

# The Burden of Diabetes in North Carolina:

Prevalence, Complications and Costs

2008

North Carolina Department of Health and Human Services  
Division of Public Health



Diabetes Prevention and Control Branch  
Chronic Disease and Injury Section

The rising clamor is warning North Carolinians of the rapidly expanding threat of “diabesity”®. Epidemic rates of obesity and diabetes in our adults and in our most precious resource - our children - are increasing as the 21<sup>st</sup> century seduces us into using more technology, being less active, and consuming more calories than we need while at the same time self-creating environments that provide less nutritious options. But the state has not been passively watching the diabesity epidemic approach or been willing to allow it to overwhelm us. With assistance from the federal Centers for Disease Control and Prevention, the N.C. Department of Human Services, public and private health stakeholders, communities, and concerned citizens across the state, we are arming ourselves to combat the encroaching burden of diabetes.

This publication summarizes the current burden of diabetes in North Carolina and provides a glimpse into the strategic planning and preliminary results of some of the campaigns under way to help ensure us a brighter future. With the battle intensifying, it is premature to celebrate more than our early successes in these various, yet presently limited, fronts. The menace of diabetes is certainly growing, encroaching on our homes, schools, workplaces and communities. But there is hope. And more than hope, there are plans. The public and private health sectors have been implementing these plans in increasingly bold campaigns. Now, we all need to do our parts with self-responsibility, and assisting others to lift the load, remove obstacles, make a difference, and not only stop the epidemic, but reduce the burden.

Onward!

Joseph C. Konen, MD, MSPH  
Chair, North Carolina Diabetes Advisory Council

# The Burden of Diabetes in North Carolina: Prevalence, Complications and Costs

April 2008

For electronic copies and periodic updates,  
Please visit [www.ncdiabetes.org](http://www.ncdiabetes.org)



State of North Carolina Michael F. Easley, Governor  
Department of Health and Human Services  
Dempsey Benton, Secretary  
Division of Public Health; Leah Devlin, State Health Director  
Chronic Disease and Injury Section  
Diabetes Prevention & Control Branch

[www.ncdhhs.gov](http://www.ncdhhs.gov)

[www.ncdiabetes.org](http://www.ncdiabetes.org)

The Department of Health and Human Services does not discriminate on the basis of race, color, national origin, sex, religion, age or disability in employment or the provision of services.

1,000 copies of this public document were printed at a cost of \$3,087.00 or \$3.09 per copy. 04/08

## Testimonials

It is imperative that we continue documenting the burden of diabetes by race and ethnicity so communities can see the disparities, understand the devastating impact of the disease, and be empowered for ACTION!

Barbara Pullen-Smith, MPH  
Director, N.C. Office of Minority Health and Health Disparities

---

Our state is facing a crisis...we need to help North Carolinians take steps to prevent diabetes or we risk being overwhelmed by the health and economic consequences of an ever-growing diabetes epidemic. If we take practical steps to identify those at risk and implement prevention strategies, the consequential negative impact of diabetes could be significantly reduced.

Marcus Plescia, MPH, M.D.  
Section Chief, N.C. Chronic Disease & Injury Section

---

If you truly want to see the devastating impact that diabetes is 'allowed' to have on an entire generation, you only need to look at the health status of the community around you. As a local health director and a person living with diabetes, I must have the most accurate data available to help my community develop effective strategies to combat this chronic disease. The Burden Book is that source.

Phillip E. Tarte, MPH  
Health Director, Union County Health Department

## Table of Contents

Acknowledgments .....	vii
Introduction.....	viii
Executive Summary.....	ix-xi
Diabetes and Pre-diabetes.....	1
Prevalence and Estimated Numbers of Persons with Diabetes.....	4-8
Prevalence of diabetes and obesity in N.C. and the U.S. from 1995-2006 .....	4-6
Increases in diabetes prevalence by gender, income, race, and age .....	6-8
Estimates of Pre-diabetes and Undiagnosed Diabetes .....	9-11
Estimates of pre-diabetes and undiagnosed diabetes in N.C.....	9-10
Prevalence of screening for diabetes in N.C.....	10-11
Prevention of Diabetes and Other Chronic Diseases.....	12-14
Compliance with Clinical Recommendations .....	15-17
Cardiovascular Conditions, Risk Factors, and Unhealthy Behaviors.....	18-19
Diabetes-related Hospitalizations .....	20-26
Diabetes as main cause of hospitalizations,1990-2006 .....	20-21
Diabetes co-morbidity and hospitalizations, 2000-2006.....	21-23
The cost of diabetes in North Carolina .....	24-26
Diabetes Mortality .....	27-30
Racial Disparities and Quality of Health Care.....	31-32
Summary of Diabetes in Adults in North Carolina.....	33
Diabetes in Children.....	34-36
Prevalence and estimated numbers of children affected by diabetes in N.C. ....	35
Diabetes prevalence in the N.C. public school system from 1997 to 2006.....	35
N.C. Diabetes Prevention & Control Programs and Partnerships .....	37-39
References.....	41-44
Appendices .....	45-46

### Index for Tables, Figures, and Diagrams

Table 1 Glycemic disorders, etiology types and stages.....	2
Table 2 Criteria for the diagnosis of normoglycemic, pre-diabetes and diabetes.....	2
Table 3 Increase in diabetes prevalence from 1995 to 2006 by demographics .....	6
Table 4 Prevalence of N.C. adults with diabetes by age over 18 in 2006.....	8
Table 5 Estimated percentage of adults with pre-diabetes and undiagnosed diabetes in N.C. , 1999-2000 rates using NHANES prevalence national results.....	9
Table 6 Prevalence of North Carolinians without diabetes reporting never having had a diabetes screening test.....	11
Table 7 Proportion of adults with diabetes receiving selected clinical care services .....	16
Table 8 Adults with diabetes and self-practice of preventive measures in N.C.....	17
Table 9 Adults with and without diabetes and selected cardiovascular conditions and risk factors in N.C.....	18

Table 10 Hospitalizations with diabetes mellitus as principal diagnosis in N.C., 2000-2006 .....	21
Table 10A Access to some form of health care insurance, 2000-2006.....	22
Table 10B Renal dialysis of transplant of patients with diabetes, 2000-2006.....	22
Table 10C CVD/Heart attack-related hospitalizations in patients with diabetes, 2000-2006.....	23
Table 10D CVA/Stroke-related hospitalizations in patients with diabetes, 2000-2006 .....	24
Table 10E Amputation-related hospitalizations in patients with diabetes, 2000-2006.....	24
Table 10F Diabetes –related blindness hospitalizations, 2000-2006.....	25
Table 11 The top ten causes of death for all ages in N.C. by rank 2000-2006.....	28
Table 12 Mortality rate for diabetes as the main cause of death, by age, in 2006 .....	28
Table 12A Diabetes mortality by sex and race, N.C., 2002-2006 .....	29
Table 13 Health disparities related to diabetes and its risk factors by race in N.C., 2006.....	31
Table 14 Health disparities related to diabetes and its risk factors by ethnicity in N.C., 2006.....	31
Table 15 Positive clinical practice recommendations and self-reported conditions in high-diabetes-prevalence populations, N.C., 2006.....	32
Table 16 Overview of N.C. total population trends related to diabetes, 2000-2006 .....	33
Table 17 Prevalence of diabetes in children in N.C., CHAMP Survey, 2005-2006.....	35
Table 18 Number and prevalence of public school children with diabetes by year in N.C. public schools, Public School Nurses’ Report, 1997-2006.....	35
Figure 1 Percent in N.C. told by doctor they have diabetes, 2006 BRFSS .....	4
Figure 2 Prevalence of diabetes in N.C. and the U.S., 1995-2006.....	5
Figure 3 Prevalence of obesity in N.C. and the U.S., 1995-2006.....	5
Figure 4 Increase in diabetes prevalence by race from 1995 to 2006 in N.C.....	7
Figure 5 Prevalence of diabetes by race, 2006 .....	8
Figure 5A Prevalence of diabetes by ethnicity, 2006 .....	8
Figure 6 Estimated number of N.C. adults with chronic hyperglycemia, 2006.....	10
Figure 7 Occurrence of type 2 diabetes by body mass index.....	13
Figure 8 Proportion of N.C. adults who follow recommended nutrition intake and exercise regimens and have normal weight.....	14
Figure 9 Selected health care indicators in people with diabetes in N.C. ....	15
Figure 10 Prevalence of non-healthy conditions in people with diabetes in N.C. ....	19
Figure 11 N.C. hospital discharge rates for diabetes as the primary diagnosis, 2001-2005 .....	20
Figure 12 Rank for diabetes as leading cause of death for all N.C. residents, 2000-2006 .....	27
Figure 13 N.C. age-adjusted mortality rates for diabetes mellitus, 2001-2006 .....	27
Diagram 1 Relationship between obesity and chronic diseases.....	12



## Dedication



**\*Janet L. Reaves**  
**1963-2008**

This document is printed in honor of Janet Reaves, a dedicated and caring public health professional who, for more than a decade, tirelessly championed diabetes prevention and chronic disease management across the state. Under her leadership, numerous programs were initiated to reduce suffering and to save the lives of thousands of North Carolinians. We salute her courage and strength as she fought to live her life with honor and dignity in spite of recurring illness. Those who knew Janet sustain an indelible memory of her; countless people who never met her will continue to benefit from her vision and her dedication to ensuring healthier lives for the people of our state.

## Acknowledgments

**W**e would like to thank:

### **Colleagues:**

Edgardo Valeriano, MD, MPH  
Ruth Barlow, RN, MS (Consultant)  
Bob Woldman, MA (N.C. State Center for Health Statistics)  
Anthea Wang, MD, MPH (Consultant)  
Sara Huston, PhD (Epidemiologist; HDSP Branch)  
Yuan Fan, MA (N.C. State Center for Health Statistics)  
Carol Schriber, BS, MA (N.C. DHHS, Office of Public Affairs)  
Tracey Jarrett, BA (N.C. DHHS, Graphic Arts Unit)  
Kathleen Jones-Vessey, MS (N.C. State Center for Health Statistics)  
Harry Herrick, MSPH (N.C. State Center for Health Statistics)

### **N.C. Division of Public Health/Diabetes Prevention & Control Branch:**

\*Janet Reaves, RN, MPH (Chronic Disease Manager)  
Chris Bryant, MEd (Branch Head)  
Parvati Potru, MA (Epidemiologist)  
April Reese, BS (Evaluator)  
Joyce Page, MPH, MSPH (Director, Project DIRECT)  
Cindy Haynes-Morgan, MSA-PA, BS HEd, RHed (Program Coordinator)  
Laura Edwards, RN (ADA Coordinator)  
Danette Brantham, BS (Operations Manager)

### **Special Contributors:**

Marcus Plescia, MD, MPH (Director, Chronic Disease & Injury Section)  
Joseph Konen, MD, MSPH (Diabetes Advisory Council Chair)  
Barbara Pullen-Smith, MPH (Office of Minority Health and Health Disparities)  
Phillip Tarte, MPH (Health Director, Union County Health Department)

This publication would not have been possible without the contributions made by colleagues, branch staff, and special contributors.

## Introduction

**D**iabetes is a major public health problem in North Carolina, affecting all socio-demographic population groups. Diabetes prevalence has increased by 102 percent over the last decade, from 4.5 percent of the state's population in 1995 to 9.1 percent in 2006. This increase exceeds the national average increase of 70.4 percent in the same time period. An estimated 600,000 people in North Carolina were living with diabetes in 2006.

Ninety percent of the diabetes in adults is type 2 diabetes, the main risk factor for which is obesity. *Diabetesity*®, a new term coined by Francine Kaufman, MD, highlights the clinical relationship and association between obesity and diabetes. This situation calls for public health strategies for prevention and control of diabetes at the local and state levels. North Carolina urgently needs important environmental changes to promote healthy eating, regular physical activity, and healthy weight maintenance in order to help reduce *diabetesity*® and prevent type 2 diabetes. Research has shown that type 2 diabetes is ultimately preventable in 58 percent of people with pre-diabetes (those who are at increased risk of developing diabetes in the future and who already show a glycemic abnormality) (15). According to a new study by RTI International, screening overweight and obese adults aged 45-74 for signs of pre-diabetes and treating those who have the condition with the Diabetes Prevention Program lifestyle intervention would improve quality of life and be cost-effective (26).

As the principal diagnosis, diabetes resulted in 15,542 hospitalizations in 2005 alone and cost over \$225 million in hospital charges. It is the seventh leading cause of death in North Carolina. People with diabetes are two to four times more likely to develop heart disease and stroke and die from those conditions. Pregnant women with diabetes and their children are at risk of developing complications, especially during the perinatal period. In addition, acute metabolic complications and infections are more common in people with diabetes. Diabetes is also the leading cause of blindness, kidney failure and lower-limb amputations. Yet, many complications caused by diabetes can be prevented by effective self-management and evidence-based care.

The North Carolina Diabetes Prevention and Control Program (N.C. DPCP) in the Department of Health and Human Services (DHHS) presents this report describing the magnitude of the diabetes epidemic in North Carolina. This report shows data on diabetes prevalence, selected care indicators, hospitalizations and costs, and mortality. It also includes a chapter on diabetes in children in North Carolina.

## Executive Summary

**M**ore than one million people in North Carolina have pre-diabetes, undiagnosed diabetes or diagnosed diabetes. People with pre-diabetes and diabetes are at increased risk of developing strokes, heart disease, blindness, kidney failure and other complications including lower extremity amputations.

In 2006, an estimated 600,000 people, or about 9.1 percent of the population 18 years or older, were living with diabetes in North Carolina. More than 38 percent of all adults reported that they had not received a screening test for diabetes in the last three years. Data indicate that another 3.4 percent of the total population in North Carolina has diabetes that has gone undetected because they have not received a screening test to detect the disease. Enhanced screening practices need to be implemented in clinical settings to detect at-risk patients and to educate or treat them. A recent study, funded by CDC, found that screening overweight and obese

adults aged 45-74 for pre-diabetes and providing appropriate lifestyle interventions would improve quality of life and be cost-effective.

Diabetes prevalence in North Carolina has increased 102 percent over the past decade, from 4.5 percent in 1995 to 9.1 percent in 2006 ( $P \leq 0.05$ ). All socio-demographic groups are involved in the overall increase in diabetes prevalence. The groups experiencing higher-than-average increases in diabetes prevalence included:

- adults with incomes of \$25,000 to \$49,900 (337%);
- adults age 65 and older (100%);
- people between the ages of 35 and 44 years (>194%);
- males (>117%); and
- whites (>128%).

