FORECASTING THE BURDEN AND COST OF STROKE IN THE UNITED STATES: PROJECTIONS BY SOCIODEMOGRAPHIC GROUPS THROUGH 2050

A Scientific Statement from the American Heart Association

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STROKE COUNCIL SCILL AND PROFESSIONAL EDUCATION COMMITTEE

American Heart Association/American Stroke Association

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BACKGROUND

BACKGROUND

- In 2020, nearly 10 million Americans were stroke survivors, with stroke affecting 3.3% of the U.S. population and costing more than $65 billion each year.

- Despite advances in stroke prevention, the U.S. stroke burden is expected to grow, with rising rates among younger and midlife adults and certain racial and ethnic subpopulations.

- By 2050, the number of U.S. stroke survivors is projected to nearly double to 20 million, while annual stroke-related costs may rise more than fivefold to $423 billion – driven largely by an aging, increasingly diverse population and rising health care cost.

- Stroke risk, outcomes, and costs are not equally distributed across populations by age, sex, race and ethnicity, socioeconomic status, education, and health insurance access.

- Objective of this statement is to estimate, across sociodemographic subgroups, the prevalence and number of adult stroke survivors and to forecast stroke-related health care costs and productivity losses from 2020 to 2050.

METHODS

FORECASTING STROKE PREVALENCE

- Pre-pandemic National Health and Nutrition Examination Survey (NHANES) data (January 2015–March 2020) were used to estimate baseline stroke prevalence and annual growth trends.
- Baseline stroke prevalence was estimated by age, sex, and race/ethnicity.
  - Age groups: 20–44, 45–64, 65–79, and 80+ years
  - Race/Ethnicity: Hispanic and non-Hispanic Black, White, Asian, and American Indian/Alaska Native (AI/AN) or multiracial
- NHANES Prevalence estimates were adjusted to account for adults living in long-term care facilities using 2017-2018 National Study of Long-Term Care Providers data
- Stroke prevalence was projected from 2020–2050 for each age, sex, race/ethnicity group using a fixed growth rate of stroke prevalence and the U.S. Census population projections.
- Bootstrap methods were used to estimate standard errors for projected stroke prevalence estimates.

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FORECASTING STROKE COSTS

- 2015–2019 Medical Expenditure Panel Survey (MEPS) data were used to estimate:
  - Healthcare expenditures
  - Productivity losses from stroke-related morbidity/disability
  - Productivity losses from premature stroke mortality

- Future cost projections incorporated annual inflation-adjusted rate in healthcare costs (1.91%) and productivity costs (0.8%), combined with projected age- and sex- specific changes in stroke prevalence; estimates are reported in 2022 dollars.
  - Morbidity-related productivity losses were not estimated for adults ≥80 years.

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RESULTS

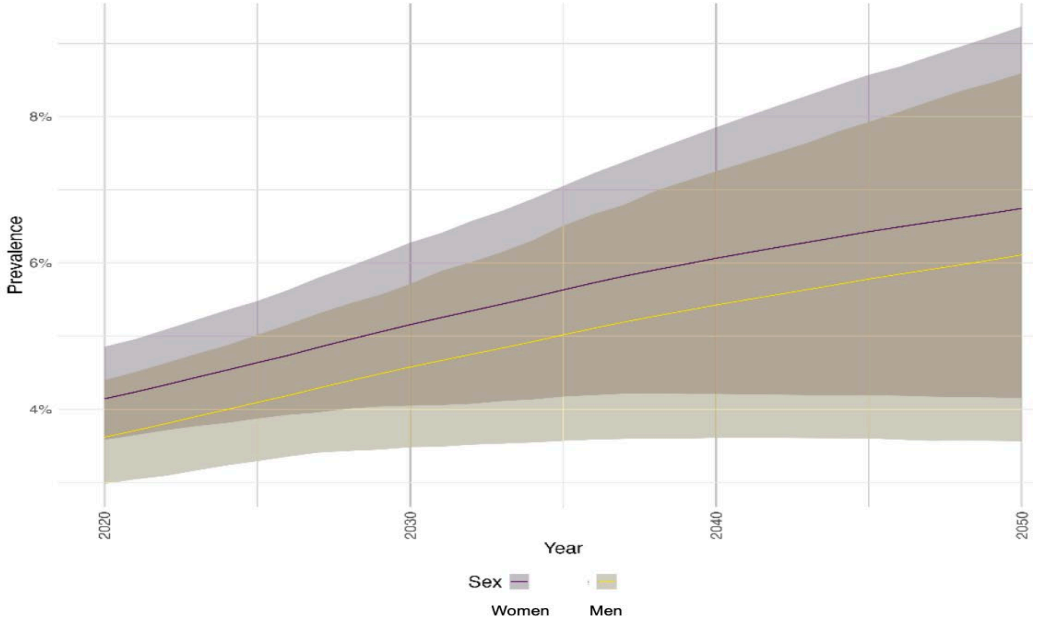
RESULTS

The study designated 80 grouping by the simultaneous consideration of age, sex, and racial and ethnic categories to project growth in prevalence rates (percentages) and absolute stroke case counts (count estimates) by 2050.

