus aerobic training) are often recommended for the prevention and treatment of common metabolic conditions such as obesity and insulin resistance/diabetes. The metabolic benefits from exercise may be mediated through body composition changes and/or occur independently of changes in body fatness or leanness. One possibility is that exercise may cause a shift in fuel (e.g., to burn more fat). To determine whether trained individuals rely more on fat than untrained persons during high intensity exercise, groups of endurance trained men and untrained men were studied during 30 minutes of exercise at 75 percent to 80 percent maximal oxygen consumption. During exercise, the whole body rate of breakdown of fat and utilization of free fatty acids was higher in the trained group. This higher rate of fat metabolism in trained individuals may play a substantial role in preserving a favorable body composition (e.g., low body fat) and in preventing the development of metabolic disorders with advancing age.

▶ **UNDERSTANDING WHY TYPE 2
DIABETES IS A COMMON DISEASE
OF THE ELDERLY**

Almost 20 percent of those aged 65 years or older are affected by diabetes and even more have pre-diabetes. Impairment in glucose tolerance increases with age and is associated with increased risk of cardiovascular disease even when there is not overt clinical diabetes. The age-related changes are most obvious in the response to a glucose challenge. The decline in glucose tolerance begins in the third decade and continues throughout the entire adult life span. The mechanisms behind these changes are not yet understood. It is not known whether they are caused by changes due to alteration in some set point sensing of glucose, insulin secretory deficits, or defective insulin action in the liver and/or muscle. Intriguing findings are emerging from epidemiologic research. For example, in the Massachusetts Male Aging Study, blood levels of testosterone were measured in men 40 to 70 years old who were then re-contacted over the ensuing seven to ten years to monitor their health. Lower levels of free testosterone were markedly associated with increased risk of subsequently developing diabetes, even after correcting for other factors, such as body weight. Despite the accrual of new information, many questions about the pathophysiology, prevention, and treatment of diabetes in the older population remain unresolved and are the focus of continued investigation.

Diabetes in Minority Populations

Minority populations — including African Americans, Hispanic Americans, Asian Americans and Native Americans — are at increased risk for diabetes and suffer disproportionately from its complications. Of particular concern is the new phenomenon of the occurrence of type 2 diabetes in children, especially in children from minority groups. Understanding the basis for this increased risk and developing approaches to reduce the burden of diabetes in minority communities rank among the highest priorities of the NIH.

▶ PREVENTING TYPE 2 DIABETES IN MINORITY POPULATIONS

Results from the Diabetes Prevention Program (DPP) clinical trial clearly demonstrated that individuals with pre-diabetes can dramatically reduce the risk of onset of diabetes and improve their blood glucose levels through modest changes in diet and exercise. Minorities comprised 45 percent of the DPP study population and the benefit from lifestyle change was seen in all the high risk racial and ethnic groups studied, including African Americans, Hispanic Americans, Asian/Pacific Islanders, and Native Americans. The challenge now is to put this research finding into practice so that all Americans, and particularly those at highest risk, can benefit. The NIH is expanding its translational research efforts and soliciting research projects aimed at developing and testing efficient and effective methods of implementing these changes in individuals and communities. A particular emphasis of the solicitation is developing culturally sensitive approaches to diabetes prevention in minority populations.

▶ INVESTIGATING GENETIC, ENVIRONMENTAL AND METABOLIC FACTORS LEADING TO THE DEVELOPMENT OF DIABETES AND ITS COMPLICATIONS IN MINORITY POPULATIONS