Studies show that obesity is the main factor associated with the increase in diabetes prevalence. Since 1995, the prevalence of obesity both in North Carolina and in the United States increased by

about 58 percent. Today, one in every four adults in North Carolina is obese. The term diabetesity® is now being used to describe the combined epidemics of diabetes and obesity. Both diseases are threatening to reduce the gains in life expectancy that have been achieved over the last century. About four million adults in North Carolina are at increased risk of developing pre-diabetes, diabetes and other chronic conditions due to being overweight or obese. The growing number of people at risk calls for public health practitioners and policy makers to provide strategies addressing the root causes of obesity and diabetes – physical inactivity, unhealthy eating, and missed or inadequate opportunities for early health care interventions.

A significant proportion of people with diabetes adhered to the clinical recommendations for diabetes control both in 2005 and 2006. Recommendations such as annual hypertension and cholesterol screening are reaching optimum levels (>92% in people

with diabetes). However, other clinical recommendations have not reached acceptable levels (>80%). These include:

- annual eye exam (71.3%);
- medical foot exam (74.7%);
- two or more hemoglobin A1c (HbA1c) tests per year (73.4%);
- influenza vaccine (57.8 %); and
- pneumococcal vaccine (51.6%).

Receipt of medical advice for weight control has improved and reached 97 percent in 2005.

In 2006, 20.5 percent of people with diabetes in North Carolina reported that, at least once in the past year, they did not have enough money to buy testing supplies and/or medications. Thus, they were at high risk for developing complications due to the lack of access to medications and proper diabetes care. Also, only about 54 percent of people diagnosed with diabetes reported having taken classes to help them manage their condition. This indicates that an estimated 276,000 people have not had the formal education necessary to improve control of their diabetes. In North Carolina, more than

53 percent of people with diabetes are at an increased risk of developing cardiovascular complications, strokes, or kidney failure due to high cholesterol and hypertension. Almost 28 percent of people with diabetes reported having a cardiovascular condition such as angina, heart attack, or stroke. That prevalence is almost four times higher than the 7.4 percent prevalence of people without diabetes who reported a cardiovascular condition.

From 2000 to 2005, the number of hospitalizations due to diabetes as the main cause increased 16.5 percent, with hospitalization costs increasing by 99.2 percent in the same time period. In 2006, 16,219 hospitalizations, costing \$257 million, occurred with diabetes as the principal diagnosis. Other serious health conditions (i.e., cardiovascular disease and renal disease), directly related to diabetes, also add significantly to these annual costs. Due to the high rate of complications, diabetes is stretching the capacity of the hospital system, and hospitalization costs are

increasing sharply. Based on research published in 2008 by the American Diabetes Association (ADA), the annual age-adjusted cost of diabetes in the U.S. was \$5,095 per capita in 2007. ADA estimated that the annual direct and indirect costs related to diabetes care and lost productivity were \$5.3 billion in North Carolina in 2006.

Diabetes was the seventh-leading cause of death in North Carolina in 2006, accounting for more than 2,230 deaths. The ranking of diabetes mortality as the main cause of death from 2000 to 2006 was higher among minorities than among whites. Diabetes ranked as the third leading of cause of death among American Indians and as the fourth in African Americans.

Before 1990, type 2 diabetes was rare in children, comprising less than 2 percent of total diabetes cases. Recently, diabetes in children has increased, with a national prevalence of 4 cases per 1,000 children, 31 percent of which are type 2. Estimates of the prevalence of both diabetes

and specifically type 2 diabetes in children in North Carolina are similar to national results. The present increase in overweight/obese children forecasts a new wave of type 2 diabetes in young adults.

The Centers for Disease Control and Prevention (CDC), the American Diabetes Association, the Diabetes Advisory Council, the North Carolina Diabetes Prevention and Control Programs (DPCP), and other partners have provided valuable data and tools to assist in the prevention and control of diabetes in North Carolina. Successful initiatives and collaborative projects include Project Direct, Diabetes Today, and Diabetes Fellowship at East Carolina University.

In 1994, the CDC funded Project DIRECT (Diabetes Interventions Reaching and Educating Communities Together) as a community-based research demonstration project responding to the excessive burden of diabetes among African-Americans.

Pre-intervention and post-intervention surveys were conducted with randomly selected adults in Raleigh and Greensboro (the control, or comparison community) during 1996-1997 and 2003-2004. The 2,311 pre-intervention and 3,083 post-intervention participants were interviewed, and over half had health examinations. Compared with the baseline, post-intervention respondents in Southeast Raleigh who were African American reported statistically significant lifestyle changes in the areas of level of physical activity, decreasing dietary fat intake, increasing awareness of diabetes risk factors, and increasing efforts to maintain or lose weight.

“Diabetes Today” is a curriculum designed by CDC to address diabetes from a public health perspective rather than exclusively as a medical problem. It provides health professionals and community leaders with the skills needed to mobilize communities and develop appropriate interventions for responding to the

burden of diabetes and improving the quality of diabetes care. Since Diabetes Today began in 1994 in North Carolina, DPCP has implemented the curriculum in approximately 86 of the state’s 100 counties.

The Diabetes Prevention & Control branch partners with the East Carolina University Brody School of Medicine to host the Diabetes Fellowship, referred to as the Hugh Young Memorial Scholarship program. This program provides scholarships to approximately 45 attendees per year from local health departments, rural health centers, and non-profit organizations that provide direct services to people living with diabetes. The week-long training provides an intensive update on current standards of care, new technologies and medications used in treating diabetes. ■



## Diabetes and Pre-Diabetes

In North Carolina, diabetes recently increased by more than 50,000 in one year, from 547,000 adults in 2005 (8.5% of the population) to 600,000 adults in 2006 (9.1% of the population). In the U.S., the total prevalence of diabetes in 2006 was 7.5 percent, compared to 7.3 percent in 2005 (8).

Diabetes is a chronic disorder characterized by abnormal metabolism of carbohydrates, proteins and fats (17, 18). It is caused by insulin deficiency and/or ineffective insulin action in the cells (17, 18). Hyperglycemia, the presence of abnormally high concentrations of glucose in the blood, is present in all types of diabetes and affects the whole body, including the heart, blood vessels, nerves, eyes and kidneys (6, 11, 12, 14, 26, 31, 35, 47, 50). People with diabetes are at increased risk for heart disease, stroke, peripheral vascular disease, neuropathy, lower extremity amputations, blindness and kidney failure (7, 11, 12, 14, 16, 27, 31, 45, 50). Good diabetes control will prevent or delay its complications (14, 27, 28, 29, 44, 49, 50).

There are three main forms of diabetes: type 1, type 2 and gestational diabetes, as well as other types of diabetes that do not fit into the main types.

### Types of Diabetes

1. Type 1 diabetes, also known as juvenile diabetes, is abrupt in onset and generally develops in children and young people. The destruction of  $\beta$ -cells in the pancreas contributes to insulin deficiency and requires the use of exogenous insulin (1, 17, 18). There are no known preventative measures that can be taken to prevent type 1 diabetes. Diet and exercise cannot be used to reverse or prevent type 1 diabetes. Type 1 diabetes comprises about ten percent of the total diabetes cases in North America.

2. Type 2 diabetes, also known as maturity-onset diabetes, is progressive, usually occurs after the age of 30, and is due to a combination of defective insulin secretion and insulin resistance or reduced insulin sensitivity. People with type 2 diabetes are generally obese, have a family history of diabetes, and have problems with insulin secretion and/or resistance (1, 17, 18). The other factor for type 2 diabetes is aging. Ninety percent of adults with diabetes have type 2 diabetes.

3. Gestational diabetes occurs only during pregnancy and affects 2 to 4 percent of all pregnant women. Obesity is a major risk factor for the development of gestational diabetes. Women who develop gestational diabetes are also at higher risk of developing type 2 diabetes (1, 17, 18).

4. Other types of diabetes do not fit into the categories of type 1, type 2 or gestational diabetes. These can be caused by several diseases, including genetic syndromes, genetic defects in  $\beta$ -cells or in the insulin chain, infections, and pancreatic diseases. Certain drugs and chemicals can also induce diabetes (1, 17, 18).

Table 1.  
Glycemic disorders: etiology types and stages

Stages	Normoglycemia  Normal Glucose Regulation	Hyperglycemia		
		Impaired Glucose Tolerance or Impaired Fasting Glucose (Pre-Diabetes)	Diabetes Mellitus	
Types			No Insulin Needed	Insulin Needed for Control
Type 1	→			
Type 2	→			
Other Types	→			
Gestational	→			

Source: ADA. Clinical Practice Recommendations 2007. Diabetes Care 30 (Sup 1): S43;(1), (17)

## Pre-diabetes

Pre-diabetes is a precursor of adult-onset, or type 2 diabetes, and is marked by carbohydrate intolerance or other symptoms of the disease. In pre-diabetes, blood glucose levels are higher than normal but below the levels needed for the diagnosis of diabetes. According to the American Diabetes Association (ADA), there are 54 million people in the United States who have pre-diabetes. Several research studies have shown that long-term damage to cardiovascular and circulatory systems may already be occurring in pre-diabetes (11, 12).

Two different tests, the fasting plasma glucose test (FPG) and the oral glucose tolerance test (OGTT) or two-hour plasma glucose test (2-h PG), are used to determine the prevalence of pre-diabetes. Table 2 outlines the criteria for classification of normoglycemia, pre-diabetes, and diabetes. Normoglycemia refers to the presence of normal concentrations of glucose in the blood. Levels less than 100 mg/dl are considered to be

Table 2.  
Criteria for the diagnosis of normoglycemia, pre-diabetes, and diabetes

Normoglycemia	Pre-Diabetes (IFG or IGT)	Diabetes
FPG*** < 100mg/dl 2-h PG* <140mg/dl	FPG≥100 mg/dl or <126 mg/dl 2-h PG* ≥140mg/dl or < 200 mg/dl	FPG ≥ 126 mg/dl** 2-h PG* ≥ 200 mg/dl**
		Diabetes symptoms plus casual blood test ≥ 200mg/dl

Source: ADA. Clinical Practice Recommendations 2007. Diabetes Care 30 (Sup 1): S46(1).  
Notes: \*2 h PG: Two-hour plasma glucose test follows World Health Organizations

recommendations for the test.

\*\* Confirmatory test is required the subsequent day before making the final diagnostic of diabetes.

\*\*\*FPG: Fasting Plasma Glucose requires at least eight hours of fasting.

normal based on a blood sample obtained after eight hours of fasting.

A majority of people with pre-diabetes will develop type 2 diabetes within ten years unless preventive measures are taken (15, 22, 23). The development of diabetes in overweight/obese people occurs when chronic maintenance of an overweight status results in insulin resistance. Unless weight reduction measures are followed, the risk of pre-diabetes increases as does type 2 diabetes (2, 6, 15, 18, 22, 24, 29, 31, 33, 45, 47, 51). Studies have shown that lifestyle changes (i.e., 5 to 10 percent decrease in weight in overweight/obese people and an increase in physical activity) can prevent the development of type 2 diabetes in 30 percent to 60 percent of people with pre-diabetes (2, 15, 19, 23, 29, 51). With the national prevalence of pre-diabetes at 6.2 percent, many North Carolinians with pre-diabetes can potentially benefit from lifestyle changes (Table 5). It is estimated that more than 400,000 North Carolina residents have pre-diabetes (Figure 6).

### **Clinical definitions of overweight and obesity**

The term “overweight” refers to an excess of body weight compared to set standards. The excess weight may come from muscle, bone, fat and/or body water. Obesity refers specifically to having an abnormally high proportion of body fat (19).

Body Mass Index (BMI) is a measure that can be used to screen for both overweight and obesity in adults. BMI is a calculation based on height and weight and is not gender-specific in adults. BMI does not directly measure percent of body fat, but it is a more accurate indicator of overweight and obesity than relying on weight alone. Defining overweight as a BMI of 25 or greater is consistent with the recommendations of the World Health Organization (WHO) and most other countries. An expert panel from the National Heart, Lung, and Blood Institute (NHLBI) identified overweight as a BMI of 25 to 29.9 kg/m<sup>2</sup> and obesity as a BMI of 30 kg/m<sup>2</sup> or greater (19).

### **Cost-effectiveness of screening for pre-diabetes among overweight and obese U.S. adults**

A new study by Research Triangle Institute International, published in the November 2007 issue of *Diabetes Care*, found that screening overweight and obese adults aged 45-74 to detect pre-diabetes *and* providing diabetes prevention lifestyle interventions to those found to have the condition improves quality of life and is cost-effective (26).

The study looked at prescreening strategies that provided lifestyle interventions to people with impaired glucose tolerance (IGT), impaired fasting glucose (IFG), or both conditions. The study indicated that it would cost the health care system \$8,181 to gain one quality-adjusted life-year (QALY) among persons who had both IFG and IGT. However, it would cost \$9,511 for the health care system to gain one QALY among with either IFG or IGT. Both ratios are better than the benchmark commonly used for cost effectiveness studies, \$50,000 to gain one QALY.

## Prevalence and Estimated Numbers of Persons with Diabetes

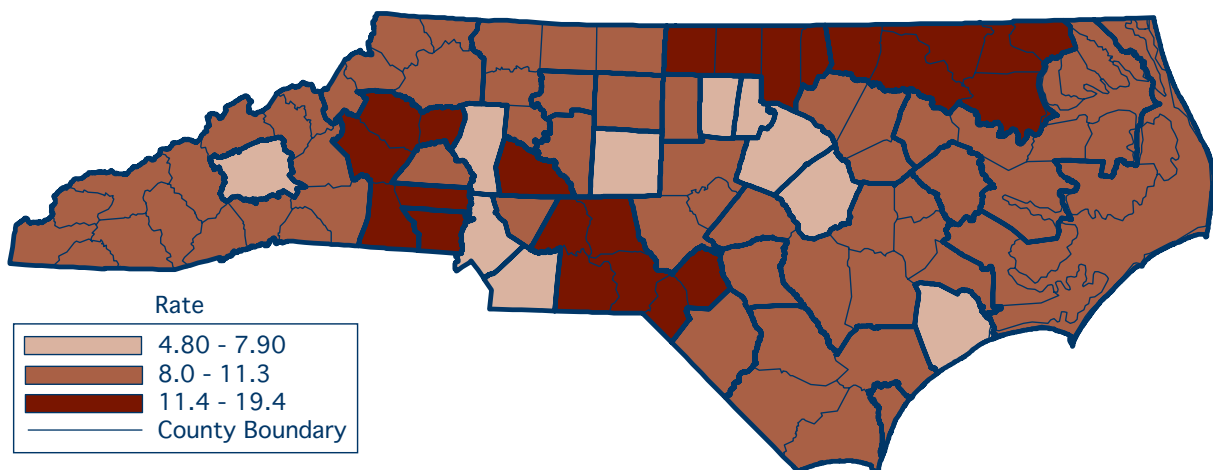
The prevalence of diabetes and other chronic conditions is estimated by the Behavioral Risk Factor Surveillance System (BRFSS) (8, 35). The BRFSS is an annual random telephone survey of adults (age 18 and older, civilian, and non-institutionalized) coordinated by the Centers for Disease Control and Prevention (CDC) in all fifty states and Puerto Rico (8). The North Carolina BRFSS, part of the Statistical Services unit of the State Center for Health Statistics (SCHS), is responsible for implementing the survey in North Carolina (35).

