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Prevalence of Diabetes in the United States
A Glimmer of Hope?

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Obesity is a major risk factor for type 2 diabetes. The prevalence of obesity in US adults, defined as a body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) of 30 or greater, changed little between 1960 and 1980 (from 13% in 1960 to 15% in 1980). Subsequently, between 1980 and 2000, the prevalence of obesity in the United States doubled from 15% to 31%.[1] Since then, there has been relatively little change in the prevalence of obesity among infants and toddlers, children and adolescents, or adults. Nevertheless, the prevalence of obesity is high with 8% of infants and toddlers, 17% of those aged 2 to 19 years, and 35% of US adults aged 20 years or older estimated to be obese.[2,3]

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An earlier study of trends in diagnosed diabetes among US adults demonstrated stable incidence and prevalence rates between 1980 and 1990 and sharp increases in both incidence and prevalence each year between 1990 and 2008, but a leveling off of diabetes prevalence and a possible decrease in diabetes incidence between 2008 and 2012.[4]

In this issue of *JAMA*, Menke and colleagues[5] analyzed data from the National Health and Nutrition Examination Survey (NHANES) to estimate the prevalence of total, diagnosed, and undiagnosed diabetes in US adults in 2011-2012 and to update national trends between 1988 and 2012. The authors defined diagnosed diabetes as self-report of a previous diagnosis of diabetes. Depending on the availability of data, they used 2 definitions for undiagnosed diabetes: (1) a hemoglobin A_{1c} level of 6.5% or greater, a fasting plasma glucose (FPG) level of 126 mg/dL or greater, or a 2-hour plasma glucose (2 hours after a 75 g oral glucose load) level of 200 mg/dL or greater or (2) a hemoglobin A_{1c} level of 6.5% or greater or an FPG level of 126 mg/dL or greater. In both instances, total diabetes was defined as the sum of the cases of diagnosed and undiagnosed diabetes.

In 2011-2012, using the hemoglobin A_{1c}, FPG, or 2-hour plasma glucose diabetes definition, the unadjusted prevalence was 14.3% for total diabetes, 9.1% for diagnosed diabetes, and 5.2% for undiagnosed diabetes. The prevalence of total diabetes was higher in older age groups but similar among men and women. Compared with non-Hispanic white participants in whom the age-standardized prevalence of total diabetes was 11.3%, the prevalence of total diabetes was higher in non-Hispanic black (21.8%) and Hispanic (22.6%) participants and marginally higher in non-Hispanic Asian (20.6%) participants. The percentage of people with diabetes who were undiagnosed was higher among non-Hispanic Asian (50.9%) and Hispanic participants (49.0%) than among non-Hispanic black (36.8%) and non-Hispanic white (32.3%) participants.

Using the hemoglobin A_{1c} or FPG diabetes definition, the age-standardized prevalence of total diabetes increased from 9.8% in 1988-1994 to 12.5% in 2007-2008, but remained at approximately 12% between 2008 and 2012. The increase in diabetes prevalence between 1988 and 2012 was due to an increase in diagnosed diabetes. Indeed, the age-standardized percentage of total diabetes that was undiagnosed decreased from 40.3% in 1988-1994 to 31.0% in 2011-2012 in the entire US population. The percentage of total diabetes that was undiagnosed did not decrease significantly in people aged 20 to 44 years (40% in 1988 and 40% in 2012).

These findings suggest that the recommendations issued by the US Surgeon General[6] and the Institute of Medicine,[7] the implementation of food, nutrition, agricultural, and physical activity policies and regulations by federal, state, and local governments,[8] and the focus on individual behavioral change related to diet and physical activity by the US Centers for Disease Control and Prevention[9] (CDC) have

begun to affect the prevalence of obesity, and secondarily, after a delay of approximately 10 years, the prevalence of type 2 diabetes.

The fact that the proportion of individuals with undiagnosed diabetes in the United States is decreasing is encouraging in that reducing the lead time between diabetes onset and clinical diagnosis, combined with prompt initiation of treatment for glycemia and cardiovascular risk factors, is likely to confer substantial health benefits.[10] However, the finding that an estimated one-quarter with diabetes in the United States remain undiagnosed is hardly surprising. Numerous studies have demonstrated that the use of different diagnostic tests identifies different individuals with diabetes and results in different prevalence rates of diabetes. An analysis of NHANES 2005-2010 data demonstrated that 2.8% of US adults would be diagnosed with diabetes by hemoglobin A_{1c} criteria alone, 4.7% by FPG criteria alone, and 9.1% by 2-hour plasma glucose criteria alone.[11]

The American Diabetes Association (ADA) recommends that the same test be used to make and confirm the diagnosis of diabetes[12]; and most clinicians perform only the hemoglobin A_{1c} or FPG test. In the study by Menke and colleagues,[5] any FPG, hemoglobin A_{1c}, or 2-hour plasma glucose test result above the diagnostic threshold was used to define diabetes. Therefore, clinicians relying on a single diagnostic test will never identify the universe of patients with diabetes who would be identified if all 3 tests were used.