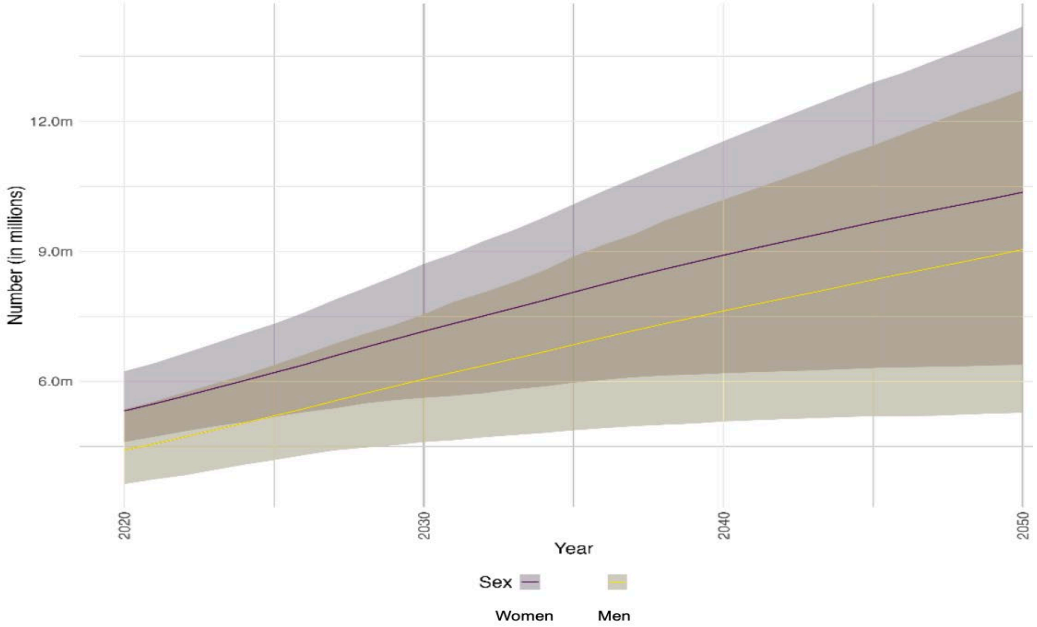
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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY SEX

A



B

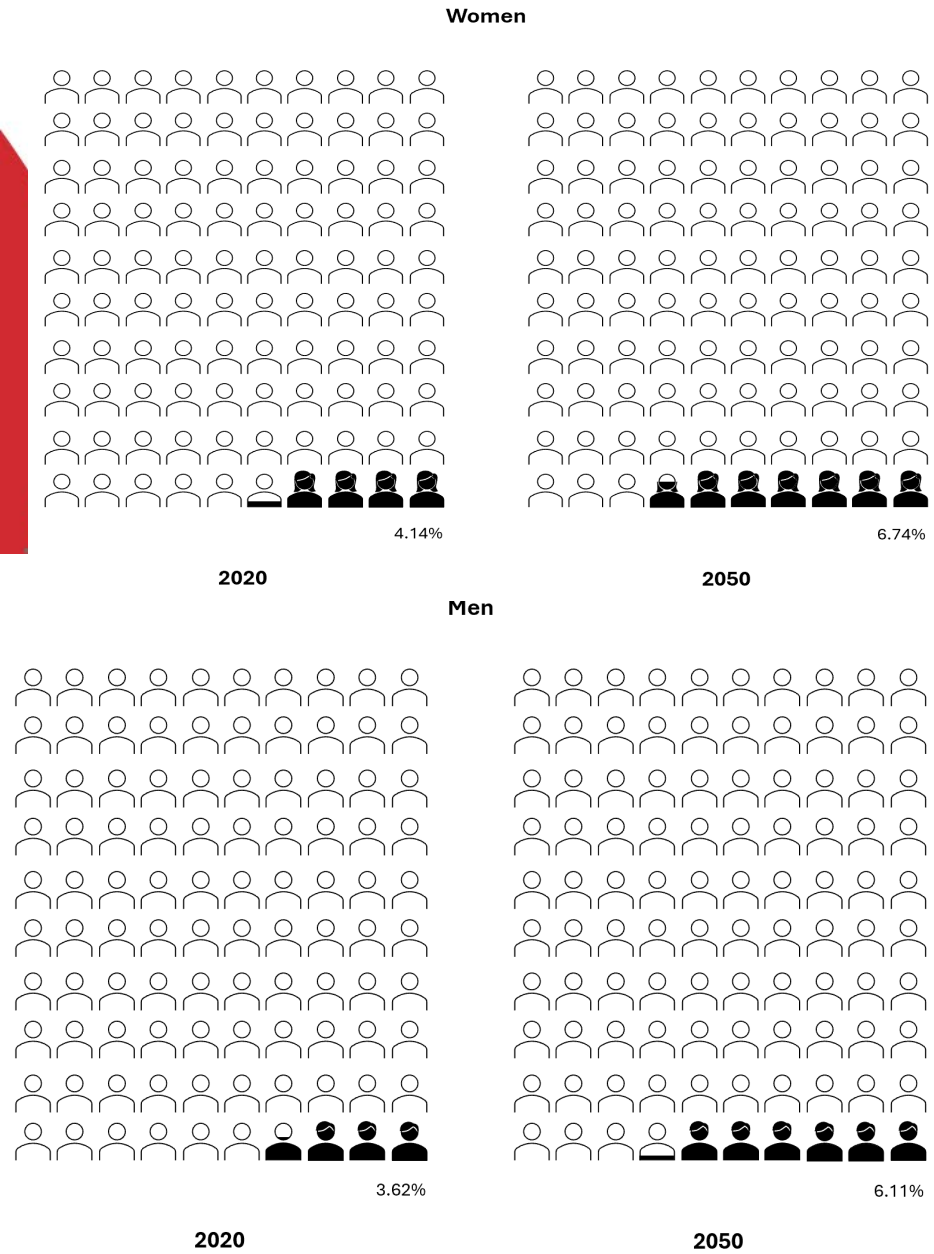


The prevalence and count estimates of adults with stroke are higher in women compared with men, partly driven by life expectancy. The annual percent change in prevalence is projected to be 0.10% in 2030, 0.07% in 2040, and 0.07% in 2050 for both sexes.