The BRFSS survey includes several modules about chronic diseases and behavioral risk factors. The Diabetes Module includes questions regarding diabetes screening, diagnosis, self-care practices, complications and recommended clinical practices. Appendix 1 shows the BRFSS questions used in the Diabetes Module. The BRFSS survey sample size includes 13,000 to 15,000 North Carolina residents.

### Prevalence of diabetes and obesity in N.C. and the U.S. from 1995 to 2006

Data from the N.C. BRFSS for 2006 indicate that the Northeast Partnership I region (Bertie, Gates, Halifax, Hertford, Northampton, and Warren counties) had the highest diabetes prevalence rate at 19.4 percent. Within the single county group, Rowan county had the highest prevalence rate at 12.1 percent in 2006, followed by Gaston county at 12.0 percent. At 4.8%, Durham county had the lowest prevalence

Figure 1:  
North Carolina Behavioral Risk Factor Surveillance System (BRFSS), Percent Answered Yes to “Have you ever been told by a doctor that you have diabetes?” by BRFSS region, 2006



Source: N.C. State Center for Health Statistics  
Note: North Carolina resident adults 18 years and older.

rate in the state in 2006. Lower diabetes prevalence rates in 2006 were also seen in the following counties: Mecklenburg (5.8%); Randolph (6.3%); Wake (6.4%); Orange (6.6%) and Union (6.7%). Figure 1 shows the distribution of low, medium and high diabetes prevalence in 2006.

Figure 2 shows the trends in prevalence of diagnosed diabetes from 1995 to 2006 in North Carolina and the nation. Diabetes prevalence is higher in North Carolina than in the nation as a whole. Diabetes has increased in North Carolina in the last 12 years, from 4.5 percent in 1995 to 9.1 percent in 2006 ( $P < 0.05$ ). In the same time period, prevalence in the U.S. increased from 4.4 percent to 7.5 percent. A small decrease in prevalence was reported in North Carolina in 2005, but prevalence increased again in 2006, from 8.5 percent to 9.1 percent (Figure 2).

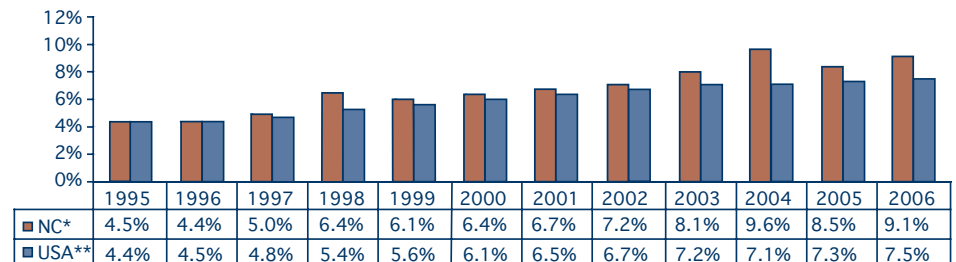
Figure 3 shows an increase in obesity in North Carolina as well as in the U.S. over the last 12 years. In 2006, 26 percent of adults in North Carolina were considered to be clinically obese,

as defined by a body mass index of equal to or greater than 30 (kg/m<sup>2</sup>). North Carolinians ranked slightly above the national average of 25.1 percent obesity rate in

2006. Obesity rates have increased since 1995 in the state. In 2007, North Carolina had the 17<sup>th</sup> highest level of adult obesity in the nation at 22.4%\*.

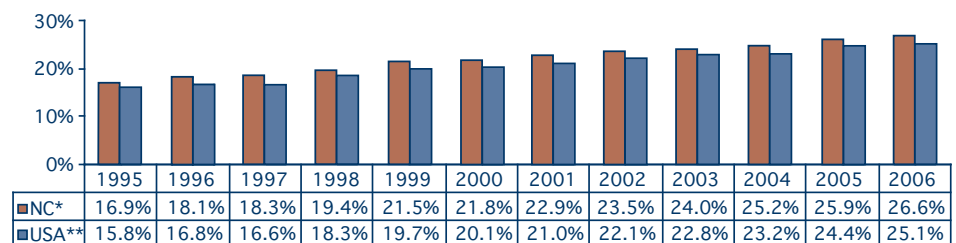
**Figure 2.**  
Prevalence of diabetes in North Carolina and U.S. from 1995 to 2006

- 102% increase in N.C. from 1995 to 2006
- 70.4% increase in U.S. from 1995 to 2006



Source: N.C. State Center for Health Statistics, \*N.C. BRFSS data 1995-2006; CDC BRFSS data 1995-2006.  
Note: \*\* USA prevalence based on the mean of the 50 states and Puerto Rico.

**Figure 3.**  
Prevalence of obesity in North Carolina and U.S. from 1995 to 2006



Source: N.C. State Center for Health Statistics, \*N.C.-BRFSS, 1995-2006.  
\*\* CDC-BRFSS, 1995-2006  
Note: \*\* USA prevalence based on the mean of the 50 states and Puerto Rico.

### Increases in diabetes prevalence by gender, income and age

From 1995 to 2006, the overall increase in diabetes in North

Carolina was 102 percent (Figure 2). Diabetes prevalence has increased 70 percent or more in all gender and age groups over the past 12 years except for 45- to

54-year-olds (Table 3). The largest increases in diabetes prevalence occurred among those who were 35 to 44 years old and those with an annual income under \$50,000.

Table 3. Increase in diabetes prevalence from 1995 to 2006 by gender, race, age, and household income in North Carolina

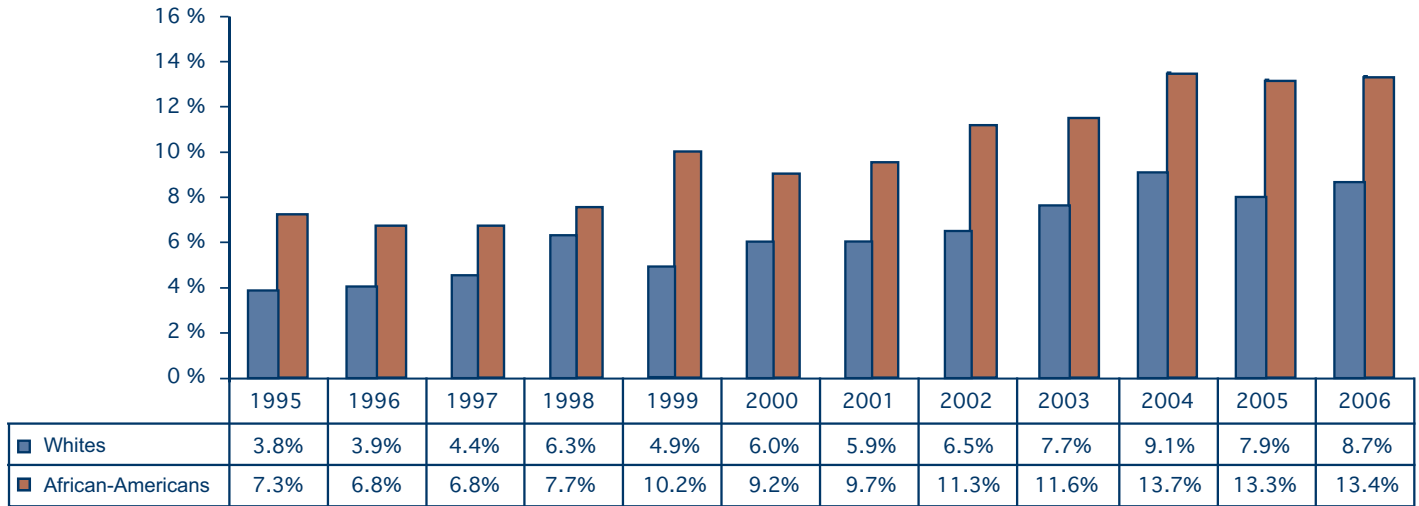
Variable	1995 Prevalence	2006 Prevalence	Increase	Variable	1995 Prevalence	2006 Prevalence	Increase
Gender				Race			
Female	5.0%	9.5%	90%	White	3.8%	8.7%	128%
Male	4.0%	8.7%	117%	African Americans	7.3%	13.4%	83%
				Other	5.0%	5.3%	6%
Age				Household Income			
>/=65 years	10.5%	21.2%	102%	<\$ 15,000	10.5%	18.1%	72%
55-64 years	8.9%	16.7%	87%	\$15K-24.9K	5.8%	11.8%	103%
45-54 years	6.6%	9.2%	39%	\$25K-49.9K	2.0%	8.7%	337%
35-44 years	1.8%	5.3%	194%	>\$50,000	2.6%	5.5%	101%
25-34 years	1.0%	1.7%	70%				
18-24 years	1.1%	2.3%	109%				

Source: N.C. BRFSS, N.C. SCHS, 1995-2006 data.

Note: BRFSS demographic data specifically identified for Asians and American Indian did not occur until 2002

\* Trust for America's Health. F As in Fat: How Obesity Policies are Failing in America, 2007. Washington, DC: Trust for America's Health; 2007. [www.healthyamericans.org](http://www.healthyamericans.org). Accessed February 19, 2008.

Figure 4.  
Increase in diabetes prevalence by race from 1995 to 2006 in North Carolina



Source: N.C. State Center for Health Statistics, N.C. BRFSS, 1995-2006

Diabetes prevalence increased by 102 percent among people who were over 65 years old, and by 337 percent in those with an annual salary between \$25,000 and \$49,900. See Table 3.

Figure 4 describes the prevalence of diabetes for whites and African Americans from 1995 to 2006.

During this time period, diabetes increased an average of 128 percent in whites and 83 percent in African-Americans.

In 2006, the highest diabetes prevalence occurred among African-Americans (13.4%), followed by American Indians (9.8%) and whites (8.7%).

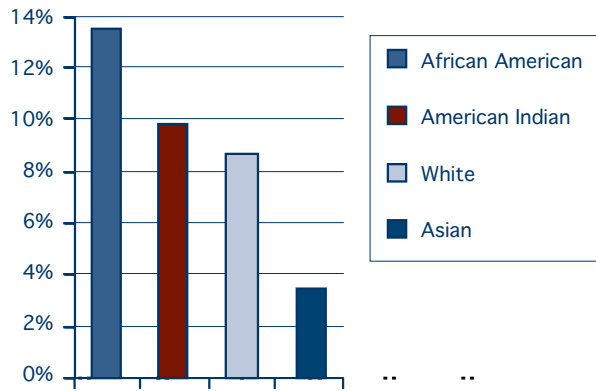
Asians had the lowest diabetes prevalence at 3.5 percent (Figure 5).

Non-Hispanics had a higher rate of diabetes prevalence (9.4%) than Hispanics (5.7%) (Figure 5A). Of note, Hispanics and Asians also reported the lowest prevalence of diabetes screening in the state

(Table 6), which may have influenced the low documented prevalence of diabetes in both groups.

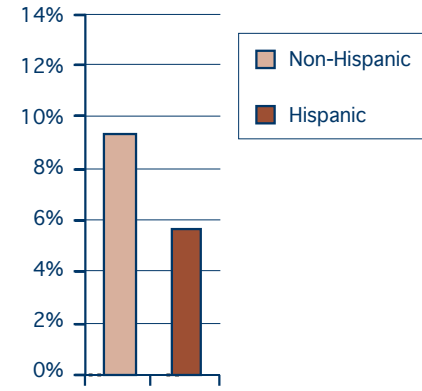
Diabetes prevalence increases with age, affecting nearly one in every ten adults over 35 years old in North Carolina (Table 4). People aged 65 and older had the highest diabetes prevalence, 21.2 percent, in 2006.

Figure 5.  
Prevalence of diabetes by race in 2006



Source: N.C. State Center for Health Statistics, N.C. BRFSS, 2006

Figure 5A.  
Prevalence of diabetes by ethnicity in 2006



Source: N.C. State Center for Health Statistics, N.C. BRFSS, 2006

Table 4.  
Prevalence of N.C. adults with diabetes by age over 18 in 2006

Age Groups	Population 2006	Diabetes Prevalence
18-34	2,088,000	1.9%
35-64	3,386,000	9.7%
65 and +	1,003,000	21.2%
Overall	6,476,000	9.1%

Source: N.C. BRFSS, 2006

## Estimates of Pre-Diabetes and Undiagnosed Diabetes and Prevalence of Screening

### Estimates of pre-diabetes and undiagnosed diabetes in North Carolina

There have been no studies on the prevalence of pre-diabetes or undiagnosed diabetes in North Carolina. The most recent and well-documented national surveys addressing pre-diabetes and undiagnosed diabetes are the third National Health and Nutrition Examination Survey (NHANES III 1988-1994) and NHANES 1999-2000 (9). In its Sept. 5, 2003 MMWR Weekly Report, the CDC presented data on the prevalence of diagnosed and undiagnosed diabetes and pre-diabetes (impaired fasting glucose) from

NHANES 1999-2000 and NHANES III (1988-1994). The NHANES 1999-2000 report estimated 29 million people in the U.S. (or an unadjusted 14.4% of people over 20 years old) had either diagnosed diabetes, undiagnosed diabetes, or impaired fasting glucose (IFG). It also indicated that 29 percent of diabetes cases were undiagnosed (9).

The NHANES 1999-2000 study included 4,880 persons age 20 and older. Of this group, 480 people were identified as having

been previously diagnosed with diabetes. A group of 1,734 were assigned to a study group to test plasma glucose levels, and a diagnostic criterion from the American Diabetes Association was used to classify the findings. Refer to Figure 6 for a conservative estimate for North Carolina based on this national data.

