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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 U.S. and Kaiser Permanente Northern California (KPNC), a large integrated healthcare delivery system.

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

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RESULTS—Declines in age-adjusted mortality rates were noted in KPNC and the U.S. for heart disease (36.3% in KPNC vs. 34.6% in the U.S.), 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 U.S. among those aged 45–65 years for heart disease (48.3% KPNC vs. 23.6% U.S.), coronary heart disease (56.3% vs. 36.4%), 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 <65 years, when compared to 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.

Keywords

Mortality rate; heart disease; stroke

We recently reported that the rate of decline of death attributed to all cardiovascular diseases, heart disease and stroke in the U.S. 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 utilized to promote value-driven health care (4). 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 attributed to heart disease, stroke, and total mortality in the overall U.S. population between 2000–2015, versus rates observed within KPNC’s large, diverse, community-based population.

METHODS

United States national mortality rates for 2000–2015 were ascertained using the Centers for Disease Control and Prevention’s Wide-Ranging Online Data for Epidemiologic Research (CDC WONDER) 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* 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 30–35 percent 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 based on annual linkages to California state death certificates and the U.S. 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 96–97% of deaths occurring in California for each year from the state death certificates, while it was not available for the 3–4% of out-of-state deaths identified only by the Social Security files.

Mortality rates were age-adjusted using the direct method, with the 2000 U.S. Census (11) as the standard population. Age-group specific mortality rates were reported for age groups < 45 years, 45–65 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 one. For example, for those >65 years, we divided 1 by the sum of individual census weights (0.0660 for 65–74, 0.0448 for 75–84, 0.0155 for 85) 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 IRB review.

RESULTS

The age-adjusted rates for all mortality endpoints were higher in 2000 in the US than in KPNC (Table 1A and 1B) except stroke for which the rates nearly identical in 2000 (heart disease 39.3%, coronary heart disease 37.4%, all-cause 27.5% higher, respectively in the US than in KPNC while stroke mortality was 0.2% lower). The percentage gaps increased, respectively, 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 U.S. than in KPNC.

Heart disease

Age-adjusted mortality—Age-adjusted mortality declined in both the U.S. and KPNC from 2000 to 2015 for deaths attributed to heart disease (Table 1A and 1B), though it increased from 2014 to 2015. The percent change decline in heart disease was slightly

greater in the KPNC population (36.3%, from 184.9 to 117.7 per 100,000 person-years) than in the U.S. (34.6%, from 257.6 to 168.5).

Age-specific mortality—The decline in heart disease mortality was twice as great in KPNC than in the U.S. for younger adults (<65 years) (Table 2A and Figure), and was markedly greater in the 45–64 years age group (48.3% KPNC vs. 23.6% U.S.) than in those in who were <45 years old. The declines in heart disease mortality were similar in those age >65 years (34.9% vs. 37.1%).

Coronary heart disease

Age-adjusted mortality—The greatest proportion of heart disease mortality was attributed to coronary heart disease in both the U.S. and in KPNC. In 2000, approximately 72% of heart disease deaths in the U.S. and 74% in KPNC were attributed to coronary heart disease, with these percentages in 2015 declining to 58% in the U.S. and 57% in KPNC. The age-adjusted mortality from coronary heart disease declined consistently from 2000 to 2015 in the U.S., while in KPNC, it increased from 2014 to 2015 after decreasing from 2000 to 2014. The percent decline in coronary heart disease mortality from 2000 to 2015 was slightly higher in KPNC (51.0%, from 136.0 to 66.6 per 100,000 person-years) than in the U.S. (48.0%, from 186.8 to 97.2).

Age-specific mortality—Declines for coronary heart disease mortality showed a similar age-specific patterns to those for all heart disease (Table 2A and Figure), higher in KPNC for younger adults (KPNC 41.0% vs. U.S. 25.6% for <45 years, 55.6% vs. 35.9% for 45–64 years) and similar declines for age >65 years (50.5% vs. 50.4%).