The interplay of genes and environment affects the risk of diabetes in all populations, but the specific factors involved and their relative contributions may differ among populations. Although it has been firmly established that excess body weight contributes to diabetes, new findings indicate that individuals of low birthweight are more insulin resistant as adults, relative to their body size, than individuals of normal birthweight. This information is of particular relevance to minority populations in whom the risk of low birthweight is increased, possibly compounding genetic risk factors. As described in the chapter on “Genetics of Diabetes,” progress in identifying genes for type 2 diabetes has come from studies in Mexican Americans and Native Americans. Increased research in minority populations is being solicited to identify the specific risk factors involved in particular populations so that targeted strategies can be developed to prevent diabetes. Ongoing studies of the Pima Indians, who have the highest

known risk of diabetes in the U.S., are yielding data relevant to other populations as well. However, more research is still needed to better understand differences among U.S. minority populations in risk factors for complications of diabetes, rates of these complications, and the extent to which metabolic, genetic, socioeconomic, and behavioral factors account for differences in complications from and incidence of diabetes. Additional data on diabetes and its complications in minorities are available from the Atherosclerosis Risk in Communities (ARIC) Study (African Americans), the Jackson Heart Study (African Americans), the San Antonio Heart Study (Mexican Americans), the Pima Indian Study and the Strong Heart Study (Native Americans), the Honolulu Heart Study (Japanese Americans) and the Seattle Japanese-American Community Diabetes Study.

▶ FOSTERING GLYCEMIC CONTROL IN MINORITY POPULATIONS

Poorly controlled blood glucose and duration of diabetes are major predictors of future complications. While glucose control, as reflected in hemoglobin A1c levels, is suboptimal for many people with diabetes regardless of racial and ethnic group, it is particularly problematic for minority populations. In a national survey of patients with type 2 diabetes, poor glycemic control (hemoglobin A1c greater than 8 percent) was more common in non-Hispanic black women (50 percent) and Mexican American men (45 percent) compared with the other groups (35 to 38 percent). Minority populations also had higher rates of extremely poor control (hemoglobin A1c greater than 9.5 percent): rates of 27 percent in

non-Hispanic blacks and 22 percent in Hispanic Americans compared to 16 percent in non-Hispanic Caucasians. Among a group of adolescents with type 1 diabetes, African American youths were at greatest risk for poor glycemic control, compared with Caucasian and Hispanic youths. Among the Pueblo Indian tribes of New Mexico, the youngest patients had the poorest blood glucose control and ate more high fat and high sugar foods that are likely to compound their problems. These studies underscore the need for improved approaches to maintain blood sugar control, and are the focus of ongoing studies in minority populations.



Photo: Indian Health Service.



Photos: Weight-Control Information Network (WIN).

▶ TRANSLATING DIABETES RESEARCH ADVANCES TO UNDERSERVED POPULATIONS

Comprehensive care of diabetes is key to preventing the devastating complications for which minorities are at particular risk. In addition to the proven benefits of glucose control, research has demonstrated the value of blood pressure and lipid control, regular eye exams, good foot care and oral hygiene, and use of particular medicines in patients with early signs of diabetic kidney disease. Yet, as is the case for glucose control, most Americans with diabetes, and particularly minorities, are not receiving the care that has proven beneficial in careful research studies. The NIH is expanding research and outreach for translation of these recent advances in the treatment of diabetes into clinical practice for individuals and communities at risk. Of particular interest are interventions that focus on translating new advances into medical practice in underserved and minority populations.

▶ USING THE INTERNET TO ENHANCE ACCESS TO DIABETES INFORMATION

NIH is working to increase the use and awareness of MEDLINEplus as a resource and learning tool for patients with type 1 and type 2 diabetes and their families. A special focus of this outreach effort targets minority and other underserved populations, including children and the elderly, and those without easy access to computers. Patients lacking a personal computer are encouraged to access internet health information using computers available at the doctor's office, public library, or other public facility.

▶ ENHANCING DIABETES-FOCUSED SCIENCE EDUCATION IN NATIVE AMERICAN TRIBAL MIDDLE AND HIGH SCHOOLS

A new initiative is supporting the development at Tribal Colleges and Universities of science education programs focused on diabetes for tribal community middle and high schools. This program will expose Native American students to the biomedical sciences through the prism of diabetes. It is intended both to inform them about lifestyle changes that can dramatically reduce the risk of diabetes in high risk families and to encourage them to prepare for biomedical careers.