A conservative estimate of the number of North Carolinians with pre-diabetes, undiagnosed diabetes, and diagnosed diabetes is approximately

Table 5.  
Estimated percentage of adults aged 20 or older with pre-diabetes and undiagnosed diabetes in N.C., 1999—2000 adjusted rates using NHANES prevalence national results

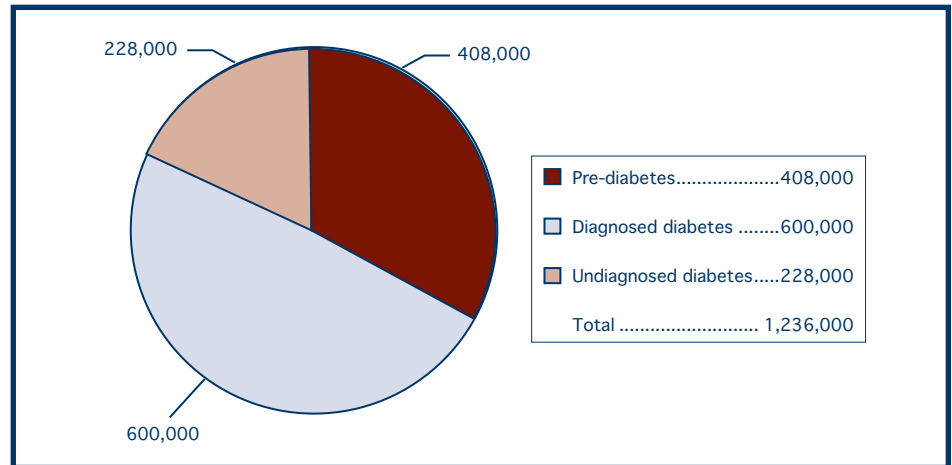
Age groups	Previously diagnosed with diabetes*	IFG or pre-diabetes	Undiagnosed diabetes
20-39	1.4 %	1.6 %	0.9 %
40-59	5.8%	6.4 %	3.3 %
60 and +	15.2%	14.6 %	4.2 %
Total	6.1%	6.2 %	2.5 %

Source: \*Prevalence of undiagnosed diabetes and impaired fasting glucose in adults, United States, 1999-2000. MMWR, 2003; 52(35); 833-37

1.24 million. Over 18 percent (18.7%) of the adult population experienced some form of chronic hyperglycemia in 2006. In 2006, 9.1 percent, or 600,000 adults, were diagnosed with diabetes in North Carolina. Based on survey responses, an estimated 38.1 percent of N.C. adults have never been screened for diabetes. Applying a 9.1 percent diabetes prevalence rate to this unscreened population would equate to an additional 3.46 percent of the total N.C. adult population, or nearly another quarter of a million people who have undiagnosed diabetes. Based on the NHANES study, an additional 6.2 percent of the population, or 408,000 residents, have pre-diabetes (Figure 6). The 1999-2000 NHANES did not use oral glucose tolerance testing in the study design, as compared to the 1988-1994 study. It is estimated that if that test was also used, an additional proportion of the participants with abnormal postload glucose tolerance would have been detected and the above percentages would therefore be even higher.

Research has shown that diabetes is preventable in 58 percent of

Figure 6.  
Estimated number of adults with some form of chronic hyperglycemia in N.C., 2006



Data sources: Diagnosed diabetes is from NC. BRFSS data; Undiagnosed diabetes and pre-diabetes is from National Health and Nutrition Examination Survey III data. Notes: All rounded to the nearest one thousand.

people with pre-diabetes (2, 14, 19, 23, 30). Public health strategies and more comprehensive health insurance policies are needed to assure preventive clinical services to people at risk for chronic conditions.

### Prevalence of screening for diabetes in North Carolina

People with pre-diabetes and diagnosed and undiagnosed diabetes are at higher risk of developing strokes, heart disease, eye diseases, and kidney diseases than those with normoglycemia (7, 11, 12, 14, 16, 28). Early detection and appropriate treatment can reduce diabetes complications (14, 27, 30, 40, 48, 49). The decision for diabetes screening in asymptomatic patients is based on clinical judgment and should be carried out in the clinical setting with proper counseling.

The 2008 ADA Clinical Practice Recommendations (1) advise testing to detect pre-diabetes and type 2 diabetes in otherwise healthy adults who are overweight or obese (BMI  $\geq 25$  kg/m<sup>2</sup>) and have one or more additional risk factors for diabetes (see below). Screening in adults without these risk

factors should begin at age 45. If results are normal, testing should be repeated at 3-year intervals.

### ADA Criteria for testing for pre-diabetes and diabetes in otherwise healthy adults

1. Testing should be considered in all adults who are overweight (BMI  $\geq 25$  kg/m<sup>2</sup>) and have additional **risk factors**:

- physical inactivity
- family history of diabetes
- members of a high-risk ethnic population (e.g., African American, Latino, Native American, Asian American, and Pacific Islanders)
- women who delivered a baby over 9 lbs. or were diagnosed with gestational diabetes
- hypertension ( $\geq 140/90$  mmHg or on therapy for hypertension)
- HDL cholesterol level of  $< 35$  mg/dl and/or triglyceride level  $> 250$
- women with polycystic ovarian syndrome (PCOS)
- previous history of IGT or IFG
- having signs or conditions associated with insulin resistance (e.g., acanthosis nigricans and severe obesity)
- history of cardiovascular disease

2. Without the above risk factors, testing for pre-diabetes and diabetes should begin at age 45 years.

3. If results are normal, testing should be repeated at least 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.

- 38.1 percent of adults without diabetes did not have screening test for diabetes.
- Males have a lower proportion of screenings than females (43.3% vs. 33.1%).
- Individuals with incomes below \$35,000 per year or who are without health insurance are more likely to not have had a diabetes screening test.
- Prevalence of diabetes has increased by 337% in the income brackets of \$25,000-\$49,900 since 1995 (Table 3).

Table 6. Prevalence of North Carolinians without diabetes who reported never having had a diabetes screening test by race, ethnicity, gender, age, household income, and insurance coverage in North Carolina, 2006

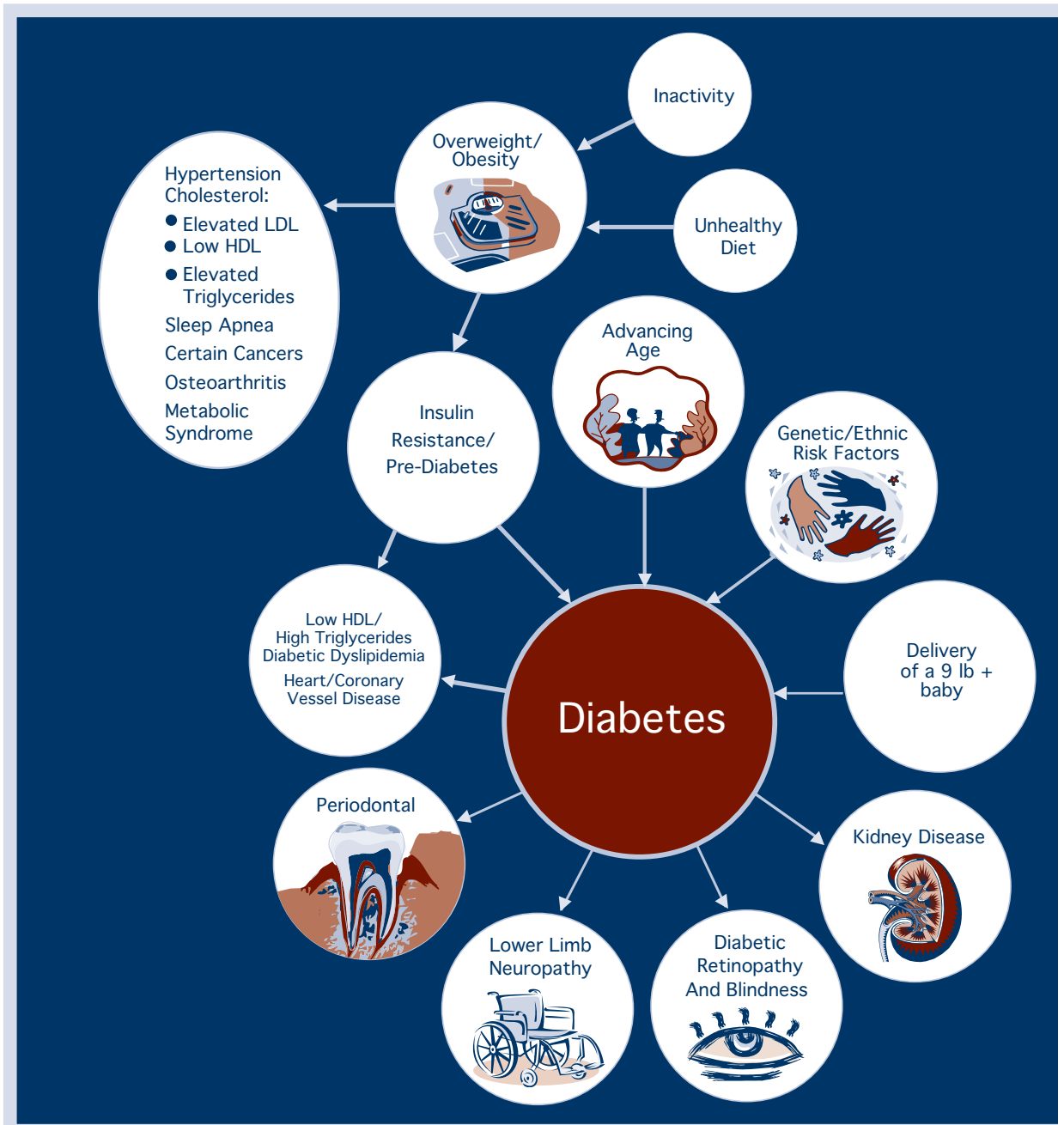
Characteristics	Prevalence 2006
<b>Total</b>	<b>38.1%</b>
<b>Race:</b>	
African-American	36.6%
American Indian	41.6%
Asian	47.8%
White	35.9%
<b>Ethnicity:</b>	
Hispanic/Latino	54.3%
Non-Hispanic	36.3%
<b>Gender:</b>	
Female	33.1%
Male	43.3%
<b>Age (18+):</b>	
18 - 24	65.3%
25 - 34	48.9%
35 - 44	35.9%
45 - 54	28.9%
55 - 64	24.2%
65-74	18.2%
75+	25.2%
<b>Household Income:</b>	
< 15K	38.7%
15-24.9K	44.6%
25-34.9K	40.1%
35-49.9K	35.3%
50 -74.9K	33.4%
75K +	30.4%
<b>Health Insurance:</b>	
Yes	34.4%
No	53.6%

Source: N.C. BRFSS Data 2006

# Prevention of Diabetes and Other Chronic Diseases

Diagram 1.

Relationship between obesity and chronic diseases

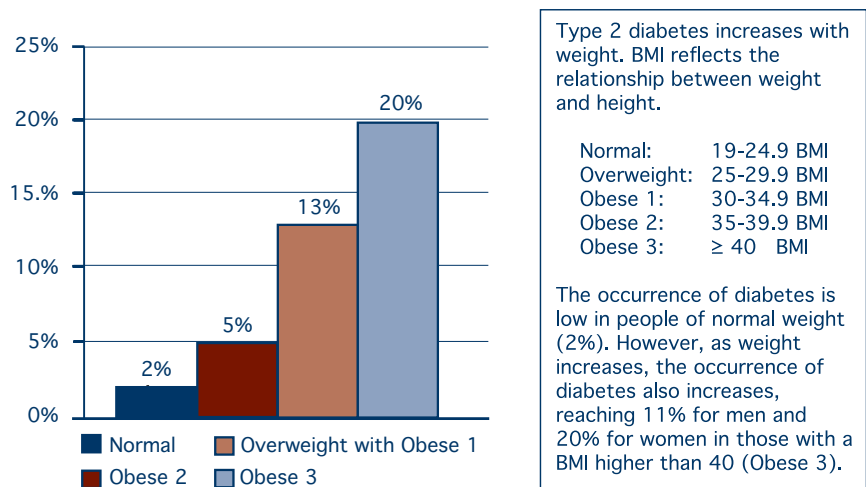


Sources: (1, 6, 7, 11, 12, 13, 14, 15, 16, 22, 23, 24, 26, 28, 33, 34, 43, 44, 47, 51)

Accelerated industrialization and technological advances in the last century have changed people's patterns of nutrition and physical activity, resulting in rapid increases in obesity (Figure 7). Obesity can lead to many chronic conditions, including metabolic syndrome, diabetes, hypertension and other cardiovascular diseases, breast and colon cancer, sleep apnea, osteoarthritis and gallbladder diseases (19, 44). (See Diagram 1). In 2003, the U.S. Department of Health and Human Services classified obesity as a disease, opening the door for its treatment and control at the level of public health. Blueprints for changing policies and environments in support of healthy eating and physical activities are found on the "Eat Smart, Move More... North Carolina" web site at [www.EatSmartMoveMoreNC.com](http://www.EatSmartMoveMoreNC.com).

The N.C. BRFSS 2005 survey data clearly points to evidence as to why a substantial number of N.C. residents are not fit and healthy.

Figure 7. Occurrence of type 2 diabetes by body mass index (BMI kg/m<sup>2</sup>)

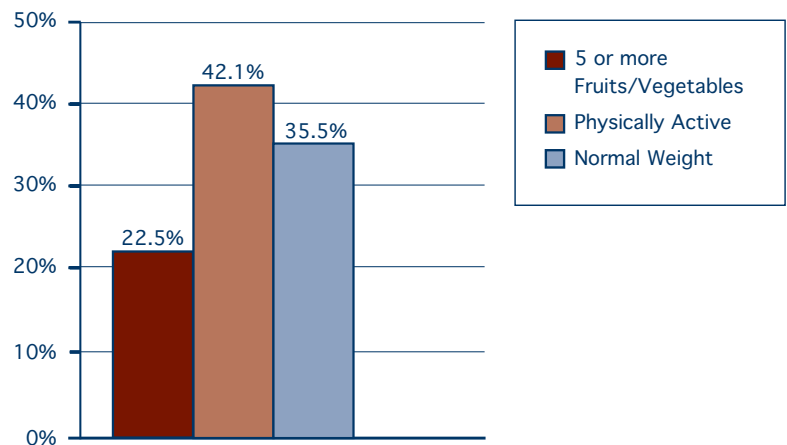


Sources: Must A et al. The disease burden associated with overweight and obesity. JAMA. 1999; 282:1523-29.  
 ADA. Clinical Practice Recommendations 2007. Diabetes Care 30 (Sup 1): S49 (1).

Only 42 percent of respondents participated in regular exercise; over 76 percent did not eat five or more servings of fruit and vegetables per day; and more than 60 percent were not at a healthy weight as indicated by their BMI (Figure 7 and 8).

In 2006, 61 percent of adults in North Carolina without diabetes reported being overweight (BMI >25 but <30) or obese (BMI >30) (Table 9). This group is at an increased risk of developing pre-diabetes, diabetes, and other chronic diseases due to overweight/obesity, unhealthy eating, and lack of physical activity (1, 2, 15, 19, 22, 29, 30, 51) (Figure 7). Effective individualized assessment, counseling, and treatment of these risk factors are needed at each medical visit. In addition, strategies are needed to make healthy food more readily available and affordable, and to embrace policies and environments that promote physical activity.

Figure 8. Proportion of adults in North Carolina who eat five or more fruits and vegetables daily, follow physical activity recommendations\*, and have normal weight.



Source: N.C. BRFSS, 2005  
\*Note: Moderate physical activity for at least 30 minutes, 5 days per week, or vigorous activity for at least 20 minutes 3 times per week.

## Compliance with Clinical Recommendations

In order to prevent or reduce complications associated with diabetes, continual self-care and appropriate medical care are needed. In 2003, the North Carolina Diabetes Advisory Council adopted clinical practice recommendations that were published by ADA as standards for the minimum guidelines for diabetes care in the state.

