CLINICAL RESEARCH STUDY

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Comparative Trends in Heart Disease, Stroke, and All-Cause Mortality in the United States and a Large Integrated Healthcare Delivery System

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ABSTRACT

OBJECTIVES: Heart disease and stroke remain among the leading causes of death nationally. We examined whether differences in recent trends in heart disease, stroke, and total mortality exist in the United States and Kaiser Permanente Northern California (KPNC), a large integrated healthcare delivery system.

METHODS: The main outcome measures were comparisons of US and KPNC total, age-specific, and sex-specific changes from 2000 to 2015 in mortality rates from heart disease, coronary heart disease, stroke, and all causes. The Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research data system was used to determine US mortality rates. Mortality rates for KPNC were determined from health system, Social Security vital status, and state death certificate databases.

RESULTS: Declines in age-adjusted mortality rates were noted in KPNC and the United States for heart disease (36.3% in KPNC vs 34.6% in the United States), coronary heart disease (51.0% vs 47.9%), stroke (45.5% vs 38.2%), and all-cause mortality (16.8% vs 15.6%). However, steeper declines were noted in KPNC than the United States among those aged 45 to 65 years for heart disease (48.3% KPNC vs 23.6% United States), coronary heart disease (55.6% vs 35.9%), stroke (55.8% vs 26.0%), and all-cause mortality (31.5% vs 9.1%). Sex-specific changes were generally similar.

CONCLUSIONS: Despite significant declines in heart disease and stroke mortality, there remains an improvement gap nationally among those aged less than 65 years when compared with a large integrated healthcare delivery system. Interventions to improve cardiovascular mortality in the vulnerable middle-aged population may play a key role in closing this gap.

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We recently reported that the rate of decline of death due to all cardiovascular diseases, heart disease, and stroke in the United States had decelerated substantially between 2011 and 2014.[1] Subsequent reports showed that the age-adjusted mortality from heart disease increased in 2015[2] and that stroke death rates increased in both 2014 and 2015.[3]

In the current healthcare landscape, models to improve the quality and efficiency of health care delivery are being used to promote value-driven health care.[4] By combining this effort with ongoing expanding discourse about access to preventative health care, it becomes important to understand and compare outcomes at a national level with health care system models focused on prevention and care integration.

Kaiser Permanente Northern California (KPNC), a large, integrated health care delivery system, has successfully implemented large-scale risk factor modification efforts[5] and observed significant declines in population trends in the incidence and outcomes of myocardial infarction.[6,7] We expanded on this work by comparing recent trends in death due to heart disease, stroke, and total mortality in the overall US population between 2000 and 2015 with rates observed within KPNC's large, diverse, community-based population.

CLINICAL SIGNIFICANCE

- Heart disease and stroke mortality rates declined considerably from 2000 to 2015 in both the United States and Kaiser Permanente Northern California (KPNC), a large integrated health care delivery system.
- Mortality rate declines were greater in KPNC for younger adults (age <65 years), especially those aged 45 to 64 years.
- Greater mortality declines among young adults in KPNC reflects, in part, the effectiveness of coordinated high-quality, population-based cardiovascular risk management programs.

METHODS

The US national mortality rates for 2000-2015 were ascertained using the Centers for Disease Control and Prevention's Wide-Ranging Online Data for Epidemiologic Research data set. This data set includes the assigned cause of death from all death certificates filed in the 50 states and the District of Columbia.[8] Categorization of the presumed underlying cause of death used *International Statistical Classification of Diseases and Related Health Problems, Tenth Edition* (ICD-10) codes as follows: heart disease (codes I00-I09, I11, I13, and I20-I51), coronary heart disease (I20-I25), cerebrovascular disease (codes I60-I69), and all-cause mortality (all ICD-10 underlying cause of death codes). Heart disease includes coronary heart disease (codes I20-I25), the largest subcategory of heart disease deaths. Heart disease and cerebrovascular disease are the most common categories of cardiovascular diseases (ICD-10 codes I00-I99), comprising 93% of all cardiovascular disease deaths in both 2000 and 2015.

KPNC is an integrated healthcare delivery system currently caring for >4.1 million individuals in the greater San Francisco Bay Area, Sacramento, California Central Valley region, and surrounding counties. Approximately 30% to 35% of the population in these counties has KPNC membership, which is highly representative of the local and statewide population.[9] Data were derived principally from the KPNC Virtual Data Warehouse, a research database resource that combines data from electronic health records and other health system source files into standardized formats and data tables.[10] The Virtual Data Warehouse includes information on age, gender, and enrollment in the health plan; diagnoses and procedures among members; and mortality, including causes of death. We identified all deaths occurring in KPNC-owned facilities, as well as deaths identified on the basis of annual linkages to California state death certificates and the US Social Security Administration Death Master Files using patient Social Security number, name, date of birth, ethnicity, and place of residence. Underlying cause of death (ICD-10 codes) was available for 96% to 97% of deaths occurring in California for each year from the state death certificates, whereas it was not available for the 3% to 4% of out-of-state deaths identified only by the Social Security files.

Mortality rates were age-adjusted using the direct method, with the 2000 US Census[11] as the standard population. Age-group specific mortality rates were reported for age groups <45 years, 45 to 65 years, and >65 years. These were further age-adjusted within the 3 age group categories by proportionately weighting the standard census weights so that they added up to 1. For example, for those aged >65 years, we divided 1 by the sum of individual census weights (0.0660 for 65-74 years, 0.0448 for 75-84 years, and 0.0155 for ≥85 years) and multiplied the quotient (7.1922) by each of the individual age group census weights to obtain the proportional weights used in the age adjustment (0.5225, 0.3548, and 0.1227).

A determination was made that the study activity was not human subjects research and therefore did not require KPNC Institutional Review Board approval.

RESULTS

The age-adjusted rates for all mortality end points were higher in 2000 in the United States than in KPNC (**Table 1A and B**), except stroke, for which the rates were nearly identical in 2000 (heart disease 39.3%, coronary heart disease 37.4%, all-cause 27.5% higher in the United States than in the KPNC, whereas stroke mortality was 0.2% lower). The percentage gaps increased from 2000 to 2015 so that they were 43.2%, 45.7%, 13.3%, and 29.4% higher for heart disease, coronary heart disease, stroke, and all-cause mortality, respectively, in 2015 in the United States than in KPNC.