The annual percent change in prevalence is projected to increase by 2050 for both sexes.

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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY SEX



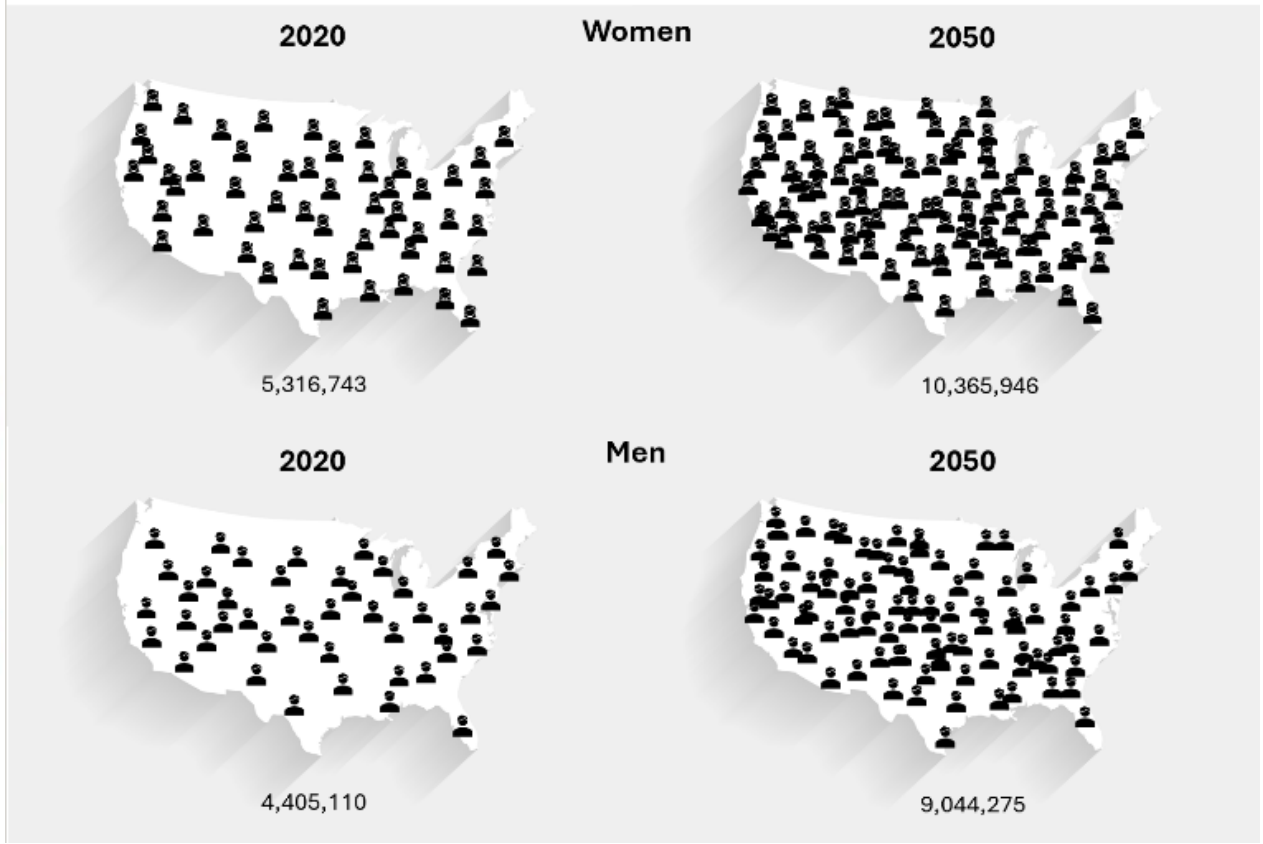
Among women, stroke prevalence was 4.1% (95% ci 3.7-4.8%) in 2020 and is projected to be 6.7% (95% ci 4.7-8.8%) in 2050, an absolute increase of 2.6 percentage points.

Among men, prevalence is projected to increase from 3.6% (95% ci 3.1-4.3%) to 6.1% (95% ci 4.1-8.2%) over the same period, an absolute increase of 2.5 percentage points

The number of cases is expected to reach 10.4 million among women and 9.0 million among men in 2050

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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY SEX



The prevalence and counts of adults with stroke are higher in *women* compared with *men* across the entire 30-year period and increase over time in both sex groups

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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY SEX, AGE GROUP, AND RACIAL AND ETHNIC CATEGORY

Across all ages and both men and women, through year 2050, a consistent pattern of increasing percent prevalence emerged across race/ethnic groups.

The change in stroke prevalence and number is highest among asian, hispanic, and white populations.