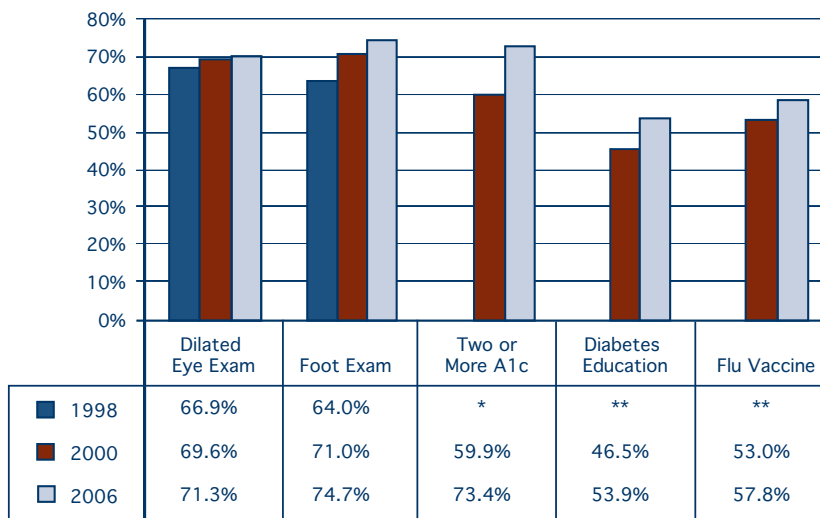
The BRFSS survey data provides information about the proportion of people with diabetes receiving

selected clinical care measures. People who self-identified as having diabetes in the BRFSS survey were asked several questions related to diabetes care practices, both self-administered and received from their health care providers. These included questions about attendance at diabetes self-management education classes, dilated eye exam and foot exam by a health care professional, frequency of hemoglobin A1c test, self-monitoring of blood sugar

levels, presence of foot sores, diagnosis of retinopathy, and availability of medications and glucose testing supplies. Specific phrasing for each BRFSS diabetes question is found in Appendix 1. More detailed results are also presented on the N.C. BRFSS survey website at [www.schs.state.nc.us/SCHS/brfss/](http://www.schs.state.nc.us/SCHS/brfss/).

Figure 9 shows an increase in the proportion of people with diabetes receiving each of five selected indicators of medical care from 1998 to 2006. In 2006, more than 73 percent of people with diabetes reported receiving at least one medical foot exam and two or more hemoglobin A1c tests per year. In the same year, 71 percent of people with diabetes reported having an annual eye exam. The number of people with diabetes who attended a diabetes education class has increased from 46.5% in 2000 to 53.9% in 2006. This means that, in 2006, 46 percent had never taken a class to learn about diabetes management and self-care.

Figure 9:  
Selected health care indicators in people with diabetes in N.C., 1998/2000/2006



Source: N.C. BRFSS Data 1998, 2000, and 2006

\* 1998 question not asked the same. Results are not comparable.

\*\* Question was not asked in 1998

Table 7 below shows the percentage of people who reported receiving selected clinical practices recommended by the American Diabetes Association. Only two of the ten practices, hypertension screening and advice for weight control, exceeded 90 percent reported rate of receipt. North Carolinians with diabetes require extensive medical care. However, in 2006, they used these services less frequently than recommended. More than 25 percent of adults with diabetes did not have annual dilated eye exams, foot exams, and two or more A1c tests, and 48.4 percent of them did not receive recommended pneumococcal vaccine.

Table 7.  
Proportion of adults with diabetes who reported receiving the following selected clinical services, North Carolina, 2005 and 2006

Indicator	Proportion of compliance
Annual dilated eye exam	71.3%
Two or more hemoglobin A1c tests/per year	73.4%
One or more medical foot exams in a year	74.7%
Recommended pneumococcal vaccine	51.6%
Annual flu vaccine	57.8%
Hypertension screening within last year*	97.2%
Urine test for proteins (one per year)	73.6%
Recommended cholesterol screening*	89.1%
Medical advice for weight control*	97.5%
Medical advice for physical activity*	70.6%

Source: N.C. BRFSS 2005\* and 2006

Table 8 shows the proportion of adults with diabetes who reported self-practicing selected preventive measures. Diabetes management requires personal lifestyle changes and education to manage the condition, but only 53.9 percent reported attending a diabetes class. Less than 30 percent reported following the recommendations for physical activity or healthy eating, and only 65 percent reported performing daily glucose monitoring.

Table 8.  
Adults with diabetes and self-practice of preventive measures, North Carolina, 2005-2006

Indicator	Proportion of compliance
Meets recommended physical activity level*	29.6%
5 or more vegetables/fruits per day*	23.3%
Diabetes self-management classes	53.9%
Daily glucose self-monitoring	65.1%
Daily foot check	73.6%
Had money for testing supplies/or medicine in last 12 months	79.5%
One or more medical visits per year for diabetes	89.9%

Source: N.C. BRFSS 2005\* and 2006

## Cardiovascular Conditions, Risk Factors, and Unhealthy Behaviors

Several studies show that diabetes is a major risk factor for developing cardiovascular disease (CVD) (4, 7, 11, 13, 16, 27, 33, 41, 46, 47, 50). CVD is the major cause of morbidity, hospitalization costs, and mortality in people with diabetes (7, 11, 12, 16, 33, 42, 43, 44, 47, 48). Blood pressure and cholesterol control (BP  $\leq$  130/80 mmHg and LDL  $\leq$  100 mg/dl), along with daily aspirin use (75-162mg/day), can be considered for people between 30 and 39 but is recommended for people over 40 years old. Tobacco avoidance is also an important measure to prevent or delay CVD in people with diabetes (1, 11, 50).

Adults with diabetes in North Carolina reported the following risk factors and cardiovascular conditions (Table 9): 15.9 percent reported current tobacco use; 91.6 percent reported having hypertension requiring medication; 59.6 percent reported high cholesterol; 27.7 percent reported a history of other cardiovascular conditions

(angina, heart attack, and/or stroke); and about 84 percent reported being overweight or obese. Sixty percent of North Carolina adults with diabetes use aspirin therapy for the prevention of CVD. A history of CVD is almost four times higher in those with diabetes than those without diabetes. A higher prevalence rate of all cardiovascular risk factors was found in people with diabetes than among those without diabetes, with the exception of being a current smoker.

Table 9. Adults with and without diabetes and selected cardiovascular conditions and risk factors in North Carolina, 2006

Risk factors and cardiovascular conditions	Prevalence in people with diabetes	Prevalence in people <u>without</u> diabetes
Current smokers	15.9%	22.7%
Diagnosed with hypertension (HTN)*	69.5%	25.5%
With hypertension and are on medication*	91.6%	73.9%
With retinopathy	22.4%	NA
With high cholesterol*	59.6%	33.4%
Have history of CVD (angina, heart attack, stroke)	27.7%	7.4%
Use aspirin for CVD prevention*	60.1%	23.1%
Overweight (BMI > 25 but less than 30)	30.6%	37.0%
Obese (BMI $\geq$ 30)	52.9%	23.6%

Source: N.C. BRFSS 2005\* and 2006 data.

Note: Prevalence for risk factors in people with diabetes is statistically significantly different ( $p < 0.5$ ) from prevalence for risk factors in people without diabetes.

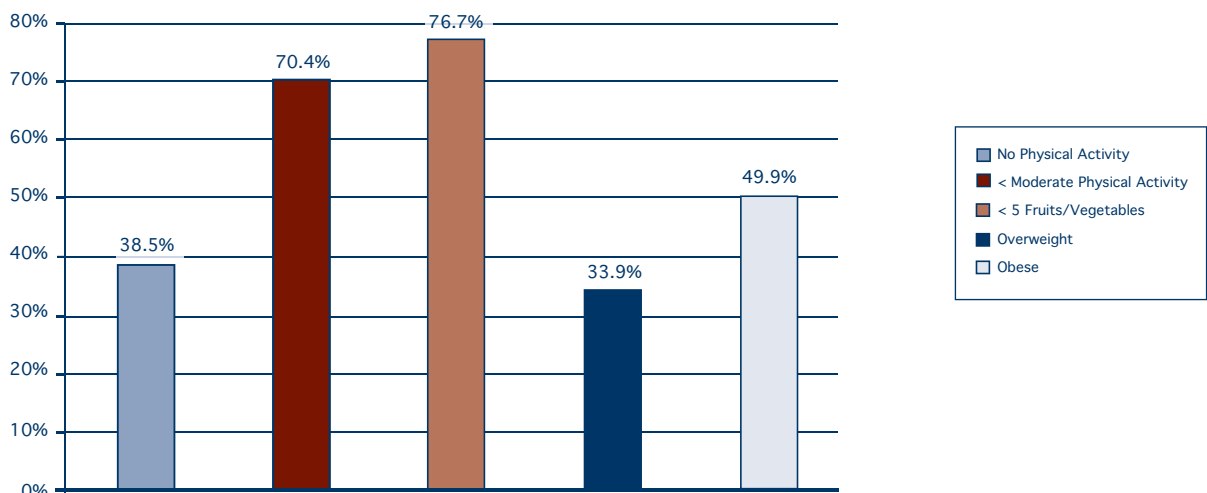
People with diabetes in North Carolina also reported the following unhealthy practices in 2005 (Figure 10):

- Seventy-seven percent reported eating less than five fruits/vegetables per day;
- Seventy percent reported not following the CDC physical activity recommendations of 30 minutes of moderate exercise at least five times per week;
- Thirty-eight percent reported not participating in any significant physical activity at all.

The wording of the questions related to this data was changed in the 2006 BRFSS. In 2006, 62.8 percent of people with diabetes reported trying to increase their fruit intake and 71 percent reported trying to increase their vegetable intake. As far as exercise, 64.8 percent of North Carolinians with diabetes reported trying to increase their level of physical activity and 62.3 percent reported participating in some form of physical activity within the past month. On average, 36 percent of people with diabetes in North Carolina did not participate in regular physical activity that was not work-related in 2006. The overweight/obesity rate (BMI>25) for North Carolinians with diabetes was 83.8 percent in 2005 and 83.5 percent in 2006.

Specific information and resources about glycemic control, healthy eating, and physical activity is available at the ADA web site at [www.diabetes.org/home.jsp](http://www.diabetes.org/home.jsp). In addition, clinical tools to help health care providers initiate the dialogue with their patients about smoking cessation, healthy eating, and physical activity are available on the N.C. Prevention Partners web site at [www.ncprevention-partners.org](http://www.ncprevention-partners.org).

Figure 10. Prevalence of non-healthy conditions in people with diabetes: lack of physical activity, not eating enough vegetables/fruits, and overweight/obesity, North Carolina, 2005



Source: N.C. BRFSS, 2005

## Diabetes-Related Hospitalizations

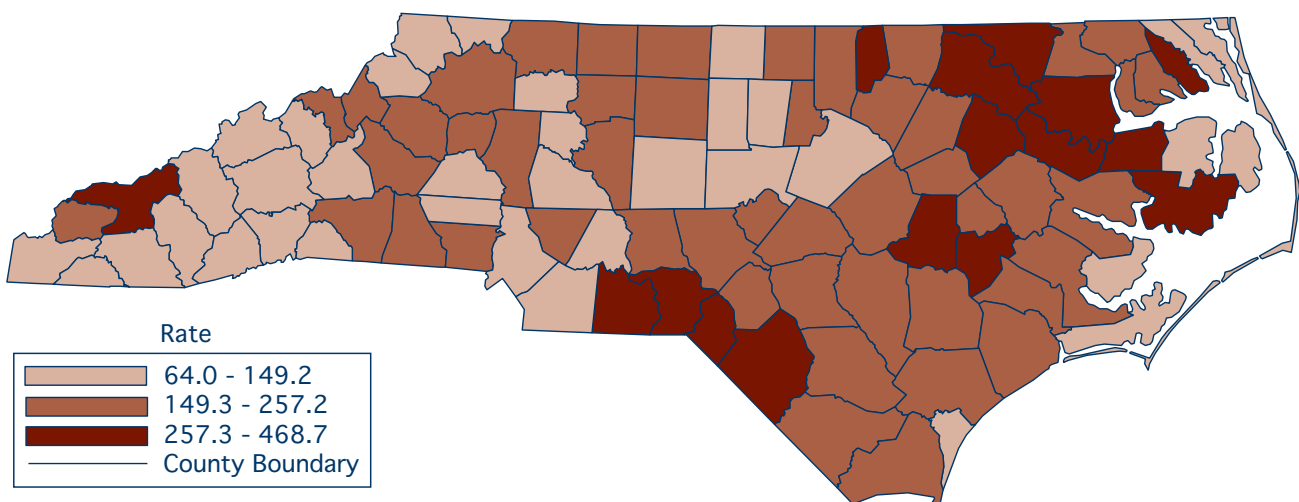
**D**iabetes accounts for a large burden of morbidity and mortality through micro- and macro-vascular complications that affect mainly the heart, brain, eyes, kidneys, and lower extremities (3, 7, 10, 12, 14, 27, 29, 33, 41, 42, 43, 44, 45, 46, 47, 50). People with diabetes also suffer crises of hypoglycemia and hyperglycemia that, when severe, require emergency care or hospitalizations (10, 16, 42).

Diabetes is one of the most prevalent chronic diseases placing an economic burden on individuals, families, and the health care system (2, 4, 7, 16, 42, 44, 47, 48). This chapter presents 2000-2006 data from hospital discharges, as well as economic costs due to diabetes as the main cause and/or ancillary cause of hospitalization (Table 10). The data for 2006 is provisional (prov).

### Diabetes as main cause of hospitalizations from 2000 to 2006

In 2006, 16,219 North Carolinians were discharged from the hospital after receiving care for diabetes as the primary admitting diagnosis, a 16.5 percent increase from 2000. This follows the upward trend of diabetes prevalence rate in the population as a whole. Hospitalization costs associated with the principal diagnosis of diabetes reached \$257 million in

Figure 11:  
N.C. Age-adjusted hospital discharge rates per 100,000 for diabetes as primary diagnosis, 2001-2005



Note: Data includes only NC Residents served in NC Hospitals and is not deduplicated per patient.  
Source: N.C. State Center for Health Statistics

2006 (99.2% increase since 2000). There has been an upward trend, with an average increase of 12.15 percent every year since 2000 (Table 10).

Figure 11 illustrates the county age-adjusted hospitalization discharge rates for diabetes as the primary diagnosis in 2005. In 2005, Anson County had the highest discharge rate for diabetes as the main cause of admission, at 4.5 per 1,000 discharges. The state average was 1.8 per 1,000 in 2005; that rate was shared by Carteret, Davidson, Guilford, Johnston, and Yadkin Counties. (NCDHHS, N.C. County Health Data Book 2007).

