**Diabetes mellitus**

*from* *Hawley's Condensed Chemical Dictionary*

A complex endocrine-metabolic disease resulting from insulin deficiency; characterized by a failure in glucose transport from the blood into cells at normal glucose concentrations, resulting in hyperglycemia.

**Summary Article: Diabetes**

*From Encyclopedia of Health Services Research*

Diabetes mellitus, often referred to simply as diabetes, is not a single disease but a group of metabolic disorders characterized by hyperglycemia (elevated blood glucose) resulting from defects in insulin secretion, insulin action, or both. It is a major public health problem in the United States, affecting 24.1 million individuals, of whom an estimated 6.6 million are undiagnosed. From 2002 to 2007, the number of individuals in the nation diagnosed with diabetes increased from 12.1 to 17.5 million. In addition, an estimated 54 million individuals have abnormalities in glucose tolerance, which places them at high risk for developing diabetes. Approximately one third of the individuals born in the nation during 2000 are likely to develop diabetes during their lifetime. The social, economic, and personal costs of diabetes are enormous. This entry describes the classifications, complications, and risk factors of diabetes. In addition, prevention and complications are discussed, along with the social, economic, and personal costs associated with diabetes. Last, this entry addresses quality-of-life issues and policy implications.

**Classification**

There are four clinical classifications of diabetes: (1) Type 1 diabetes, (2) Type 2 diabetes, (3) “other specific types,” and (4) gestational diabetes mellitus (GDM). In addition, there are two categories of abnormal glucose tolerance: (1) impaired glucose tolerance (IGT) and (2) impaired fasting glucose (IFG). Type 1 and Type 2 diabetes are the most common forms of diabetes, representing approximately 10% and 90% of the diabetes population, respectively. Gestational diabetes mellitus, a form of diabetes diagnosed during pregnancy, affects 4% of all pregnancies. “Other specific types” of diabetes may result from a variety of factors, including genetic conditions, surgery, drugs, malnutrition, and infections. IFG is characterized by elevated (though nondiabetic) fasting blood glucose levels, while IGT is characterized by elevated postmeal blood glucose levels. Individuals with IGT and IFG have a substantially increased risk of developing Type 2 diabetes.

**Diabetes Complications**

A variety of acute and chronic complications are associated with diabetes. The acute complications are medical emergencies and include diabetic ketoacidosis (DKA), hyperosmolar hyperglycemic syndrome (HHS), and hypoglycemia. The chronic complications include disorders associated with microvascular (small vessel) changes in the eyes, nerves, and kidneys, along with macrovascular (large vessel) changes in the heart, veins, and arteries. These changes result in retinopathy (eye disease, e.g., blindness); neuropathy (nerve disease, e.g., nerve damage affecting sensation and pain pathways in the hands and feet, nerve damage affecting the ability to digest food); nephropathy (kidney disease, e.g., end-stage renal disease requiring dialysis or renal transplantation); and premature and accelerated development of coronary heart disease (CHD), cerebrovascular disease, and peripheral vascular disease (PVD).
Particular, heart disease and stroke account for 65% of deaths in people with diabetes. Diabetes-related complications are associated with excessive morbidity and mortality from heart disease, blindness, kidney failure, extremity amputations, and other chronic conditions.

**Risk Factors**

The development of Type 1 diabetes is associated primarily with an autoimmune destruction of the insulin-producing cells of the pancreas and is characterized by a nearly complete loss of insulin secretion. In contrast, Type 2 diabetes is characterized by insulin resistance and decreased insulin secretion. The development of both Type 1 and Type 2 diabetes is initiated by the interplay between genetics and the environment. Type 1 diabetes results when an environmental insult, in an individual genetically predisposed to the disorder, initiates autoimmune destruction of the insulin-producing cells. The environmental factor initiating this destruction is not known and is an area of intense investigation.