	White	Black	Hispanic	AI/AN/Multiple	Asian
Men (20–44)	250%	145%	261%	115%	421%
Women (20–44)	243%	141%	259%	113%	411%
Men (45–64)	51%	28%	54%	22%	95%
Women (45–64)	50%	27%	53%	21%	94%
Men (65–79)	21%	11%	22%	9%	40%
Women (65–79)	20%	11%	22%	9%	39%
Men (80+)	11%	6%	11%	5%	21%
Women (80+)	11%	6%	11%	4%	20%

	White	Black	Hispanic	AI/AN/Multiple	Asian
Men (20–44)	204%	172%	421%	319%	634%
Women (20–44)	197%	159%	415%	290%	612%
Men (45–64)	36%	75%	186%	161%	246%
Women (45–64)	29%	55%	167%	137%	230%
Men (65–79)	17%	86%	277%	119%	215%
Women (65–79)	11%	70%	229%	119%	203%
Men (80+)	138%	286%	446%	308%	319%
Women (80+)	116%	227%	379%	303%	326%

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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY EDUCATION, INCOME, AND HEALTH INSURANCE STATUS

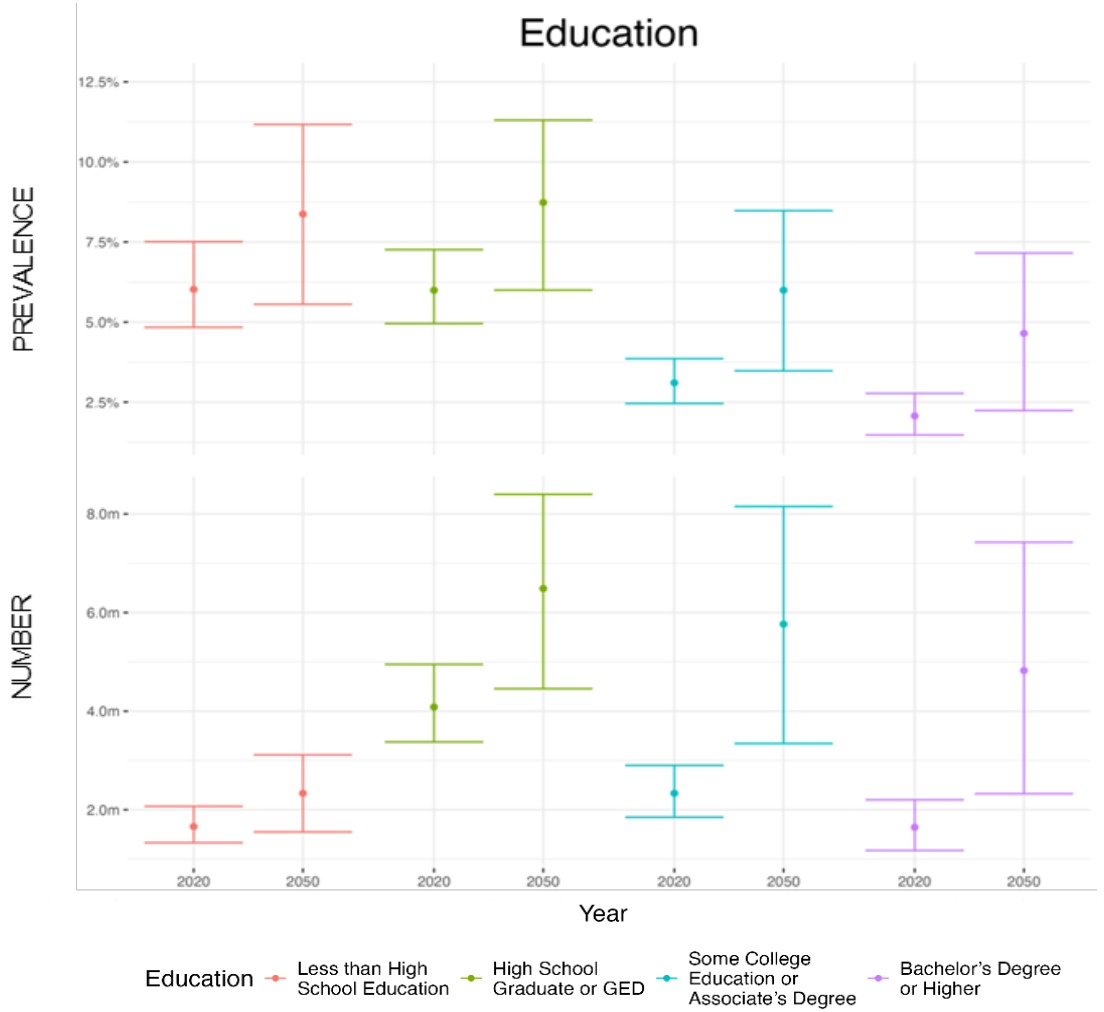
Across all education groups, estimates of stroke prevalence and counts are expected to increase between 2020 and 2050 with prevalence forecasted to be highest among those with *lower educational attainment*.

For those in whom the highest level of education was less than high school, stroke prevalence was 6.0% in 2020 with a projected increase to 8.8% in 2050.

For those in whom the highest level of education was a high school or equivalent degree, stroke prevalence was 6.0% in 2020 with a projected increase to 9.3% in 2050.

For those in whom the highest level of education was some college or an associate's degree, stroke prevalence was 3.1% in 2020 with a projected increase to 5.9% in 2050.

For those in whom the highest level of education was a bachelor's degree or higher, stroke prevalence was 2.1% in 2020, with a projected increase to 4.2% in 2050.