**Diabetes co-morbidity and hospitalizations from 2000-2006**

As previously mentioned, diabetes has a high co-morbidity relationship with other health conditions such as renal disease, cardiovascular disease, incidence of cardiovascular accidents or stroke, necrosis and retinopathy. Care, treatment, and associated costs related to these conditions have also increased since 2000.

Table 10:  
Hospitalizations with diabetes mellitus as principal diagnosis in N.C., 2000-2006

Year	Length of stay in days	Total charges in millions	Number of discharges
2000	75,557	\$129	13,914
2001	74,528	\$143	14,144
2002	74,104	\$161	14,627
2003	78,441	\$184	14,836
2004	77,258	\$197	14,973
2005	80,251	\$225	15,542
2006 prov	84,182	\$257	16,219

Source: N.C. SCHS; Hospital discharge data; 2000-2006. Associated hospital charge data has been rounded to the nearest million.

While health care costs have increased, actual utilization of hospital care has decreased for all of these co-morbid conditions (Tables 10, 10B-10F). This downward trend may be a result of better outpatient treatment protocols. It does not appear to be the result of a decreased level of access to health care resulting in a decrease in hospital utilization, as access to health care as measured by health insurance coverage has remained relatively stable (Table 10A).

Diabetes-related retinopathy and blindness is generally treated on an outpatient basis beyond the hospital setting. Consequently, the cost data and treatment statistics are not available for comparison or to present the full scope of usage for this particular diagnosis.

Beyond the principal diagnosis of diabetes as the primary cause of hospitalization among North

Table 10A:  
Access to some form of health care insurance, 2000-2006

Year	2000	2001	2002	2003	2004	2005	2006
Insurance Total Population %	88.9	85.8	83.3	82.6	82.9	80.9	82.2
Coverage For people with Diabetes %	87.1	89.8	87.0	90.8	85.8	88.6	87.9

Source: N.C. BRFSS 2000-2006

Table 10B:  
Renal dialysis or transplant of patients with diabetes, 2000-2006

Year	Length of stay in days	Total charges in millions	Number of discharges
2000	63,742	\$132	8,409
2001	62,601	\$147	8,830
2002	63,222	\$173	8,874
2003	70,396	\$208	9,886
2004	69,533	\$221	9,700
2005	65,875	\$231	9,514
2006 prov	61,532	\$232	9,069

Source: N.C. SCHS; Hospital discharge data; 2000-2006

Table 10C:  
CVD/Heart attack-related hospitalizations in patients with diabetes, 2000-2006

Year	Heart Attack		
	Length of stay in days	Total charges in millions	Number of discharges
2000	186,993	\$543	36,721
2001	187,227	\$608	37,728
2002	181,421	\$706	37,464
2003	185,786	\$810	38,407
2004	176,608	\$883	37,970
2005	166,632	\$923	36,421
2006 prov	159,455	\$969	36,199

Source: N.C. SCHS; Hospital discharge data; 2000-2006

Carolina residents living with diabetes, heart attacks and cardiovascular disease and stroke were the main reasons for hospitalizations every year from 2000 to 2006 (Tables 10C, 10D) followed by renal disease (Table 10B). This finding correlates with the previously cited research and the four-fold increase in prevalence of cardiovascular events in persons with diabetes as compared to the population that does not have diabetes. In addition, 8.3 percent of those with diabetes used the emergency room for a diabetes-related illness in 2006, compared to 7.8 percent in 2005. Continued improvements in strategies for prevention and primary/secondary care of diabetes are needed to help decrease the rates and costs of hospitalization due to diabetes and diabetes-related illnesses.

Table 10D:  
CVA/Stroke-related hospitalizations in patients with diabetes, 2000-2006

Year	Length of stay in days	Total charges in millions	Number of discharges
2000	44,190	\$86	7,990
2001	44,520	\$97	8,114
2002	43,618	\$109	8,069
2003	42,847	\$116	7,994
2004	41,445	\$126	8,048
2005	39,144	\$138	7,905
2006 prov	37,633	\$145	7,851

Source: N.C. SCHS; Hospital discharge data; 2000-2006

Table 10E:  
Amputation-related hospitalizations in patients with diabetes, 2000-2006

Year	Length of stay in days	Total charges in millions	Number of discharges
2000	35,786	\$67	3,124
2001	33,658	\$70	3,006
2002	32,020	\$75	2,932
2003	33,318	\$84	3,055
2004	31,830	\$86	2,903
2005	30,237	\$90	2,855
2006 prov	30,225	\$101	2,875

Source: N.C. SCHS; Hospital discharge data; 2000-2006

### The cost of diabetes in the U.S. and in North Carolina \*

The American Diabetes Association published an article in *Diabetes Care* in March 2008, entitled "Economic Costs of Diabetes in the U.S. in 2007." The study estimates that the total annual economic cost of diabetes in the U.S. was \$174 billion 2007. Direct estimated medical costs of diabetes were \$116 billion, compared to \$92 billion in 2002. The remaining \$58 billion were the estimated indirect costs related to lost productivity. Indirect costs include increased factors such as absenteeism, reduced productivity, and lost productive capacity due to early mortality. The study estimated that the unadjusted annual per capita medical expenditure for people with diabetes was \$11,744, compared to \$2,935 for people without diabetes. One out of every five health care dollars is spent on persons living with diabetes, while one in ten health care dollars is attributed to diabetes. On average, persons with diabetes have

\* American Diabetes Association. Economic cost of Diabetes in the U.S. in 2007. *Diabetes Care* 31:1-20, 2008

approximately 2.3 times higher medical costs than those without diabetes. The age-adjusted annual per capita cost for those with diabetes was \$5,095.

In 2007, diabetes resulted in:

- 15 million work days absent
- 120 million work days with reduced performance
- 6 million work days with reduced productivity for those not in the workforce
- 107 million work days lost due to unemployment disability
- 445,000 cases of unemployment disability
- 284,000 deaths.

The study also points out that the national burden of diabetes likely exceeds the \$174 billion estimate because it does not take into account the pain and suffering, care provided by non-paid caregivers, and costs due to undiagnosed diabetes. The burden is spread across society, as nearly one in ten people have diabetes. These estimates are likely to be conservative if healthcare

Table 10F:  
Diabetes-related blindness hospitalizations, 2000-2006

Year	Length of stay in days	Total charges	Number of discharges
2000	10	\$13,819	3
2001	5	\$12,308	1
2002	12	\$51,072	4
2003	23	\$54,938	5
2004	11	\$36,264	4
2005	6	\$26,149	3
2006 prov	9	\$35,912	4

Source: N.C. SCHS; Hospital discharge data; 2000-2006.

expenditures continue to exceed the cost of living and the obesity rate continues to rise, contributing to the onset of type 2 diabetes.

According to the ADA's new diabetes cost calculator, the total

estimated cost of diabetes for people in North Carolina in 2006 was \$5.3 billion\*. This estimate includes excess direct medical costs of \$3.6 billion, and indirect costs due to lost productivity valued at \$1.7 billion.

\* [www.diabetes.org/advocacy-and-legalresources/cost-of-diabetes.jsp](http://www.diabetes.org/advocacy-and-legalresources/cost-of-diabetes.jsp)

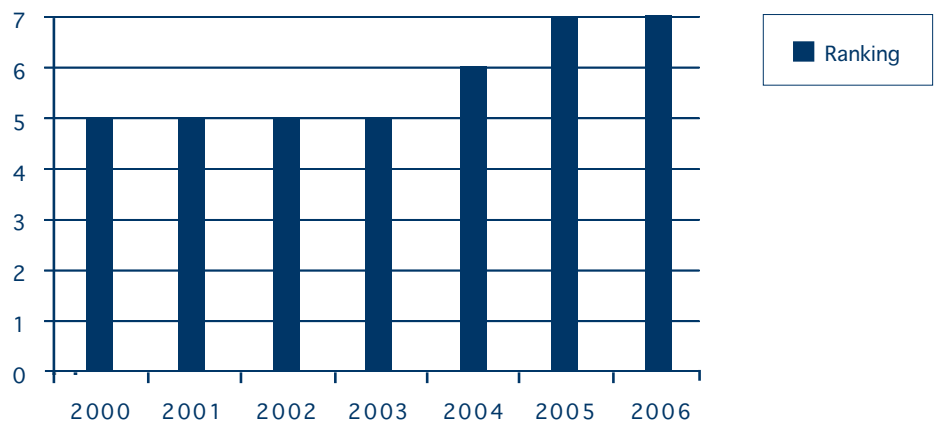


## Diabetes Mortality

**D**iabetes ranked as the seventh leading cause of death in North Carolina in 2006 (Figure 12). A total of 2,230 residents had diabetes listed as the main cause of death on their death certificate in 2006. North Carolina had a 27.1 per 100,000 age-adjusted mortality rate during the period 2002-2006 (Figure 13).

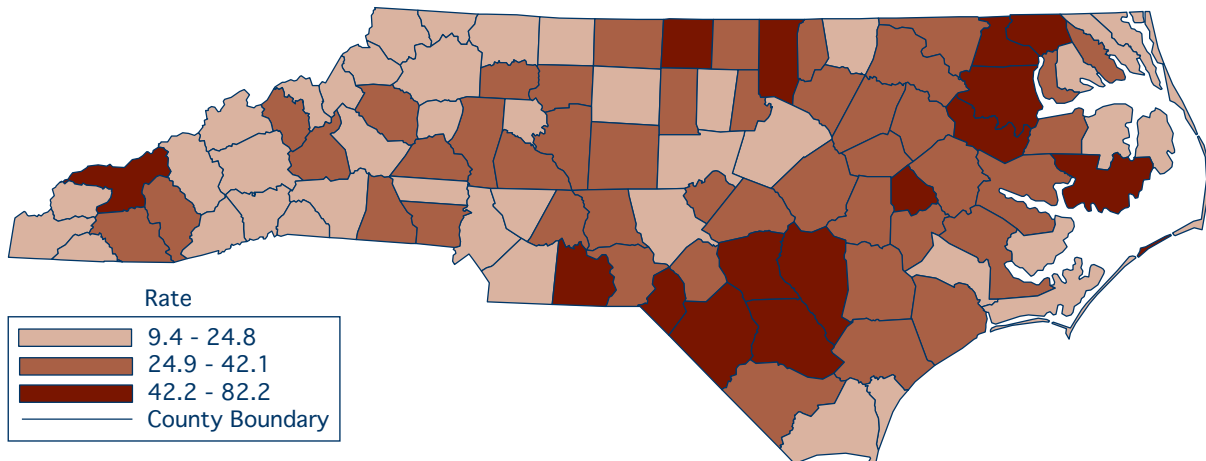
From 2000 to 2006, diabetes ranked in the top seven leading causes of death for North Carolinians. Diabetes moved from ranking fifth in 2000 to sixth in 2004 and then to seventh in 2005

Figure 12.  
Rank for diabetes as leading cause of death for all N.C. residents, 2000-2006



Source: N.C. SCHS: Detailed Mortality Statistics Report, 2007

Figure 13.  
North Carolina age-adjusted mortality rates per 100,000, diabetes mellitus, 2002-2006



Source: N.C. State Center for Health Statistics

Table 11.

The top ten causes of death for all ages in North Carolina from 2000 to 2006 by rank

Cause	2000	2001	2002	2003	2004	2005	2006
Heart Disease	1	1	1	1	1	1	2
Cancer	2	2	2	2	2	2	1
Cerebrovascular disease	3	3	3	3	3	3	3
Chronic lower respiratory disease	4	4	4	4	4	4	4
Diabetes Mellitus	5	5	5	5	6	7	7
Pneumonia and influenza	6	7	8	8	8	8	8
Other unintentional injuries	7	8	6	6	5	5	5
Alzheimer's disease	8	6	7	7	7	6	6
Motor vehicle injuries	9	9	9	9	9	9	9
Nephritis, nephrotic syndrome, nephrosis	10	10	10	10	10	10	10

Source: N.C. DHHS/ SCHS Vital Statistics 2000-2006

(Table 11). Among people aged 55 to 64, diabetes was the sixth leading cause of death in 2006 (North Carolina Vital Statistics Reports, Vol. 2, 2006). Diabetes also contributes greatly to deaths from cardiovascular disease and renal disease.

As stated before, diabetes is a disease of old age. Table 12 shows the age-specific death rates for North Carolinians ages 15 and over with diabetes listed as the main cause of death in 2006. The

Table 12.

Mortality rates for diabetes as the main cause of death, by age, in North Carolina, 2006

Age	Total Deaths	Population	Mortality Rate
15-19	2	621,709	0.32
20-24	2	657,234	0.30
25-34	21	1,198,899	1.75
35-44	82	13,335,071	6.14
45-54	203	1,255,518	16.17
55-64	402	944,129	42.58
65-74	529	570,791	92.68
75-84	600	356,348	168.38
85+	388	132,412	293.03
Total, ages 15 & over	2,229	7,072,111	31.52

Source: NC DHHS: State Center for Health Statistics, 2006

overall diabetes mortality rate in North Carolina was 31.5 percent in 2006. The diabetes mortality rate was highest among people aged 85 years old and over.

From 2002 to 2006, diabetes was listed as the primary cause of death in 11,323 deaths of people in the state. For an additional 29,285 deaths, diabetes was mentioned as a cause of death (Table 12A).

From 2002 to 2006, diabetes mortality rates were higher for men than women (29.8 percent vs. 24.1 percent) and higher for African Americans than whites. Estimates of the impact of diabetes using death certificate data may be low due to the many cases of undiagnosed diabetes.

Table 12A.  
Diabetes mortality, North Carolina, by sex and race, 2002-2006

		Diabetes as the primary cause of death	Any mention of Diabetes as cause of death
Total	Number	11,323	40,608
	Rate*	26.7	96.3
Males	Number	5,277	19,479
	Rate*	29.8	113.0
Females	Number	6,046	21,129
	Rate*	24.1	84.1
White Males	Number	3,586	14,131
	Rate*	24.8	100.1
White Females	Number	3,622	13,886
	Rate*	18.0	67.9
Black Males	Number	1,597	5,064
	Rate*	56.7	183.3
Black Females	Number	2,248	6,853
	Rate*	51.5	157.3
American Indians	Number	191	540
	Rate*	52.7	151.7
Other	Number	39	134
	Rate*	12.1	40.9

\* Per 100,000, age-adjusted to North Carolina Population  
Source: DHHS, State Center for Health Statistics, 2008

Deaths due to diabetes are particularly high among North Carolinians. According to CDC, North Carolina ranked 16<sup>th</sup> highest among all 50 states and the District of Columbia in 2004 in age-adjusted diabetes mortality rates.

African Americans, American Indians and females are identified as the demographic populations with the highest incidence of diabetes. Diabetes was the fourth leading cause of death among African Americans and third among American Indians\*. The age-adjusted death rates for diabetes from 2001 to 2006 among African Americans was 54.4 percent compared to 21.2 percent among whites and 11.4 among Hispanics. However, Hispanics were less likely to report their diabetes than both whites and African Americans (Source: NC DHHS, SCHS, January 2008).