Risk factors for Type 2 diabetes include genetics, age, ethnicity/race, dyslipidemia (excess levels of blood lipids or fats), obesity, hypertension (high blood pressure), prior gestational diabetes, polycystic ovary syndrome, and physical inactivity. Type 2 diabetes, a disease traditionally associated with middle-aged and older adults, has been increasing among children and adolescents. A variety of clinic-based reports and small-population studies indicate that this increased prevalence of Type 2 diabetes is highest among the youth of Native Americans, Blacks, and Hispanics. Currently, there are no large epidemiological studies of Type 2 diabetes among the youth; however, estimates from some urban clinic-based studies range from 30% to 50%.

The increased prevalence of Type 2 diabetes among minority youth is consistent with evidence that diabetes disproportionately affects the ethnic/racial minority populations of the United States. Among adults aged 20 years or older, the national prevalence of Type 2 diabetes is estimated to be 8.7% for Whites, 13.3% for Blacks, 9.5% for Hispanics, and 12.5% for American Indians/Alaskan Natives. In addition, ethnic/racial populations have higher rates of diabetes-related complications. For example, there are higher rates of retinopathy and diabetes-related renal disease in Blacks and Hispanics than in Whites. In particular, diabetes-related renal disease is 2.6 times higher among Blacks than among Whites. Diabetes-related complications among ethnic/racial minority populations are also associated with greater morbidity and mortality. During the years 1979 to 2004, diabetes death rates for Black youths were approximately twice those for White youths. In 2004, the annual average diabetes death rate was estimated at 2.46 per million for Black youths and 0.91 per million for White youths. The burden of the evolving epidemic of Type 2 diabetes, particularly among minority youths, has yet to be realized. As youths with early-onset Type 2 diabetes approach middle age, the excessive mortality and morbidity associated with diabetes-related complications will contribute to the increasing social, economic, and personal burden imposed by diabetes. The reason why minority groups bear a disproportionate burden of diabetes is multifactorial; however, poor access to healthcare among these groups appears to be a major contributor.

**Primary Prevention of Type 2 Diabetes**

Weight gain and physical inactivity are the primary factors contributing to the epidemic of Type 2 diabetes. Lifestyle modification, involving change in diet, weight loss, and increase in physical activity, can slow the progression to overt diabetes. The Diabetes Prevention Program (DPP), a large research study sponsored by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), compared the effects of dietary and exercise counseling (control group), intensive dietary and exercise...
interventions (lifestyle group), and medications (particularly metformin, a popular antidiabetic drug) in preventing diabetes in men and women with IGT. After an average follow-up of 2.8 years, a 58% relative reduction in the progression to diabetes was noted in the lifestyle group, and a 31% relative reduction in the progression of diabetes was noted in the metformin group compared with the control group.

**Prevention of Diabetes Complications**

As the prevalence of diabetes increases, the complications of the disease also will increase, unless aggressive treatment strategies are implemented. The results of two research studies—the Diabetes Control and Complications Trial (DCCT) and the United Kingdom Prospective Diabetes Study (UKPDS)—clearly indicate that diabetes-related microvascular complications (retinopathy, neuropathy, and nephropathy) could be prevented or reduced by maintaining normal blood glucose levels. In addition, there is evidence that diabetes-related macrovascular complications (CHD, cerebrovascular disease, and PVD) can be reduced by factors such as blood pressure control, lipid control, smoking cessation, and aspirin use. Patients with diabetes can use intricate pharmacological regimens (along with diet and exercise) to normalize blood glucose levels. Newer insulin preparations, insulin delivery systems, oral medications, and blood-glucose-monitoring systems have been developed to assist patients in maintaining normal blood glucose levels.

There are specific goals for glucose level, blood pressure, and blood lipid concentration. Chronic glucose control is measured periodically by hemoglobin A1C level, which correlates to average blood glucose levels over the previous 3 months. Daily self-management of diabetes requires constant vigilance and adjustment of diet, medications, and physical activity to normalize A1C levels. The best benefits can be achieved when there is a strong problem-solving relationship between the patient and the healthcare provider. This allows the patient to make adjustments to the plan of care (e.g., diet, exercise, oral medications, and/or insulin) in a supportive atmosphere.