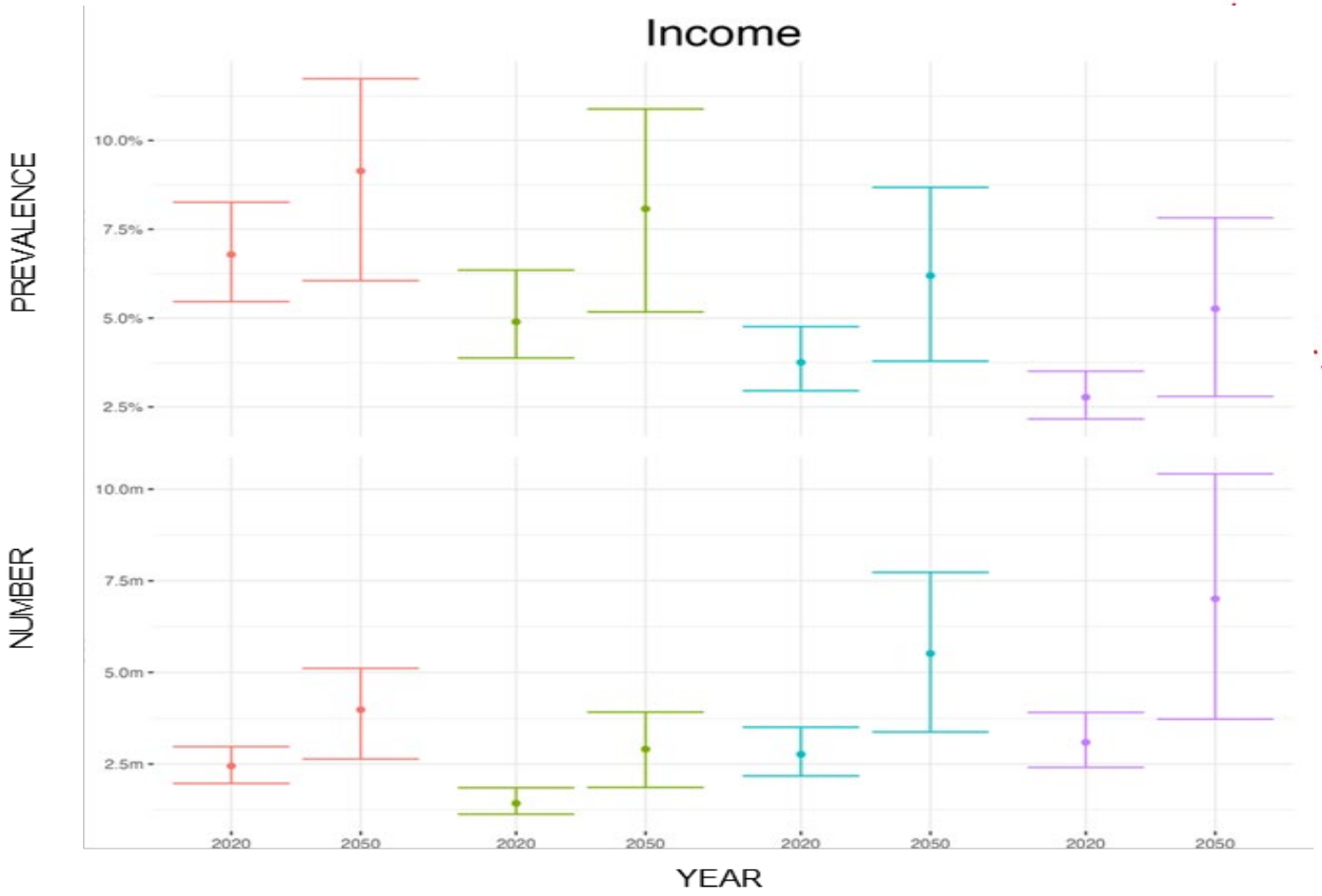


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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY EDUCATION, INCOME, AND HEALTH INSURANCE STATUS

The higher income level group had lower stroke prevalence estimates than those in the very low-income category

For example, the high-income category had an estimated stroke prevalence of 2.8% in 2020, projected to increase to 5.3% in 2050, compared with the very low-income category, where prevalence was 6.7% in 2020 and 9.1% in 2050.