From 2002 to 2006, mortality rates were highest for African American males (56.7 per 100,000 as primary cause; 183.3 per 100,000 as any mention of diabetes as the cause) and lowest for white women (18.0 per 100,000 as primary cause; 67.9 per 100,000 as any mentioned cause). African American women were 2.9 times more likely than white women to have died from diabetes, and African American men were 2.3 times more likely than white men to have died from diabetes (Table 12 A).

\* North Carolina Vital Statistics, Volume 2, Leading Causes of Death - 2006, SCHS.

## Racial Disparities and Quality of Health Care

Inequalities in health care are still widespread and contribute to the gap in diabetes prevalence/incidence, complications, and mortality. Tables 13 and 14 show data by race/ethnicity for diabetes diagnosis and risk factors such as obesity, lack of physical activity, and reduced access to health insurance. Important differences in the prevalence of these indicators were observed by race. African Americans and American Indians had the highest prevalence of diabetes and obesity, while Hispanics and Asians had the lowest prevalence (Table 13). As previously noted, the Asian and Hispanic groups also reported the lowest proportion of people who ever had a blood test for diabetes, which may contribute to an artificially lower prevalence rate in those groups. The Hispanic group\* had the highest proportion of people without health insurance (Table 14).

Table 15 is based on BRFSS 2005 and 2006 diabetes data. It presents reported practices and conditions (clinical practice recommendations received from

health care providers, self-care practices, and self-reported conditions) in high-prevalence populations. A higher percentage of African Americans (76.9%) with diabetes had the HbA1c blood test in 2006 than whites (73.7%). American Indians with diabetes had the highest percentage (92.9%) of receiving an annual foot exam, followed by African

Americans (79.6%) and whites (73.3%). American Indians with diabetes had a higher percentage (81.4%) of receiving a dilated eye exam than African Americans (78.1%) and whites (69.2%). However, this difference is not very significant as the confidence interval was too wide for the rate for American Indians.

Tables 13 and 14.

Health disparities related to diabetes and its risk factors, by race (Table 13) and ethnicity in all adults (Table 14), in North Carolina, 2006

13. Race	Obesity status: BMI ≥ 30	No physical activity in the past month	Had never had a blood test for diabetes	Prevalence of diabetes	Has some form of health insurance
White %	24.3	20.3	35.9	8.7	87.9
African American %	39.4	30.5	36.6	13.4	82.5
Asian %	5.7	14.9	47.8	3.5	91.7
American Indian %	35.2	33.1	41.6	9.8	75.1
14. Hispanic Origin					
Hispanic %	22.6	38.6	54.3	5.7	40.0
Non-Hispanic %	27.0	22.2	36.3	9.4	86.7

Source: N.C. BRFSS data 2006

\*The source for Hispanic data is: [www.schs.state.nc.us/SCHS/pdf/FactsHL.pdf](http://www.schs.state.nc.us/SCHS/pdf/FactsHL.pdf)

Table 15 shows that not enough adults in higher diabetes-prevalence populations are following good preventive practices to manage their diabetes. Only 43.3 percent of American Indians with diabetes reported attending diabetes self management classes, compared to 55.8 percent of African Americans. More than 25 percent of all these adults reported not performing daily foot checks. Foot checks are important, as people with diabetes are at an increased risk of foot ulcers and amputation due to neuropathy. Only 52.6 percent of American Indians reported no diagnosis of retinopathy, compared to 80.5 percent of whites.

This data indicates that there is room for continued improvement in medical surveillance in North Carolina's population living with diabetes. The most significant finding is in the area of self-care, where only 69 percent or less report conducting daily self-monitoring for blood glucose levels (SMBG). Self-monitoring for blood glucose levels is an important element in diabetes care and management.

Table 15.  
Positive clinical practice recommendations and self-reported practices/conditions in high-diabetes-prevalence populations, North Carolina, 2006

<b>Positive Clinical Practice Indicators:</b>	<b>African American %</b>	<b>White %</b>	<b>American Indian %</b>
Two or more HbA1c per year	76.9	73.7	71.3
Annual dilated eye exam	78.1	69.2	81.4
Annual medical foot exam	79.6	73.3	92.9
Medical advice on exercise*	75.3	69.3	63.4
Medical advice on weight control*	97.4	97.4	98.6
<b>Positive self preventive practices:</b>			
Diabetes management class/course	55.8	53.2	43.3
Daily SMBG**	68.6	64.6	68.2
Daily foot check	76.3	73.7	73.1
<b>Self-reported conditions</b>			
No foot sore/lesion lasting more than 4 weeks	94.0	90.5	92.7
No report of diagnosis of retinopathy	73.0	80.5	52.6

\*\*SMBG- Self Monitoring Blood Glucose check  
Source: N.C. BRFSS data 2005\* and 2006

Health care professionals are providing counseling on weight control to patients with diabetes, but there is a disparity in the data on providing advice on weight control and exercise. Among all the groups, at least 97 percent indicated receiving advice on weight control, but less than 76 percent reported receiving

advice on increasing their level of physical activity. This finding, coupled with the statistic that 77.8 percent of North Carolina's residents reported not getting some form of physical activity, further supports the need for health care professionals to increase clinical teaching opportunities related to exercise.

## Summary of Diabetes in Adults in North Carolina

**D**iabetes ranks as the seventh leading cause of death in adults in North Carolina. Recently, the state's population with diabetes increased by 7.1 percent in one year, from 8.5 percent in 2005 to 9.10 percent in 2006. In 1995, 4.5 percent of North Carolinians were living with diabetes, while 16.9 percent of North Carolina residents were obese, compared to 26.6 percent in 2006. Conditions that increase the risk for development of diabetes – such as inactivity, overweight and obesity, and poor nutrition – continue to exist at significant levels. Table 16 summarizes trends in major risk factor indices from 2000 to 2006 in the North Carolina population.

Ongoing programs that encourage healthy eating, physical activity and weight control continue to be critical in the effort to reduce risk factors related to the development of type 2 diabetes and the management of both type 1 and type 2 diabetes.

Table 16.  
Overview of N.C. total population trends related to diabetes, 2000-2006

Year	2000	2001	2002	2003	2004	2005	2006
Statistics related to:							
% U.S. adults with diabetes	6.1	6.5	6.7	7.2	7.1	7.3	7.5
% N.C. adults with diabetes	6.4	6.7	7.2	8.1	9.6	8.5	9.1
N.C. diabetes mortality rank	5	5	5	5	6	7	7
% overweight	37.4	35.9	42.6	37.0	37.9	36.7	36.2
% obese	21.8	22.9	23.5	24	25.2	25.9	26.6
% reporting no physical activity	30.4	26.4	29.5	25.	25.2	25.6	23.8
% < 5 fruits/vegs./day	77.8	74.9	76.4	76.8	NA	77.5	NA

Source: N.C. Vital Statistics 2000-2006 (SCHS) and CDC and N.C. BRFSS 2000-2006

## Diabetes in Children

Type 1 diabetes is the most frequently occurring type of diabetes in children (21). Other types of diabetes in children include type 2 diabetes, atypical diabetes, autosomal dominant disorder which affects mostly African American children, and maturity-onset diabetes of the young (MODY), a rare condition occurring mostly in white children (25, 40).

Type 2 diabetes in children was rare prior to 1980, accounting for only 1 to 2 percent of diabetes cases in children in the United States (39). The NHANES III (1988-94) data found the prevalence of diabetes in children to be 4.1 per 1,000 children, with 31 percent of diabetes cases in adolescents (12-19 years old) being type 2 (20, 21). Several national studies have reported increases in prevalence and incidence of type 2 diabetes in children, with one of the key links being obesity and resulting insulin resistance (20, 21, 32, 39, 52). Obesity and family history are

related to those increases (39, 40). The Centers for Disease Control (CDC) predicts that one in three children will develop diabetes in their lifetimes\*. In 2006, the North Carolina Nutrition and Physical Activity Surveillance System found that 25.2 percent of children ages 5-11, and 29.5 percent of adolescents ages 12-18, were overweight (BMI  $\geq$  95th percentile) (refer to [www.eatsmartmovemore.com/data/](http://www.eatsmartmovemore.com/data/)). Since there are no published studies of diabetes prevalence in children in North Carolina, two different sources of information were compared to estimate the number of children with diabetes in North Carolina: the Child Health Assessment and Monitoring Program (CHAMP) survey and the Annual School Health Services Report.

The CHAMP is a random telephone survey of households participating in the N.C. BRFSS survey that reported having at least one child age 0-17. In a

household reporting more than one child, the interviewer chose one of the children at random for a computerized interview. This interview was conducted by phone with each child's caregiver and included questions about demographic information, risk factors, health care accessibility, and health conditions including diabetes.

The Annual Health School Services Report is an annual report made by public school nurses across the state since 1997. The report enumerates the number of children with chronic diseases, including diabetes. The type of diabetes was not specified for all children in the report.

## Prevalence and estimated number of children affected by diabetes in North Carolina

In the CHAMP survey, caregivers of over 3,000 children each year were asked if their children have diabetes. Table 17 shows the reported prevalence of diabetes among children in 2005 and 2006. In 2006, the mean

Table 17.  
Prevalence of diabetes in children in North Carolina, CHAMP Survey, 2005 -2006\*

Prevalence Mean and 95% Confidence Interval	Diabetes Prevalence N/1,000 children		Pre-Diabetes N/1000 children	
	2005 (n=16)	2006 (n=17)	2005 (n=27)	2006 (n=13)
Prevalence Mean	6.0/1,000	4.0/1,000	7.0/1,000	4.0/1,000
Lower 95% confidence Interval	4.0/1,000	2.0/1,000	5.0/1,000	2.0/1,000
Upper 95% Confidence Interval	11.0/1,000	7.0/1,000	11.0/1,000	7.0/1,000

\*Reference Appendix 2 Technical Notes related to statistics  
Source: North Carolina State Center for Health Statistics; CHAMP Survey 2005 and 2006

Table 18.  
Number and prevalence of public school children with diabetes by year in North Carolina, Public School Nurses' Report, 1997- 2006

School Year	Total represented in survey/ % of total student population	Number of children with diabetes	Diabetes prevalence
1997-1998	1,157,203/95%	2,485	2.15/1,000
1998-1999	1,206,183/99%	2,828	2.34/1,000
1999-2000	1,229,006/99%	3,083	2.51/1,000
2000-2001	1,238,801/99.6%	2,620	2.11/1,000
2001-2002	1,268,526/99.7%	2,595	2.06/1,000
2002-2003	1,189,830/93%	2,423	1.89/1,000
2003-2004	1,305,501/99%	3,643	2.79/1,000
2004-2005	1,332,009/100%	3,871	2.91/1,000
2005-2006	1,363,695/100%	4,437	3.2/1,000
1997-2006 Average	1,254,452/98.2%	3,109	2.44/1,000

Source: North Carolina Annual School Health Services Reports for Public Schools/School Nursing Services, 1997-2006, Women and Children Branch, Division of Public Health.

prevalence rate for diabetes was 4 cases per 1,000 children, with 95 percent confidence intervals (CI) at 2-7. In that year, the mean prevalence for pre-diabetes was also 4 cases per 1,000 children, with 95 percent confidence intervals at 2-7. The CHAMP survey also found that 25 percent of diabetes cases were type 2. This estimated diabetes prevalence and proportion of Type 2 is similar to that found in NHANES III, which was 4.1 cases per 1,000 children, with 31 percent of cases being type 2 (20, 21).

### **Diabetes prevalence in the North Carolina public school system from 1997 to 2006**

Table 18 presents the total number of children represented in survey in public schools, the number of children reported with diabetes, and the estimated prevalence by year from 1997 to 2006.

The public school nurses reported that from 1997 to 2006, on average, 3,109 children were living with diabetes in North Carolina annually. This rate average is similar to the lower end of the 95% CI of the diabetes prevalence from the CHAMP survey. This report found that 4,437 public school students in North Carolina had diabetes

in 2005-2006; 3,419 monitor blood glucose at school; 1,918 receive insulin injections at school; and 1,414 have insulin pumps. Positive management of diabetes through acquiring healthy lifestyle skill sets is the key to the health and well being of these children as they grow into adulthood. Efforts need to be ongoing to prevent children from being overweight and obese. Information regarding programs such as “Color Me Healthy” (catered to preschool children), “Energizers” (classroom- based physical activities for elementary and middle school children), “Eat Smart School Standards”, and “Move More School Standards” which can be found at [www.eatsmartmovemorenc.com](http://www.eatsmartmovemorenc.com).

## N.C. Diabetes Prevention & Control Program and Partnerships

**T**he North Carolina Diabetes Prevention and Control Program (DPCP) is responsible for helping North Carolina residents reduce the impact of diabetes through leadership, education, surveillance, communication, community involvement and capacity building, advocacy and policy development. The DPCP has established partnerships with various national, state and local government agencies, non-profit organizations, and educational institutions to increase awareness of diabetes prevention and control strategies. Some of the community programs highlighted here are Project DIRECT, Diabetes Today, and Diabetes Fellowship at East Carolina University Brody School of Medicine.

### **Project DIRECT**

This successful Community-Based Diabetes Program was funded in 1994 by the Centers for Disease Control and Prevention. Project DIRECT (Diabetes Interventions Reaching and Educating Communities Together) (41) is

a community-based research demonstration project responding to the excessive burden of diabetes among African-Americans. DIRECT was the first community project with a comprehensive approach to reduce the burden of diabetes by addressing all three levels of prevention (primary, secondary, and tertiary) where interventions were designed to increase physical activity, diabetes self-management care, quality of care through health care providers, and knowledge of nutritional needs.

Project DIRECT, located in the Southeast Raleigh community in North Carolina, was designed as a partnership among the CDC, the N.C. Department of Health and Human Services, Wake County Human Services, and the Southeast Raleigh community. In 1996, the first interventions began and focused on three areas:

1. Community Outreach. Activities focused on screening for undiagnosed diabetes, recruiting participants into program activities, and reaching the faith community.

2. Health Promotion. Activities focused on increasing physical activity by establishing walking groups, training exercise leaders, reducing fat intake by conducting nutrition workshops in the community and with church kitchen committees, and developing individual church health plans.
3. Diabetes Care. Activities focused on teaching diabetes self-management classes and improving the quality of diabetes care through health care providers.

CDC conducted an extensive evaluation of the project and found that it had a major impact on residents in the Southeast Raleigh community. The community experienced a significant change in behavior related to diabetes care and prevention. Pre-intervention and post-intervention surveys were conducted with randomly selected adults in Raleigh and Greensboro (the control, or comparison, community) during

1996-1997 and 2003-2004. The 2,311 pre-intervention and 3,083 post-intervention participants were interviewed, and over half had health examinations. Compared with the baseline, post-intervention respondents in Southeast Raleigh who were African American reported the following statistically significant lifestyle changes:

- Sedentary lifestyles decreased from 39.3% to 30.9%.
- Eating a high-fat diet decreased from 82.8% to 79.4%.
- Awareness of six or more possible risk factors for diabetes increased from 66.8% to 83.9%.
- For persons with diabetes, having at least one medical visit in the past year increased from 86.4% to 90.8%.
- Trying to maintain or lose weight increased from 77.3% to 85.8%.