Photo: Indian Health Service.

A Special Program for Special Populations

The National Diabetes Education Program (NDEP), a joint effort of the NIH and the CDC, is charged with translating the results of diabetes clinical research into broad clinical practice.

THE NATIONAL DIABETES EDUCATION PROGRAM

To enhance this effort in the diverse populations affected by diabetes, the NDEP has specific working groups focused on special populations, including African Americans, Hispanic Americans, Asian and Pacific Islanders, Native Americans, children, and the elderly. The program began after the Diabetes Control and Complications Trial (DCCT) demonstrated the importance of good glycemic control in preventing microvascular complications, and focused on getting this important prevention message to each of the minority and other populations at increased risk of diabetes and its complications. Each of the NDEP's working groups collaborates with a wide variety of organizations dedicated to minority health issues, children's health and/or the health of older Americans. For example, the NDEP is developing and disseminating the "Diabetes Management in the School" program to improve the care given to diabetic children in the school setting and to help schools meet Federal anti-discrimination requirements for people with disabilities. Through these collaborations and close ties to specific communities affected by diabetes, the NDEP fosters the development of culturally sensitive messages to meet the needs of minority individuals and other special populations. While continuing its first campaign to improve glucose control, the NIH is now dissemin-

ating the findings of the DPP as rapidly as possible to the public and to health practitioners through the NDEP. As with all NDEP programs, messages will be targeted to each of the major racial and ethnic groups with increased rates of diabetes in the U.S.

The NDEP is also targeting its efforts at enhancing comprehensive care of diabetes. The NDEP has launched a campaign to promote the control of risk factors for heart disease in people with diabetes: "Be Smart About Your Heart." The campaign's call to action is "Control the ABCs of Diabetes," with A standing for the hemoglobin A1c test that assays blood sugar level over time, B for blood pressure, and C for cholesterol. This effort is complemented by related education programs targeted at high blood pressure, cholesterol, eye disorders, and kidney disease. Each of these programs has substantial efforts focused on prevention of complications of diabetes. As the NIH continues to conduct and learn from clinical trials and to better understand the cultural, familial, and other factors that influence health-related behaviors, the NDEP and the related education programs that address diabetes will be the vehicles to translate this new knowledge into improved outcomes for each of the special populations affected by diabetes.

PATIENT PROFILE: Cliff Mitchell

MANAGING TYPE 2 DIABETES

Cliff Mitchell was diagnosed with type 2 diabetes at age 60. “What was strange,” says Cliff, now 64, “is that a few months prior to my diagnosis I’d had a complete physical and my doctor gave me a clean bill of health.” However, because Cliff’s mother had diabetes and Cliff was overweight, his doctor cautioned him about the disease. One night, while driving, Cliff’s vision started to blur. “I was having trouble seeing the highway signs,” says Cliff, who is the coordinator of Faith and Community Partnership Initiatives for the Center for Substance Abuse Treatment, a federal government agency located in Rockville, MD. He was also experiencing frequent urination, which he attributed to drinking lots of water. The next night, while watching a football game on TV, Cliff realized he couldn’t read the words scrolling across the bottom of the screen. He began to get worried, so the following day he went to an eye doctor who sold him a pair of glasses — which, it turns out, Cliff didn’t need. But the optometrist, suspecting diabetes as a cause for Cliff’s blurred vision, also advised him to follow up with another visit to his physician. A blood test confirmed that Cliff’s blood sugar, or glucose level, was high and that he had type 2 diabetes. Two years ago, Cliff’s oldest daughter, age 38, was also diagnosed with the disease.

Conservative estimates find that diabetes costs the nation \$98 billion annually in direct and indirect costs, including disability, work loss, and premature death.



Cliff Mitchell was diagnosed with type 2 diabetes at the age of 60. Testing for diabetes is recommended in high-risk individuals because early on, there are no symptoms of the disease. Cliff did not discover his diabetes until his vision began to blur.