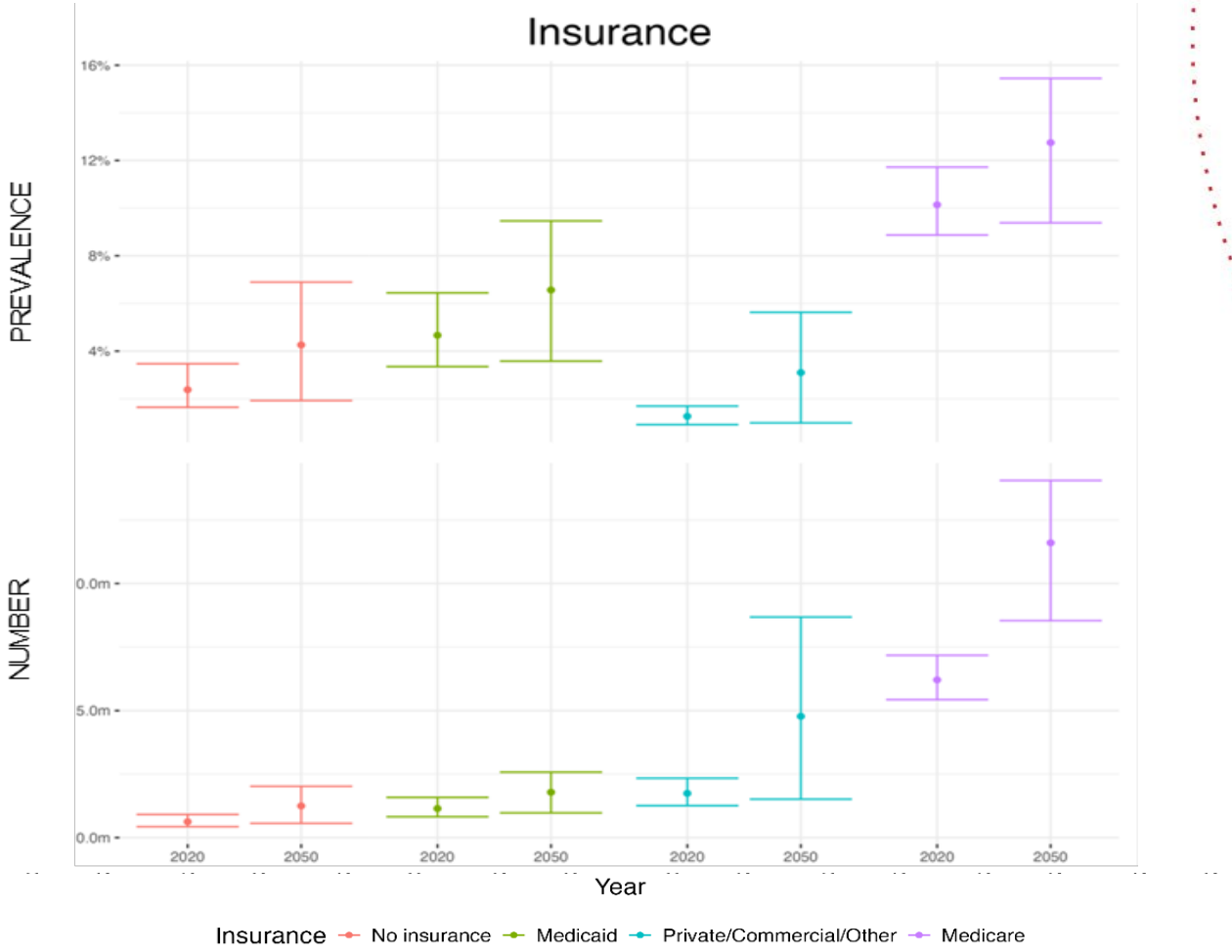


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PREVALENCE AND NUMBER OF ADULTS WITH STROKE, BY EDUCATION, INCOME, AND HEALTH INSURANCE STATUS

Stroke prevalence is projected to increase over time across all four insurance groups (no insurance, medicare, medicaid, and private/other).

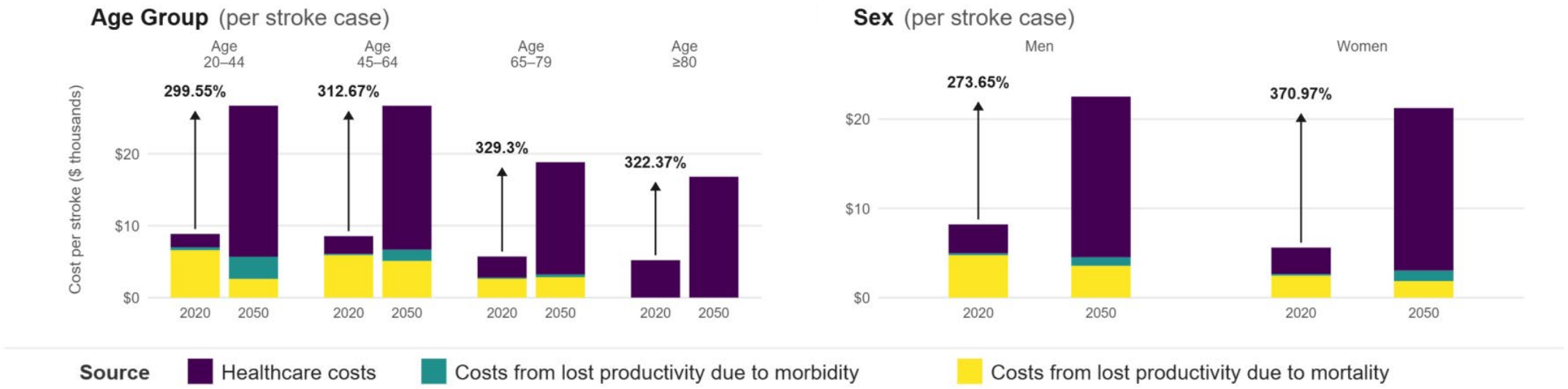
Stroke prevalence rates were higher among adults in the medicare and medicaid groups than among adults with no insurance and those with private/other insurance, as expected, because most people with medicare are age 65 years and older.