Although the prevalence of diabetes rose in both communities from the baseline survey in 1996-97 to the final survey in 2004, the prevalence rates in 2004 were significantly lower in Southeast Raleigh (16.2%)

compared to Greensboro (19.3%). While the prevalence of diabetes increased by only 5.1% from 11.1% to 16.2% in Southeast Raleigh, it almost doubled by 9.4% from 9.9% to 19.3% in Greensboro. The lessons learned from Project DIRECT are shared through the DIRECT Academy. The Academy is a forum where the community leaders and government agencies responsible for leading Project DIRECT share experiences and lessons learned for developing and sustaining community partnerships with other communities across the state.

### **Diabetes Today**

Diabetes Today is a curriculum designed by CDC to address diabetes from a public health perspective rather than exclusively as a medical problem. It provides health professionals and community leaders with the skills needed to mobilize communities and develop appropriate interventions for responding to the burden of diabetes and improving the quality of diabetes care. Since Diabetes Today began in 1994

in North Carolina, DPCP has implemented the curriculum in approximately 86 of the state's 100 counties.

In 2004, Diabetes Today expanded to a regional initiative modeling the N.C. Heart Disease and Stroke Prevention Program, to expand community mobilization to a broader geographic region. This initiative is designed to have local health departments in their catchment area increase the spread of community-based programs focused on reducing the burden of diabetes through awareness, education, and prevention strategies. The partnerships with the local health departments, Division of Indian Affairs, El Centro Hispano, and Medicaid Managed Care Programs have provided the DPCP with a venue to address health disparities for African Americans, Hispanics, and the American Indian populations through community-based health education programs.

## **Diabetes Fellowship at East Carolina University Brody School of Medicine**

The Diabetes Prevention and Control Branch in North Carolina partners with the East Carolina University Brody School of Medicine to host the Diabetes Fellowship, referred to as the Hugh Young Memorial Scholarship program. This program offers scholarships to approximately 45 attendees per year from local health departments, rural health centers, and non-profit organizations that provide direct services to people living with diabetes. The week-long training provides an intensive update of current standards of care, new technologies used in treating diabetes, and a study in medications used by diabetes educators and professionals. This program enhances the state's ability to support effective diabetes education, thereby improving the state's ability to treat diabetes patients. ■



## References

1. American Diabetes Association. Clinical Practice Recommendations, 2008. *Diabetes Care*, 2008; Volume 31 (Supp 1):S1–S104.
2. American Diabetes Association. The prevention or delay of type 2 diabetes. *Diabetes Care*, 2002; 25: 742-749.
3. Barzilay J, et al. The association of fasting glucose levels with congestive failure in diabetic adults > or = 65 years. *J Am Coll Cardiol*, 2004; 43:2236-2241.
4. Bell R. (Ed.). *Diabetes 2001, Vital Statistics*. First ed. Alexandria, VA. American Diabetes Association; 2003.
5. Bell R, Page J. Focus on Diabetes in N.C. Diabetes Prevention and Control Unit, DHHS. July, 2000.
6. Bloomgarden Z. Obesity, hypertension and insulin resistance. *Diabetes Care*. 2002; 25: 2088-2097.
7. Center for Disease Control and Prevention. Self reported heart disease and stroke among adults with and without diabetes, United States, 1999-2001. *MMWR*. 2003; 52: 1065-1070.
8. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System (BRFSS); 1990-2006.
9. Cowie C., et al. Prevalence of undiagnosed diabetes and impaired fasting glucose in adults, United States, 1999-2000. *MMWR* 2003; 52: 833-837.
10. Curtis J, To T, Muirhead S, Daneman D., Cummings, E. Recent trends in hospitalization for diabetic ketoacidosis in Ontario children. *Diabetes Care*, 2002; 25:1591-1596.
11. DECODE Study Group: Glucose intolerance and cardiovascular mortality. *Arch Intern Med.*, 2001; 161:397-405.
12. DECODE Study Group. Is the current definition of diabetes relevant to mortality risk from all causes and cardiovascular and non-cardiovascular diseases? *Diabetes Care*, 2003; 26: 688-696.
13. Despres J, Lamarche B, Maurige P, Cantin B, Dagenais G, Moorjani S, Lupien P. Hypersinsulinemia as an independent risk factor for ischemic heart disease. *The New England Journal of Medicine*, 1996; 334: 952-957.
14. Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *The New England Journal of Medicine*, 1993; 329: 977-986.
15. Diabetes Prevention and Complication Trial Research Group: Reduction in the incidence of type 2 diabetes with life-style intervention or metformin. *The New England Journal of Medicine*, 2002; 346: 393-403.
16. Erkens J, Klungel O, Stolk R, et al. Cardiovascular drug use and hospitalizations attributable to type 2 diabetes. *Diabetes Care*, 2001; 24: 1428-1432.

17. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: Report of the Expert Committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care*, 1997; 20:1183-1197.
18. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Follow-up report of the diagnosis of diabetes mellitus. *Diabetes Care*, 2003; 26: 3160-3167.
19. Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in adults. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Arch Intern Med.*, 1998; 158:1855-1867.
20. Fagot-Campagna A, Narayan KM, Imperatore G. Type 2 diabetes in children. *British Medical Journal*, 2001; 322: 377-378.
21. Fagot-Campagna, A, Saaddine JB, Flegal KM, Beckles GL. Diabetes, impaired fasting glucose and elevated HBA1c in U.S. adolescents: The Third National and Nutrition Examination Survey. *Diabetes Care*, 2001; 24: 834-837.
22. Field A., et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Inter Med*, 2001;161:1581-1586.
23. Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *The New England Journal of Medicine*, 2001; 344:1343-1350.
24. Greenberg A, Obin M. Obesity and the role of adipose tissue in inflammation and metabolism. *American Journal of Clinical Nutrition*, 2006; 83:461S-465-S.
25. Hattersley AT. Diagnosis of maturity-onset diabetes of the young in the pediatric diabetes clinic. *Journal of Pediatric Endocrinology & Metabolism*. 2000; 13: 1411-1417.
26. Hoerger T, Hicks K, et al. Cost-Effectiveness of Screening for Pre-Diabetes Among Overweight and Obese U.S. Adults. *Diabetes Care*, November 2007; 30: 2874-2879.
27. Kanaya A, Herrington D, Vittinghoff E, and et al. Impaired fasting glucose and cardiovascular outcomes in postmenopausal women with coronary artery disease. *Annals of Internal Medicine*, 2005; 142: 813-820.
28. Kern P, Subramanian R, Li C, Wood L, Ranganathan G. Adipose tissue tumor necrosis factor and interleukin-6 expression in human obesity and insulin resistance. *Am J Physiol Endocrinol Metab*, 2001; 280: E745-E751.
29. Klein S, Sheard N, Pi-Sunyer X, Daly A, Rosett J, Kulkarni K, Clark N. Weight management through life style modification for the prevention and management of type 2 diabetes: rationale and strategies. *Diabetes Care*, 2004; 27:2067-2073.
30. Levitan E, Song Y, Ford E, Liu S. Is nondiabetic hyperglycemia a risk factor for cardiovascular disease? *Arch Intern Med*, 2004; 164:2147-2155.

31. Matz K, Tatschi C, Keresztes K, Dachenhausenm A, Brainin M, Tuomilehto J. et al. Disorder of glucose metabolism in acute stroke patients. *Diabetes Care*, 2006; 29:792-797.
32. Nesmith JD. Type 2 diabetes mellitus in children and adolescents. *Pediatrics in Review*, 2001; 22:147-152.
33. Nichols G, Hillier T, Erbey J, Brown J. Congestive heart failure in type 2 diabetes, prevalence, incidence, and risk factors. *Diabetes Care*, 2001; 24:1614-1619.
34. Nielsen C, Lange T. Blood glucose and heart failure in nondiabetic patients. *Diabetes Care*, 2005; 28: 607-611.
35. North Carolina Behavioral Risk Factor Surveillance System N.C., available at: <http://www.schs.state.nc.us/SCHS/brfss/index.html>.
36. North Carolina State Center for Health Statistics, Department of Health and Human Services, Raleigh. *Vital Statistics*, 2005; Vol 2. Available at: [www.schs.state.nc.us/SCHS/](http://www.schs.state.nc.us/SCHS/).
37. North Carolina State Center for Health Statistics, Department of Health and Human Services, Raleigh: *Diabetes hospitalization data, 1990-2005*.
38. North Carolina State Center for Health Statistics, Department of Health and Human Services, Raleigh. *Diabetes mortality data, 1980-2005*.
39. Pinhas-Hamiel O, Dolan LM, Daniels SR, Standiford D, Khoury PR, Zeitler P. Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *Journal of Pediatrics*, 1996; 128: 608-615.
40. Ponder SW, Sullivan S, McBath G. Type 2 diabetes in teens. *Diabetes Spectrum*, 2000; 13: 95-105.
41. RTI International (Research Triangle Institute) (2005). *Project DIRECT: Phase 2. Evaluation of impact of multilevel community intervention: Final Report*. Atlanta, GA: Division of Diabetes Translation, CDC, National Center for Chronic Disease Prevention and Health Promotion.
42. Russel L, Valiyeva E, Roman S, et al. Hospitalization, nursing home admissions, and deaths attributable to diabetes. *Diabetes Care*, 2005; 28:1611-1617.
43. Sasso F, Carbonara O, Nasti R, Campana B, and et al. Glucose metabolism and coronary heart disease in patients with normal glucose tolerance. *JAMA*, 2004; 291:1857-1863.
44. Saydah S, Loria C, Eberhardt M, Brancati F. Subclinical states of glucose intolerance and risk of death in the U.S. *Diabetes Care*, 2001; 24: 447-53.
45. Sechi L, Catena C, Zingaro L, Melis A, De Marchi S. Abnormalities of glucose metabolism in patients with early renal failure. *Diabetes* 2002; 51: 1226-1232.
46. Selvin E, Wattanakit K, Steffes M, Coresh J, Sharret A. HbA1c and peripheral arterial disease in diabetes. *Diabetes Care*, 2006; 29: 877-882.

47. Sullivan P, Morrato E, Ghushchyan V, Wyatt H, Hill J. Obesity, inactivity and the prevalence of diabetes and diabetes-related cardiovascular co-morbidities in the U.S., 2000-2002. *Diabetes Care*, 2005; 28:1599-1603.
48. Valeriano E, Reaves J, Porterfield D, Munoz-Plaza C. Diabetes in North Carolina, a summary report - 2002. Diabetes Prevention Control Branch, N.C. DHHS, [www.ncdiabetes.org](http://www.ncdiabetes.org).
49. United Kingdom Prospective Diabetes Study Group. Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet*, 1998; 352: 837-853.
50. United Kingdom Prospective Diabetes Study Group. Tight blood pressure control and risk of macro-vascular and micro-vascular complications in type 2 diabetes (UKPDS 38). *British Medical Journal*, 1998; 317:703-713.
51. Williams K, Bertoldo A, Kinahan P, Cobelli C, Kelley D. Weight loss-induced plasticity of glucose transport and phosphorylation in the insulin resistance of obesity and type 2 diabetes. *Diabetes* 2003; 52:1619-1626.
52. Women's and Children's Health Section, North Carolina Department of Health and Human Services.

## Appendix 1

### CDC and N.C. Behavioral Risk Factor Surveillance Survey Data DIABETES MODULE

These foundation questions were included in the BRFSS survey from 2000 to 2006 to collect data related to diabetes and diabetes care:

- Have you ever been told by a doctor that you have diabetes?
- How old were you when you were told you have diabetes?
- Are you now taking insulin?
- Are you now taking diabetes pills?
- About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do not include times when checked by a health professional.
- About how often do you check your feet for any sores or irritations? Include times when checked by a family member or friend, but do not include times when checked by a health professional.
- Have you ever had any sores or irritations on your feet that took more than four weeks to heal?
- About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?
- A test for hemoglobin 'A one C' measures the average level of blood sugar over the past three months. About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for hemoglobin 'A one C'?
- About how many times in the last year has a health professional checked your feet for any sores or irritations?
- When was the last time you had an eye exam in which the pupils were dilated? This would have made you temporarily sensitive to bright light.
- Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?
- Have you ever taken a course or class in how to manage your diabetes yourself?

## Appendix 2

### Technical Notes

- Data collected in certain instances may have a small sample size or may contain rates or percentages with a small numerator. Caution is recommended when interpreting rates based on small numbers. (Buescher, P. Statistical Primer; April 1997: N.C. DHHS, State Center for Health Statistics)
- The State Center for Health Statistics frequently releases data by race for only two groups – “white” and “minority.” Many obstacles hamper efforts to obtain accurate health measures for specific minority populations. Smaller minority populations within a geographic sector often result in very small sample sizes. A small number of health events in the numerator of a rate leads to unstable rates, a situation encountered for the smaller minority groups. Base data for the denominator comes from census data, which is not collected every year.
- Rates and percentages are not considered statistically reliable if the numerator or sample size is less than 20 (Racial and Ethnic Differences in Health in North Carolina: 2004 Update; N.C. DHHS: May 2004).

## Notes

overall diabetes mortality rate in North Carolina was 31.5 percent in 2006. The diabetes mortality rate was highest among people aged 85 years old and over.

From 2002 to 2006, diabetes was listed as the primary cause of death in 11,323 deaths of people in the state. For an additional 29,285 deaths, diabetes was mentioned as a cause of death (Table 12A).

From 2002 to 2006, diabetes mortality rates were higher for men than women (29.8 percent vs. 24.1 percent) and higher for African Americans than whites. Estimates of the impact of diabetes using death certificate data may be low due to the many cases of undiagnosed diabetes.

Table 12A.  
Diabetes mortality, North Carolina, by sex and race, 2002-2006

		Diabetes as the primary cause of death	Any mention of Diabetes as cause of death
Total	Number	11,323	40,608
	Rate*	26.7	96.3
Males	Number	5,277	19,479
	Rate*	29.8	113.0
Females	Number	6,046	21,129
	Rate*	24.1	84.1
White Males	Number	3,586	14,131
	Rate*	24.8	100.1
White Females	Number	3,622	13,886
	Rate*	18.0	67.9
Black Males	Number	1,597	5,064
	Rate*	56.7	183.3
Black Females	Number	2,248	6,853
	Rate*	51.5	157.3
American Indians	Number	191	540
	Rate*	52.7	151.7
Other	Number	39	134
	Rate*	12.1	40.9

\* Per 100,000, age-adjusted to North Carolina Population  
Source: DHHS, State Center for Health Statistics, 2008