**Social, Economic, and Personal Costs**

Diabetes and its related complications are associated with significant personal, social, and economic costs. National medical expenditures attributed to diabetes in 2007 were estimated at $174 billion, including $116 billion in medical costs and $58 billion in indirect costs. Direct medical costs include expenditures related to hospital inpatient care, diabetes medications and supplies, retail prescriptions for diabetes complications, and physician office visits. Indirect medical costs include the costs resulting from increased absenteeism from work, reduced productivity at work and home, unemployment, disability, and loss of productivity due to premature death. Expenditures for diabetes were attributed to institutional care ($65.3 billion), outpatient medications and supplies ($27.7 billion), and outpatient care ($22.7 billion). In particular, the costs were greatest for inpatient hospital stays ($58.3 billion), physician's office visits ($9.8 billion), diabetes medications and supplies ($14.1 billion), and retail prescriptions ($12.7 billion).

Individuals with diabetes have medical expenditures that are approximately 2.3 times higher than what expenditures would be in the absence of the disease. Indirect costs related to diabetes include the following: absence from work ($2.6 billion), reduced performance at work ($20.0 billion, or a loss of 120 million days), reduced productivity for those not in the workforce ($0.8 billion), permanent disability ($7.9 billion), and mortality ($26.9 billion).

**Quality of Life**
Diabetes profoundly influences the lives of those affected and their families. Patients with Type 1 diabetes are treated with insulin, diet, and exercise, whereas patients with Type 2 diabetes are treated with diet and exercise and sometimes with insulin and/or oral medications. Patients may use insulin pumps or multiple insulin injections per day. Such a regimen necessitates frequent blood glucose testing with portable glucose monitors. The ability to minimize complications largely depends on the ability and willingness of patients to integrate the treatment regimens into their lifestyle. The ability of patients to integrate treatment regimens is influenced by many factors, including access to a healthcare provider, ability to pay, insurance coverage, perceptions of complication risk, and perception of treatment burden. Endstage complications, such as blindness, have the greatest perceived burden on the quality of life; however, comprehensive treatment regimens also have a high perceived burden on the quality of life. In a recent report, a small group of patients stated that they were willing to give up 8 to 10 years of life in perfect health to avoid life with treatment. The importance of understanding the factors that influence adherence to treatment regimens cannot be overestimated.

Policy Implications
The United States is in the midst of an epidemic of diabetes, which has increased exponentially over the past two decades. Diabetes is associated with a number of acute and chronic medical complications that lead to significant morbidity and mortality. Minority ethnic/racial populations in the nation disproportionately carry the burden of diabetes complications. Lifestyle modification programs, especially those incorporating intensive weight loss and physical-activity interventions, can result in the primary prevention of Type 2 diabetes. In patients with diagnosed diabetes, treatments aimed at normalizing blood glucose levels and controlling risk factors such as hypertension and dyslipidemia can delay the progression and development of diabetes-related complications. Health policy initiatives need to incorporate both primary prevention of diabetes and prevention of secondary complications from the disease. The challenge to healthcare policymakers is to balance the personal and societal benefits of preventing and treating diabetes with their monetary costs.

See also
Access to Healthcare, Chronic Care Model, Disease, Disease Management, Ethnic and Racial Barriers to Healthcare, Morbidity, Preventive Care, Public Health

Web Sites
American Association of Diabetes Educators: http://www.diabeteseducator.org
American Diabetes Association: http://www.diabetes.org
Centers for Disease Control and Prevention (CDC): http://www.cdc.gov/diabetes
Juvenile Diabetes Research Foundation (JDRF): http://www.jdrf.org

Further Readings

https://search.credoreference.com/content/topic/diabetes_mellitus_type_1
APA

Chicago

Harvard

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