Stroke

Age-adjusted mortality—Age-adjusted mortality declined from 2000 to 2015 for deaths attributed to stroke in both the U.S. and KPNC (Table 1A and 1B). Deceleration in decline of rates in stroke mortality since 2011 occurred in both the U.S. and KPNC, with increases in the stroke mortality rate taking place during the past 2 years (2014–2015). The percent decline in the stroke mortality rate was greater in the KPNC population (45.5%) than in the U.S. (38.2%)

Age-specific mortality—The decline in stroke mortality was twice as great in KPNC than in the U.S. for younger adults (<65 years), with similar declines in those <45 years old and in the 45–64 years age group (55.8% vs. 21.7% for <45 years, 55.8% vs. 26.0% for 45–64 years). The mortality rate decline was 11.5% greater in KPNC than in the U.S. for those >65 years old (44.5% vs. 39.9%) (Table 2A and Figure).

All-cause

Age-adjusted mortality—The all-cause mortality rate declined from 2000 to 2014 and then increased in 2015 in both the U.S. and KPNC. The percentage decline in the age-adjusted rate from 2000 to 2015 was slightly higher in KPNC (16.8%) than in the U.S. (15.6%). Because the declines in all-cause mortality were much smaller than those for heart disease and stroke, we were interested in whether the mortality rate from all causes except

for heart disease and stroke had increased, and determined that there had been a slow decline in this rate from 2000 to 2015 in both the U.S. and KPNC (from 550.5 to 527.0 (4.3%) decline in U.S., from 435.6 to 415.8 (4.5%) in KPNC). Stated in another way, the decline in mortality rate from all causes except for heart disease and stroke accounted for only 17% of the total percent decline in the all-cause mortality rate in both the U.S. and KPNC (23.5/135.9 for the U.S. and 17.8/114.8 for KPNC), so that the decline in heart disease and stroke accounted for most (83%) of the decline in the all-cause mortality rate from 2000 to 2015.

Age-specific mortality—The rate of decline in all-cause mortality was more than 3 times as high in KPNC than in the U.S. among those <65 years (25.6% vs. 7.8% for ages <45 years, 31.5% vs. 9.1% for ages 45–64 years) and was somewhat greater in the U.S. than in KPNC for those ages 65 years or higher (13.6 % decline in KPNC vs, 17.9% decline in the U.S.) (Table 2A and Figure).

The supplement Appendix provides mortality rates and change data within each 10-year age group for the U.S. and KPNC.

Sex-specific findings

Heart Disease—Total and age-specific mortality rates were substantially higher in males than in females in both the U.S. and in KPNC. The total mortality rate decline was greater in males but smaller in females in KPNC than in the U.S. Age-specific changes from 2000 to 2015 were higher in the younger age groups (<45 years and 45–64 years) in KPNC than in the U.S. for both males and females (Table 2B). The mortality declines in the >65 years age group were slightly lower in the U.S. (36.3%) than in KPNC (37.2%) for males, but greater in the U.S. (39.0%) than in KPNC (33.2%) for females. The decline rate in heart disease mortality in females <45 years was quite low in the U.S. (6.6%) especially compared with KPNC (30.3%), with heart disease mortality rates very low in this age group in both the U.S. and KPNC.

Coronary Heart Disease—In general, the patterns in coronary heart disease mortality rates reflected those for heart disease, with the exception that the percent total mortality declines were slightly higher in KPNC than the U.S. for both males and females. Age-specific changes from 2000 to 2015 were higher in the younger age groups (<45 years and 45–64 years) in KPNC than in the U.S. for both males and females and were particularly large for females (Table 2B). The mortality declines in the >65 years age group were nearly identical in males (50.4% U.S. vs. 50.5% KPNC) and females (47.9% vs. 46.7%) in the U.S. and in KPNC.

Stroke—Total and age-specific mortality rates were generally slightly higher in males than in females in both the U.S. and in KPNC. The total and age-specific mortality rates declines were greater in KPNC, markedly so for the <45 and 45–64 years age groups in which they were they were more than twice as great in KPNC as in the U.S (Table 2B).