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Type 2 diabetes is the most common form of the disease, accounting for 90 to 95 percent of diagnosed diabetes cases. Unlike patients with type 1 diabetes, in which the body’s immune system destroys the insulin-producing beta cells required to build and store energy, patients newly diagnosed with type 2 diabetes usually do not require daily injections of insulin to control their glucose levels in order to survive. In fact, many people with type 2 diabetes are able to control the disease for years through diet and exercise, often in combination with oral medications to lower blood glucose levels. However, even with good care, patients with type 2 diabetes can ultimately become insulin-dependent, as their beta cells gradually stop secreting insulin properly. Moreover,

patients with type 2 diabetes face the prospect of developing one or more serious complications as a result of the disease.

As a result of research conducted by the NIH, scientists are beginning to gain an increased understanding of the genetic underpinnings of this complex disease. This progress is expected to lead eventually to new therapies, more effective prevention efforts, and, ultimately, a cure for type 2 diabetes.

In addition, public awareness and education programs are aimed at reducing the death and disability associated with diabetes and its complications. For example, individuals who are obese or are of African American, Hispanic American or Native American heritage are particularly at risk for this disease. The NIH and other organizations are working to alert at risk populations about current recommendations for getting tested for diabetes and pre-diabetes, ways to reduce risk for development of diabetes or its complications, and what they can do to help control their weight and to manage this disease.

Although type 2 diabetes affects all segments of the population, it is particularly prevalent in African Americans, Mexican Americans, other Latin Americans, Native Americans and Alaska Natives, as well as Asian Americans and Pacific Islanders. The NIH has made significant efforts to increase recruitment of minority populations into clinical trials of type 2 diabetes prevention and treatment — including the recent Diabetes Prevention Program trial, in which 45 percent of participants were from minority groups (see “Clinical Research and Clinical Trials of Critical Importance”).

Living with the Disease

Because type 2 diabetes most often can be controlled by diet and exercise, it is sometimes referred to as a “manageable disease.” However, managing type 2 diabetes is a daily struggle for many, including Cliff. “When I was first diagnosed, I started exercising by walking and swimming three or four times a week, cut back on eating sweets, and stopped drinking alcohol, which for me amounted to about one or two drinks a week.” He also tested his glucose levels two or three times a day by pricking his finger and using a sugar testing machine, called a meter. But as time passed, Cliff became less diligent. “Now I’m having trouble controlling my weight because I’m not exercising as much as I should,” says Cliff, who currently weighs 280 pounds and stands six-feet three-inches tall. The fact that Cliff’s wife is a gourmet cook doesn’t make controlling his weight any easier, and he’s not testing his glucose levels as regularly as he did when he was diagnosed. “I’m testing only when I feel bad,” he says, meaning when his eyesight begins to get fuzzy, or when he starts feeling unusually tired or starts urinating frequently. To help control his glucose levels, Cliff takes diabetes medication.

But Cliff must remain cautious. The fact that he is African American puts him at increased risk for devastating complications of diabetes that can be fatal. For example, type 2 diabetes can lead to:

- ◆ *Cardiovascular disease*, with a two- to four-fold increased risk of heart attack and an increased risk of stroke.
- ◆ *Kidney disease*, including kidney failure, also referred to as end-stage renal disease (ESRD).

PATIENT PROFILE: Cliff Mitchell

- ◆ *Diabetic eye disease*, causing impaired vision and ultimately leading to blindness.
- ◆ *Diabetic nerve disorders*, including pain or loss of sensation in the feet and hands, which can lead to amputations, and also including impotence and digestive problems.

Yet, clinical trials have shown that with proper attention to blood glucose, blood pressure, and lipid control, the risk for developing these complications can be dramatically reduced.

Although impressive progress has been made, much more research is still needed to help people with type 2 diabetes. In the meantime, Cliff and his daughter will need to manage their blood sugar levels vigilantly to avoid or minimize the complications of the disease.

To help others with the disease, Cliff is a member of the National Diabetes Education Program (NDEP) African American Task Force. He assists in the development of culturally relevant media campaigns, which include public service announcements, posters, and other literature targeting the African American community.

