Prevalence of Stroke—United States, 2006–2010

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In 2008, mortality from stroke was the fourth leading cause of death in the United States, and stroke was a leading cause of long-term severe disability. Nearly half of older stroke survivors experience moderate to severe disability. Care for stroke survivors cost an estimated $18.8 billion in the United States during 2008, and lost productivity and premature mortality cost an additional $15.5 billion. A 3.6% decline in stroke mortality during 2007–2008 means that the prevalence of stroke (defined in this report as the percentage of noninstitutionalized persons who have ever experienced a stroke) will increase if stroke incidence and the mean length of post-stroke survival does not decrease and the proportion of institutionalized stroke survivors does not change. Measuring the prevalence of stroke at the state level enables CDC and state health officials to target resources to populations or regions with high prevalence. A previous report of state-level stroke prevalence used 2005 Behavioral Risk Factor Surveillance System (BRFSS) data. To measure recent trends in stroke prevalence by sociodemographic characteristics and state of residence, CDC analyzed 2006–2010 data from BRFSS. This report describes the results of that analysis, which indicated that during this period, overall self-reported stroke prevalence did not change. However, consistent with findings in the previous report, there were disparities in stroke prevalence identified by age, race/ethnicity, and level of education. Specifically, older adults, blacks, American Indians/Alaska Natives, persons with lower levels of education, and persons living in the southeastern United States had higher stroke prevalence.

BRFSS is a state-based surveillance system. Each year, state health departments (with assistance from CDC) conduct random-digit–dialed, landline telephone surveys of the noninstitutionalized civilian population aged ≥18 years in all 50 states, the District of Columbia (DC), Puerto Rico, Guam, and the U.S. Virgin Islands. Median response rates during 2006–2010 ranged from 50.6% to 54.6%. Since 2005, the core component of the survey has included a cardiovascular disease section, which includes one question related to stroke: “Has a doctor, nurse, or other health professional ever told you that you had stroke?” Participants who answered “yes” to this question were defined as having self-reported stroke. Participants were excluded if they answered “don’t know” or refused to answer this question. Stroke prevalence was calculated based on the proportion of the population answering “yes.” Data on the following sociodemographic characteristics were obtained from BRFSS core questions and included in this analysis: age group (18–44 years, 45–64 years, and ≥65 years), sex, race/ethnicity (white, black, Hispanic, Asian or Native Hawaiian/Other Pacific Islander [Asian/NHOPI], and American Indian/Alaska Native), level of education, and state of residence.

Data analyses were conducted using statistical software. Sample weights were applied in all analyses to account for the probability of nonresponse and noncoverage in the complex sampling design. Age-adjusted prevalence of stroke was estimated using the 2000 U.S. standard population. Linear trends across survey periods were assessed using orthogonal polynomial coefficients, and results with a p-value <0.05 were considered significant.

The total number of BRFSS participants ranged from 347,790 in 2006 to 444,927 in 2010 from all 50 states and DC. The sample size for states (including DC) ranged from 1,964 (Alaska, 2010) to 39,549 (Florida, 2007). Age-adjusted prevalence of stroke was 2.7% in 2006 and 2.6% in 2010 (p for trend=0.05). A nearly 10-fold difference in stroke prevalence estimates was observed between persons aged ≥65 years and those aged 18–44 years, and...
this pattern appeared to be consistent over the entire study period (Table). Among racial/ethnic groups, age-adjusted prevalence was highest among American Indians/Alaska Natives and lowest among Asians/NHOPIs. Age-adjusted prevalence was higher among adults with a lower level of education compared with those with a higher level of education. From 2006 to 2010, no statistically significant change in stroke prevalence was observed among women or among any particular age group, race/ethnicity, or level of education. For men, prevalence declined from 2.8% in 2006 to 2.5% in 2009, and then increased to 2.7% in 2010 (p for trend <0.01) (Table).

In 2006, age-adjusted stroke prevalence ranged from 1.8% (Colorado, Massachusetts, North Dakota and Vermont) to 4.4% (Alabama). In 2010, age-adjusted stroke prevalence ranged from 1.5% in Connecticut to 4.1% in Alabama. From 2006 to 2010, only two states had a significant decline in stroke prevalence: Georgia, from 3.3% to 2.8% (p for trend <0.01) and South Dakota, from 2.2% to 1.8% (p for trend=0.04). In 2010, the states with higher stroke prevalence generally were states in the southeastern United States and Nevada.

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**Editorial Note:** In 2007, CDC reported state-specific stroke prevalence based on BRFSS data for 2005. The report showed large disparities by sex, race/ethnicity, education, and state of residence in the prevalence of stroke. During the past 5 years, the age-adjusted prevalence of stroke marginally declined, from 2.7% to 2.6%. However, for men and for the states of Georgia and South Dakota, significant declines occurred. No other report on recent trends of stroke prevalence in the United States is available; however, one report demonstrated that stroke hospitalizations declined from 1997 to 2004. The Framingham Heart Study (which predominantly included whites) showed that, during the past 50 years, annual incidence of stroke has declined, but lifetime risk for stroke declined at a slower rate. A similar decline in stroke incidence has not been observed among blacks.