All-cause—Total and age-specific mortality rates were considerably higher in males than in females in both the U.S. and in KPNC. The total mortality decline was greater for males

in KPNC (22.0%) than in KPNC (18.1%), while it was lower for females (11.7% KPNC, 14.7% U.S.). Age-specific declines were substantially higher in KPNC than the U.S. for younger age groups in both males and females and in >65 years age group for female, while they were nearly identical in >65 years age group in KPNC (20.3%) and U.S. (21.2%) males (Table 2B).

DISCUSSION

Compared to the US population, mortality rates and the 15-year percent decline in mortality rates attributed to heart disease, coronary heart disease, and stroke were greater in a large integrated healthcare delivery system. Furthermore, the percent decline was substantially greater for the young (<45 years) and at-risk middle age (45–64 years) population. However, given the much higher absolute rates of cardiovascular mortality in middle-aged compared with younger adults, the gap observed between our healthcare delivery system and the nation is alarming and highlights the potential for improvement in the more vulnerable 45–65 years age group. The declines in heart disease and stroke mortality accounted for most of the decline in all-cause mortality rates. The all-cause mortality rate was slightly higher in KPNC than in the U.S., but the declines were much greater in KPNC for younger adults and smaller in older (>65 years) adults.

Our finding is consistent with another report that there is evidence of stagnation for coronary heart disease mortality in younger adults in the U.S., especially women (12). The declines in coronary heart disease mortality were lowest in the <45 years followed by the 45–64 age years groups in the U.S., with minimal decline in coronary heart disease mortality among young (<45 years) women in the U.S., though not in KPNC. Potential contributing factors include underestimation of cardiovascular risk in younger adults undermining prevention efforts, the trend toward earlier onset of overweight, obesity, and diabetes during the past three decades, and the presence of nontraditional social and psychological risk factors such as depression and perceived stress, particularly in young women (12). It should be noted that the rates of coronary heart disease mortality in women <45 years were quite low in 2000 for both the U.S. (2.2 per 100,000 person-years) and KPNC (1.0) so that the presence or absence of significant changes in these rates from 2000–2015 might not have substantial population-level impact.

In the U.S., chronic diseases are the primary causes of disability and death, and account for the majority of healthcare expenditures (13). The Center for Disease Control and Prevention advocates that public health and healthcare systems deploy integrated approaches that bundle proven interventions, address multiple risk factors and conditions simultaneously, and create population-wide changes to effectively address the burden of chronic diseases (13). In 2010, the three leading risk factors for global disease burden were hypertension, smoking and alcohol use (14). Concerted public health efforts have contributed substantially to the long-term decline in cardiovascular disease, including measures such as restrictions on smoking and an enhanced focus on lowering cholesterol and blood pressure (15,16).

The continued decline in heart disease mortality within KPNC is consistent with other reports from the KPNC population showing the declining incidence of hospitalized

myocardial infarction between 2000 and 2014 (5,6). Reduced mortality attributed to heart disease and stroke within KPNC parallels with the implementation of comprehensive health system-wide prevention and risk factor management programs. Adoption, evaluation, and distribution, and systematic implementation of updated evidence-based practice guidelines facilitate the ability to introduce new treatment options and re-emphasize existing evidence-based recommendations. A prime example of this is the comprehensive management of hypertension within KPNC, associated with a near doubling of the proportion of the KPNC membership with controlled hypertension between 2001 and 2009, compared with only modest improvements observed statewide and nationally (5). Key elements of the KPNC program include establishment of a comprehensive hypertension registry, development and sharing of performance metrics, simplified treatment protocols based on evidence-based guidelines, task sharing in the form of medical assistant visits for blood pressure measurement, and single pill combination pharmacotherapy (5).

Implementation of a comprehensive cardiovascular reduction program, the PHASE (Preventing Heart Attacks and Strokes Everyday) program in KPNC towards the end of 2004 may have contributed, in part, to the trends we observed. The PHASE program systematically identifies and treats individuals with established or at high risk for cardiovascular disease by promoting healthy lifestyle, prescribing cardiovascular medications (such as aspirin, statins, and ACE inhibitors), and controlling risk factors (such as blood pressure, cholesterol, and blood glucose).