One of the greatest challenges in treating a chronic disease is maintaining “chronic vigilance.” Chronic vigilance is particularly difficult in diabetes management in the U.S. because it requires patients to struggle constantly against prevalent cultural and behavioral messages surrounding food and leisure—a battle they sometimes lose. Unfortunately, the long-term complications of diabetes can be tremendously devastating to personal health and well-being. Thus, it is especially important to ensure that patients have access to all of the information and aid available to help them remain vigilant and manage their disease. To this end, the NIH supports a number of educational, outreach, and translational efforts in diabetes. Through campaigns such as the “Be Smart About Your Heart: Control the ABCs of Diabetes,” run by the NDEP, patients are both reminded that they have a serious disease with serious complications and given information and tools that empower them to manage it successfully.

PATIENT PROFILE: Krystle Kelly

LIVING WITH TYPE 2 DIABETES AS A TEEN

Going through adolescence is tough enough. Being a 17 year-old girl with type 2 diabetes makes the going that much tougher. Just ask Krystle Kelly. Diagnosed with the disease at age 13, Krystle says that her classmates tease her about what she eats and are aghast when she has to prick her finger to check her blood sugar, or glucose, levels. As for those fast food franchises where teens like to hang out, these establishments present a real risk for someone with Krystle's disease. In addition, her diabetes increases her appetite, which makes it doubly difficult for her to control her weight. "The kids in school call me the peanut butter girl because I eat a lot of peanut butter, and go 'Ooh, that's sick,' when they see me eat cottage cheese for lunch or prick my finger to check my blood. I try to tell them what diabetes is," says Krystle, "but they don't understand."

At age 17, it may be of little consolation to Krystle, but the fact is she's not alone in her adolescent fight against type 2 diabetes. Once a disease diagnosed in adults, type 2 diabetes is rising dramatically among children, especially minority adolescents, including African Americans, Hispanic Americans, and Native Americans. Currently, there are no national population-based data. However, studies conducted in several cities across the U.S. indicate that the percentage of children with newly diagnosed diabetes who are classified as having type 2 diabetes has risen from



Krystle Kelly finds that having type 2 diabetes is an additional challenge to her daily life as an adolescent. The disease increases appetite, and her favorite foods are starchy ones that could make her blood sugar rise to above-normal levels. Says Krystle, "I just hope they find a way to get rid of this disease."

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less than five percent before 1994 to 30 to 50 percent in subsequent years. Why this dramatic surge? Type 2 diabetes in children, as in adults, is closely linked to a sedentary lifestyle, a family history of the disease, and obesity—and the prevalence of obesity in adolescents has nearly tripled in the past 20 years. According to a report by the U.S. Surgeon General, 13 percent of children six to 11 years old, and 14 percent of adolescents 12 to 19 years old were overweight in 1999 in the U.S.

PATIENT PROFILE: Krystle Kelly

Overweight children are at increased risk of developing type 2 diabetes during childhood and later in life. Genetic susceptibility, lack of physical activity and unhealthy eating patterns all play important roles in determining a child's weight. They also contribute to a child's risk for type 2 diabetes and other complications of being overweight.

Living with Type 2 Diabetes as a Teenager

Krystle was never obese as a child, but she was overweight by 10 or 15 pounds—enough to be considered a risk factor for diabetes. She also had another risk factor that could not be ignored; her father has type 2 diabetes. He was diagnosed in his early 30s. So at around age 13, when Krystle began feeling tired and lethargic, never wanting to do anything, her family had her tested for the disease. Her first blood test turned out negative. However, the second time she was tested, the test proved positive for type 2 diabetes. “I was upset and angry when I found out I had diabetes,” says Krystle. As a result of her father’s having the disease, she knew what it was like to live with type 2 diabetes “and I just didn’t want to go through that.” Despite her anger and disappointment, Krystle has made a noble effort to control her weight and blood sugar levels through exercise, diet and medications in order to stay healthy. But it has not been easy.