The greater prevalence of undiagnosed diabetes among Asian American individuals suggests that less screening and diagnostic testing is being performed among less obese Asian American individuals, despite the greater cardiometabolic risk that occurs at lower BMI levels.[13] This finding supports the recent recommendation of the ADA to consider diabetes testing for all Asian American individuals with a BMI of 23 or greater.[13] The higher prevalence of undiagnosed diabetes in younger people and Hispanic individuals with diabetes may reflect less access to health care. Greater access to care through the Affordable Care Act may help to address this disparity.[14]

Although obesity and type 2 diabetes remain major clinical and public health problems in the United States, the current data provide a glimmer of hope. The shift in cultural attitudes toward obesity,[15] the American Medical Association's (AMA's) recognition of obesity as a disease,[16] and the increasing focus on societal interventions to address food policy and the built environment[8] are beginning to address some of the broad environmental forces that have contributed to the epidemic of obesity. The effort of the AMA to promote screening, testing, and referral of high-risk patients for diabetes prevention through its Prevent Diabetes STAT program[17] and the CDC's efforts to increase the availability of diabetes prevention programs, ensure their quality, and promote their use[9] appear to be helping to identify at-risk individuals and provide the infrastructure to support individual behavioral change.

Providing insurance coverage for intensive behavioral therapies for obesity[18] and using behavioral economic approaches to encourage their uptake[19] are further removing barriers to patient engagement and are providing strong incentives for individual behavioral change. Together, these multifaceted approaches addressing both environmental factors and individual behaviors appear to be slowing the increase in obesity and diabetes, and facilitating the diagnosis and management of diabetes. Progress has been made, but expanded and sustained efforts will be required.

ARTICLE INFORMATION

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Progress in the Care of Extremely Preterm Infants

Roger F. Soll, MD

In this issue of *JAMA*, Stoll and colleagues report on care practices, morbidity, and mortality of 34 636 infants 22 through 28 weeks' gestation, weighing 401 to 1500 g, born at 26 National Institute of Child Health and Human Development (NICHD) Neonatal Research Network centers between 1993 and 2012.[1] This article provides an important historical perspective over the last 2 decades in neonatal-perinatal medicine and the most recent update on trends in neonatal care.

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For the overall population of these preterm infants, survival increased from 70% in 1993 to 79% in 2012. The improvement in survival was greatest between 2009 and 2012 among infants 23 weeks' (reaching 33%) and 24 weeks' (reaching 65%) gestational age; with smaller relative increases for infants 25 and 27 weeks' gestation; and no change for infants aged 22, 26, and 28 weeks' gestation. Perhaps not seeing substantial changes in survival in the more mature infants in this cohort is not surprising; these infants are no longer at high risk of dying. What is heartening is the improvement in survival without morbidity observed among infants at 27 and 28 weeks' gestation (27 weeks: 35% in 1993 to 50% in 2012 among infants surviving to discharge; 28 weeks: 43% to 59%). The unfortunate corollary to this finding is that although survival improved in the least-mature infants, no improvement in survival without morbidity was seen in infants who were 22 to 24 weeks' gestation.

Details regarding the individual morbidities experienced by these infants over the past 20 years are less clear. Severe intracranial hemorrhage decreased, but these improvements were restricted to infants at 26 to 28 weeks' gestation. Similarly, improvements in periventricular leukomalacia were limited to this more mature population. Little improvement was observed in necrotizing enterocolitis, and bronchopulmonary dysplasia increased. Late-onset sepsis presented a mixed picture; no changes were seen for the first 12 years and then substantial improvements occurred in the last 8 years.

Similar findings have been reported by the Vermont Oxford Network (VON), a voluntary collaboration of health care professionals whose mission is to improve the quality and safety of medical care for newborns and their families.[2] VON member centers are more diverse than the NICHD Neonatal Research Network, including both community and academic neonatal intensive care units and many of the Neonatal Research Network centers. Approximately 90% of very low-birth-weight infants born in the United States are currently included in the VON database. Trends over the past 20 years have been reported in 2 articles.[3,4] The first detailed outcomes for a cohort of 118 448 infants who weighed 501 to 1500 g at birth from 362 neonatal intensive care units between 1991 and 1999.[3] The rates of mortality, as well as many morbidities including pneumothorax, intraventricular hemorrhage, and severe intraventricular hemorrhage, declined between 1991 and 1995, but did not change significantly in the latter half of the 20th century.

A second article reported outcomes between 2000 and 2009 and found meaningful but smaller changes in mortality and morbidity.[4] Among infants weighing 501 to 1500 g at birth, mortality decreased from 14.3% to 12.4% and major morbidity in survivors decreased from 46.4% to 41.4%. As in the current study, changes in mortality were greatest in the smallest and least mature infants; for infants weighing 501 to 750 g at birth, mortality decreased by 5.3% (41.8%-36.6%). Of note, rates of mortality and morbidity were lower in the VON database, likely due to differences in the populations reported (infants weighing 401-500 g at birth are not reported by VON) and perhaps reflecting differences in case mix. Certain outcomes seem to have been somewhat resistant to change in both networks; little change or worse outcomes were seen in chronic lung disease, periventricular leukomalacia, and necrotizing enterocolitis.

What might account for these changes in outcome? Throughout these 20 years, there have been many changes in practice. In both the Neonatal Research Network and VON, substantial differences were noted in obstetric practices, including the increased use of antenatal corticosteroids and cesarean delivery.[1,3-5] Undoubtedly, evidence-based interventions, such as the increased use of antenatal corticosteroids, have contributed to improving many outcomes.[6]

Many other practices have changed, but the effect on outcomes seems less certain. In the past 10 years, delivery room intubation has decreased and the use of noninvasive respiratory support has increased.[1,5] High-frequency ventilation has increased substantially throughout the past 2 decades. Yet little change has been seen in bronchopulmonary dysplasia, the outcome most linked to these respira-