The prevalence of stroke depends on incidence, mortality, and mean length of survival after stroke. During 2006–2010, stroke mortality declined continuously. However, no incidence data were reported for this period. The percentage of institutionalized stroke survivors actually might have increased; trends in stroke hospitalization data show that the percentage of stroke patients discharged to long-term–care facilities increased from 1988 to 2004.

Because no national surveillance of stroke incidence exists in the United States, prevalence data can provide some evidence of disparities in stroke incidence. American Indians/Alaska Natives and blacks had higher stroke prevalence than other racial/ethnic groups.
groups. Persons with lower levels of education had higher stroke prevalence. These disparities have not decreased since 2005. Similar to trends observed in stroke mortality, the southeastern region had a higher prevalence of stroke than other regions of the United States. Hypertension is the leading risk factor for stroke and is more prevalent in the southeastern region than other regions of the United States. Increased clinical and community action to control hypertension is needed not only to reduce the incidence of stroke but to eliminate disparities in stroke incidence.

The findings in this report are subject to the at least four limitations. First, BRFSS does not include persons in institutions, long-term-care facilities, nursing homes, the military, or correctional institutions, and therefore might exclude a substantial proportion of persons with stroke, leading to underestimation of actual stroke prevalence. Second, because the response rate was only 50.6%

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CDC’s State Heart Disease and Stroke Prevention Program currently funds programs in 41 states and DC, as well as the Paul Coverdell National Acute Stroke Registry, to improve the quality of acute stroke care. A major goal of these programs is to build capacity to conduct public health activities to prevent and improve control of the major risk factors for heart disease and stroke, including hypertension and high cholesterol. The findings in this report demonstrate the variation in stroke prevalence during 2006–2010, a period in which stroke mortality declined continuously. Especially in states with high stroke prevalence, these findings can help public health officials to develop targeted programs for heart disease and stroke prevention.

**REFERENCES**

10 Available.

*Additional information available at http://www.cdc.gov/brfss.*

†Persons identified as Hispanic might be of any race. Persons identified as white, black, or other race are all non-Hispanic.


**What is already known on this topic?**

Combustion byproducts are a known threat to indoor air quality in ice arenas; however, nitrogen dioxide gas (NO2) is monitored less frequently than carbon monoxide, and signs and symptoms of NO2 intoxication are less well known than those of carbon monoxide.

**What is added by this report?**

The use of propane-powered ice-resurfacing equipment for 60-90 minutes in an indoor ice arena without an operating ventilation system caused symptoms of NO2 intoxication in 31 of 43 exposed persons, including 31 of 42 persons who first entered the arena more than 6 hours after the ice resurfacing had been completed.

**What are the implications for public health practice?**

Because exposure to NO2 can occur more frequently than is recognized, public health agencies should consider educating ice arena operators about the importance of arena ventilation, air monitoring for combustion gases, and maintenance of propane-powered equipment, if use of electric ice resurfacing equipment is not feasible. Additionally, ice arena operators as well as ice hockey players and coaches who use indoor rinks should be familiar with the signs and symptoms of NO2 toxicity.

**Exposure to Nitrogen Dioxide in an Indoor Ice Arena—New Hampshire, 2011**

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1 figure, 1 table omitted

In January 2011, the New Hampshire Department of Health and Human Services (NHDHHS) investigated acute respiratory symptoms in a group of ice hockey players. The symptoms, which included cough, shortness of breath, hemoptysis, and chest pain or tightness, were consistent with exposure to nitrogen dioxide gas (NO2), a byproduct of combustion. Environmental and epidemiologic investigations were begun to determine the source of the exposure and identify potentially exposed persons. This report summarizes the results of those investigations, which implicated a local indoor ice arena that had hosted two hockey practice sessions during a 24-hour period when the arena ventilation system was not functioning. A total of 43 exposed persons were interviewed, of whom 31 (72.1%) reported symptoms consistent with NO2 exposure. The highest attack rate was among the hockey players (87.9%). After repair of the ventilation system, no additional cases were identified. To prevent similar episodes, ice arena operators should ensure ventilation systems and alarms are operating properly and that levels of NO2 and carbon monoxide (CO) are monitored continuously for early detection of increased gas levels.

On January 4, 2011, NHDHHS was notified that a previously healthy male aged 19 years was hospitalized for sudden onset of cough, shortness of breath, and hemoptysis shortly after a team ice hockey practice. His physical examination was notable for crackles heard in both lung bases, and his oxygen saturation was decreased to 88%-91% on room air (normal: >95%). Bilateral in-