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COSTS PER CAPITA

Economic burden

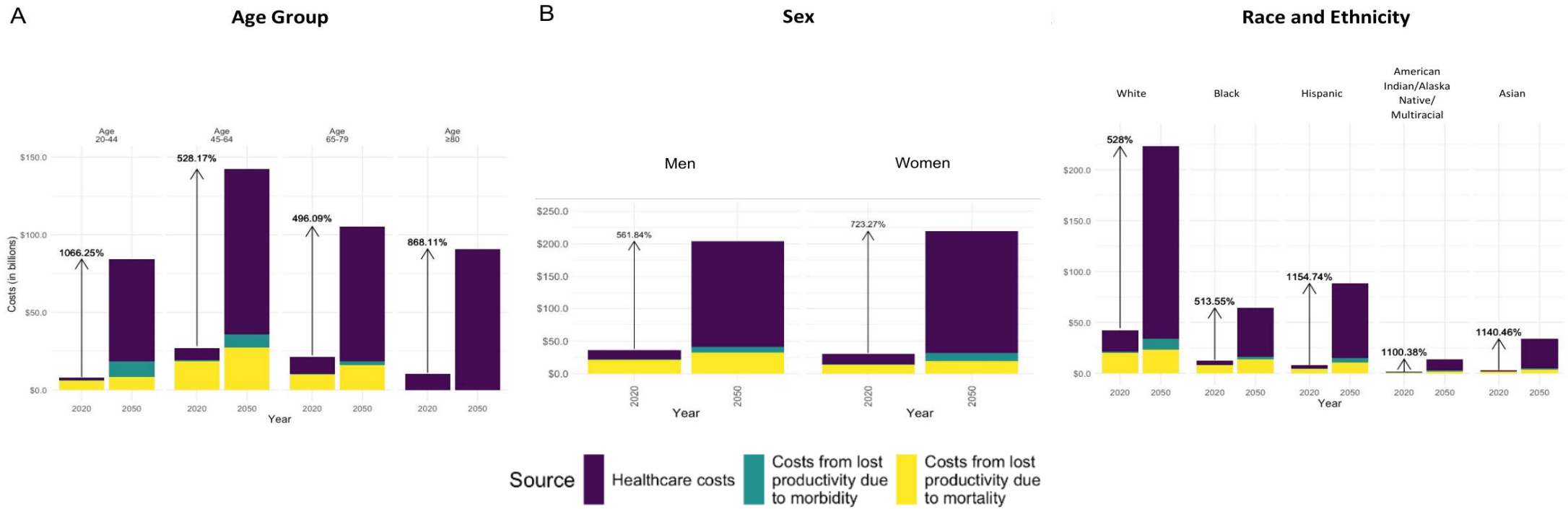


- Per-capita stroke health care costs are projected to rise substantially by 2050 across age groups and by sex, after adjustment for inflation.
- Per-capita estimates are not stratified by race, ethnicity, education, income, or insurance because barriers to care can distort observed costs.

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COSTS BY AGE, SEX, RACE, AND ETHNICITY

Population-level economic burden

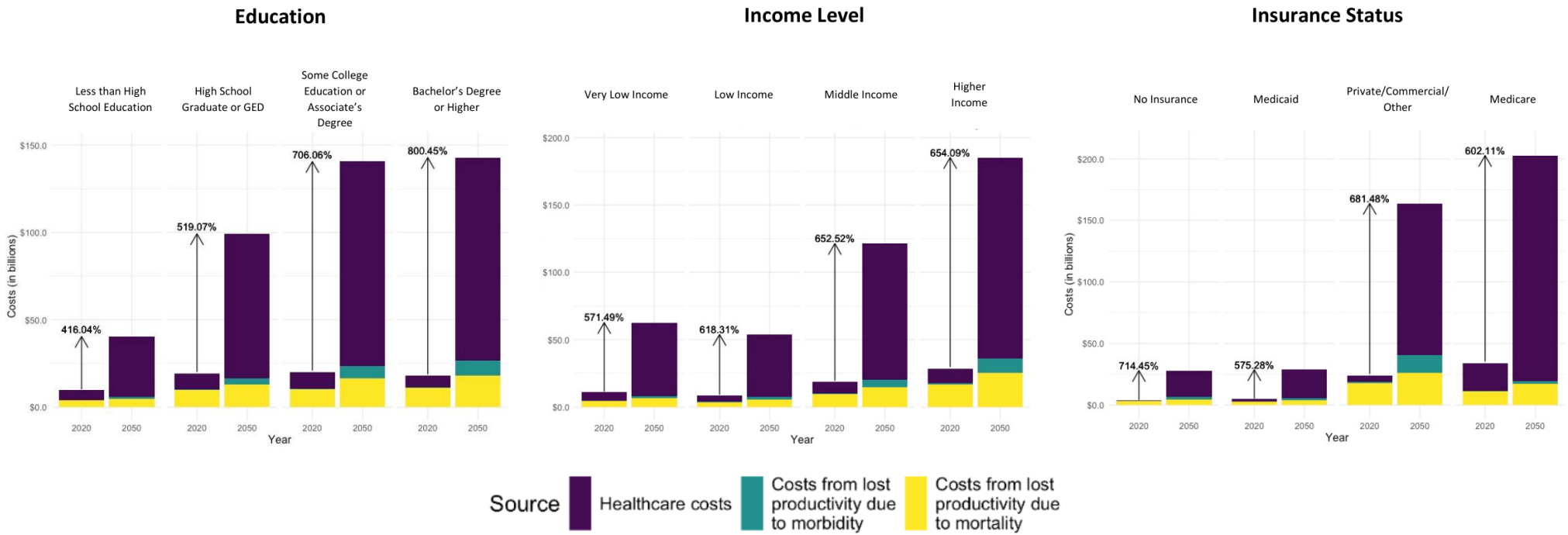


- The highest increase in total costs over time was projected for adults aged 20–44, from $7.9 billion in 2020 to $84.4 billion in 2050.
- Costs are expected to exceed $100 billion annually in both the 45–64 and 65–79 age groups. Cost increases are expected to exceed 1000% in Hispanic, Asian, and AI/AN/multiracial groups.