“Having this disease is extra hard when you’re a teenager,” says Krystle’s mom, Sharan Kelly. “It’s more difficult for kids like Krystle to be accepted by their peers,” she says. “The dietary choices teens are constantly confronted with are certainly not good choices for teens with type 2 diabetes, and the fact that kids with diabetes want to avoid being embarrassed by their classmates whenever they need to prick their fingers means they’re not taking as good care of themselves as they should.” It also has a lot to do with the day and age we live in, adds Mrs. Kelly. “I must confess that when you’re a family with two working parents, some nights it’s hard to put a balanced meal on the table.”

Being the parent of a teen with type 2 diabetes also presents a constant concern. “I’m always worried about the potential long-range complications of this disease as Krystle gets older,” says Mrs. Kelly. “I feel like I’m always hounding her, but that’s because I understand the complications better than she does.” And Mrs. Kelly has every reason to be concerned. Complications of diabetes can result in heart disease, stroke, high blood pressure, blindness, kidney disease, nervous system disease, amputations, and dental disease, as well as other health difficulties. To date, there is no cure for diabetes.

Because there is no known cure for type 2 diabetes, researchers agree that the best one can do is to bring his or her blood sugar levels into a healthier target range through diet, weight loss, physical activity, stress reduction, and diabetes medication. Therapies that reduce blood pressure and cholesterol are also critical for decreasing the risk of developing complications.

Treating the Disease

So far, Krystle manifests no complications as a result of her diabetes. One factor may be that she tries to exercise at least three or four times a week. “I’m a member of the YMCA, I walk, and ride my bike or roller blade as often as I can,” says Krystle. Exercise has been shown to improve insulin sensitivity in people with type 2 diabetes.

If exercise is a good thing for Krystle, the worst thing about having diabetes for her is “the eating part.” Her favorite foods are bread, pasta and desserts. At 5-feet 3-inches tall and 146 pounds, Krystle is 10 to 15 pounds overweight, and has remained in that range for several years. Although she stays in fairly good control of her diet, “We’re constantly counting carbohydrates,” says Mrs. Kelly. “Some days she eats the wrong foods and her blood sugar rises. Other days she’ll eat the right foods, but too much of them.” Portion control is a problem for most people with diabetes. The disease increases appetite, which makes the person feel hungry. This can often lead to bad eating habits.

Fortunately, the advent of new medications is helping people with type 2 diabetes control their blood sugar levels. Krystle, for example, takes two types of insulin. She takes low doses of a quick-acting insulin when she’s going to have a meal or for corrections in between meals to help bring her sugar level down. She takes a longer-acting insulin to help regulate her blood glucose levels throughout the day and night. She also takes metformin, an oral diabetes medication, at breakfast and dinner. Today, almost one-third of the people with type 2 diabetes take some form of insulin to control their sugar levels.

But much more still needs to be done. The NIH is funding clinical trials to prevent and treat type 2 diabetes in children. These studies will try to develop ways to stem the rising tide of type 2 diabetes in children and to treat the disease safely and effectively in those who do develop it. The prevention trials will focus on developing cost-effective interventions that can be widely applied in schools and communities across the country.

“For children like Krystle, who already have type 2 diabetes, it’s critical to give the safest, most effective therapy as early as possible,” says the chair of one of the NIH studies, Francine Kaufman, MD. “Yet we can’t assume that the therapies used in adults have the same safety and efficacy profiles for children,” adds Dr. Kaufman, who also is president of the American Diabetes Association and director of the Comprehensive Diabetes Center at the Childrens’ Hospital of Los Angeles.

The overriding concern is that the longer a person has diabetes — meaning, the earlier the onset — the greater the chances of developing the disabling, life-threatening complications that go along with diabetes. “We are seeing young people in their late teens who are already developing the complications of type 2 diabetes,” says Dr. Kaufman. As far as 17-year-old Krystle is concerned, “I just hope they find a way to get rid of this disease.”