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COSTS BY EDUCATION, INCOME, AND INSURANCE

Population-level economic burden



- By 2050, annual total costs are projected to reach $141.2 billion among adults with some college education and $142.9 billion among those with a college degree.
- Costs are projected to reach $121.4 billion in the middle-income group and $185.2 billion in the high-income group. Medicare costs are projected to exceed $200 billion.

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DISCUSSION

DISCUSSION: DRIVERS OF THE PROJECTED BURDEN

Changing population and stroke risk

- Population aging, distribution of prevalent stroke by sex, and growth in racial and ethnic subgroups contribute to the projected increase in stroke burden.
- Women's longer life expectancy, greater risk of atrial fibrillation-related stroke, and risk factors related to pregnancy and menopause contribute to their increasing prevalence.
- Increasing stroke at younger and midlife ages likely reflects earlier onset and increasing prevalence of diabetes, obesity, and hypertension. Substance use disorders may also contribute.
- Differences across racial and ethnic groups reflect differences in access to care and the prevalence and treatment of risk factors. Self-reported or assigned race and ethnicity are unreliable proxies for genetic ancestry.

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DISCUSSION: PREVENTION AND ACCESS TO CARE

Public health and policy priorities

- Prevention programs need to support access to care for under-resourced populations and use plain language materials with feasible behavior changes.
- Comprehensive prevention requires systems and policy change that supports healthy environments, food systems, and neighborhoods.
- Life's Essential 8 provides a primordial prevention framework that can be adapted to different populations.
- The American Heart Association continues to advocate for health insurance that is accessible, affordable, and adequate.
- Advances in acute stroke therapies, post-acute care and rehabilitation, and long-term services will be critical to mitigate the burden as stroke prevalence rises.

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DISCUSSION: DISABILITY AND ECONOMIC LOSSES

Stroke during working and family life

- Stroke at younger and midlife ages can cause disability during peak working and earning years and while people are building and caring for families.
- Younger survivors may have lower medication adherence, potentially related to lower disposable income, increasing the risk of recurrent stroke, disability, or death.

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DISCUSSION: DIAGNOSTICS AND TREATMENT COSTS

Near-term spending and longer-term outcomes

- Greater availability of diagnostics, including magnetic resonance imaging and extended cardiac monitoring, may contribute to rising costs per person with stroke.
- Acute stroke therapies and rehabilitation can improve outcomes and potentially reduce long-term costs, however, generate additional costs in the acute and subacute phases.
- Mechanical thrombectomy has demonstrated cost-effectiveness. Further cost-effectiveness and other evaluations of value are important as newer therapies become available.

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DISCUSSION: MOBILE STROKE UNITS AND ARTIFICIAL INTELLIGENCE

Potential benefits and costs

- Mobile stroke units for acute care and artificial intelligence-driven approaches to secondary stroke prevention and restoration of function may be costly though beneficial.
- The effects of future artificial intelligence advances on stroke care delivery and post-stroke employment are difficult to predict.
- Investments in improved stroke surveillance data collection, research infrastructure, and wider access to new treatments and technologies may help reduce the burden of stroke.

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DISCUSSION: FORECASTING LIMITATIONS

Uncertainty and data gaps

- Forecasts did not distinguish first from recurrent stroke or individual stroke types and did not model for stroke incidence, mortality, or severity.
- Self-reported stroke can introduce misclassification.
- Sample size limits separate projections for several populations.
- Forecasts do not account for future advances in prevention, including GLP-1 agonists for cardiometabolic disease, improved cardioembolic risk management, or advances in managing or preventing common risks factors for stroke in the young, such as improved cancer therapies.
- Costs exclude informal caregiving, TRICARE-insured military populations, or incarcerated populations.

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DISCUSSION: CONCLUSIONS

Implications of the forecasts

- The prevalence and economic burden of stroke are projected to increase steeply across sociodemographic groups through 2050.
- Some groups will be affected disproportionately, reflecting healthcare disparities and an aging and diversifying population.
- The forecasts call for urgent public health planning and policy to strengthen stroke prevention.
- Investment in stroke surveillance, research infrastructure, and wider access to treatments can help reduce the future burden.

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PREVALENCE OF STROKE: PROJECTIONS, 2020 TO 2050

Sociodemographic subgroups with the highest forecasted prevalence in 2050:

Women	~ 7%
Black men and women > 80 years	~ 25%
AI/AN/multiracial men and women > 80 years	~ 30%
High school graduate/GED education	~ 9%
People with very low income	~ 9%
People with Medicare	~ 13%

$$$ COST OF STROKE: PROJECTIONS, 2020 TO 2050

Sociodemographic subgroups with the largest forecasted increases in total population-level costs* from 2020 to 2050:

Women	~ 700%
Young adults (20-44 years old)	~ 1000%
Hispanic adults	~ 1200%
College educated	~ 800%
People with high income	~ 650%
People with private insurance	~ 700%

- STROKE COUNTS, PREVALENCE, AND COSTS ARE INCREASING ACROSS THE ENTIRE POPULATION
- TARGETED AND COST-EFFICIENT PROGRAMS AND POLICIES TO PREVENT AND TREAT STROKE ARE URGENTLY NEEDED
- STRATEGIES TO PREVENT AND TREAT STROKE MUST CONSIDER INEQUITIES AND BARRIERS TO CARE AMONG SOCIODEMOGRAPHIC GROUPS

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