These findings are not explained by differential distribution of age in the U.S. vs. KPNC. For example, in 2015, 14.9% of the U.S. population was ≥ 65 years compared with 15.0% in KPNC. Similarly, 59.0% of the U.S. population was <45 years old compared with 57.5% of the KPNC population. It is possible that in KPNC, a higher proportion of cardiovascular deaths occurred among out-of-state deaths that could not be ascertained. However, the percentage of out-of-state deaths in KPNC members was low (3–4%) during the study period and stable from year to year, so this would not explain the observed mortality trends.

Given the high societal burden and associated costs of heart disease and stroke (17), our findings support enhanced preventative efforts nationally, especially among middle-aged adults to promote further declines in cardiovascular mortality. The encouraging findings from an example of a large integrated health care delivery system highlights the importance of access to a coordinated care that combines both prevention and therapeutic interventions that may help guide future large- scale national policy initiatives.

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Appendix. Age-specific mortality per 100,000 person-years from heart disease, coronary heart disease, stroke, and all causes, US and KPNC, 2000 and 2015

	US			KPNC		
Age group, yr	Age-specific rate (per 100,000 p-y)		% decline	Age-specific rate (per 100,000 p-y)		% decline
Heart disease	2000	2015		2000	2015	
1	13.0	7.3	43.8%	3.2	8.5	-165.4%
1 to 4	1.2	0.9	25.0%	1.4	0.6	54.8%
5 to 14	0.7	0.5	28.6%	0.2	0.4	-87.6%
15 to 24	2.6	2.3	11.5%	1.3	1.3	5.6%
25 to 34	7.4	8.0	-8.1%	4.9	3.4	31.4%
35 to 44	29.2	25.6	12.3%	14.8	11.3	23.7%
45 to 54	94.2	79.3	15.8%	52.8	31.9	39.7%
55 to 65	261.2	188.1	28.0%	177.7	84.7	52.3%
65 to 74	665.6	389.5	41.5%	445.7	223.6	49.8%
75 to 84	1780.3	1071.6	39.8%	1295.9	812.9	37.3%
85	5926.1	3986.5	32.7%	4601.2	3363.5	26.9%
Coronary Heart Disease	2000	2015	% decline	2000	2015	% decline
1	0.8	***	n/a	0	0	n/a
1 to 4	***	***	n/a	0	0	n/a
5 to 14	***	***	n/a	0	0	n/a
15 to 24	0.3	0.3	0%	0.2	0	100.0%
25 to 34	2.3	1.1	4.3%	1.2	1.2	0%
35 to 44	16.7	12.0	28.1%	7.6	6.2	18.4%
45 to 54	66.1	46.6	29.5%	29.9	24.2	19.1%
55 to 65	196.7	119.6	39.2%	110.4	64.3	41.8%
65 to 74	505.1	249.1	50.7%	340.3	155.1	54.4%
75 to 84	1324.2	640.8	51.6%	1055.2	472.1	55.3%
85	4182.5	2130.1	49.1%	3971.0	1871.3	52.9%
Stroke	2000	2015	% decline	2000	2015	% decline
1	3.3	2.2	33.3%	0.0	0.0	n/a
1 to 4	0.3	0.3	0.0%	0.7	0.0	100%
5 to 14	0.2	0.2	0.0%	0.0	0.2	n/a
15 to 24	0.5	0.4	20.0%	1.1	0.2	80.3%
25 to 34	1.5	1.3	13.3%	0.5	0.4	23.4%
35 to 44	5.8	4.4	24.1%	4.5	2.0	56.0%
45 to 54	16.0	12.3	23.1%	12.0	5.3	55.5%
55 to 65	41.0	29.6	27.8%	34.6	15.2	55.9%
65 to 74	128.6	75.5	41.3%	122.9	50.1	59.2%

	US			KPNC		
Age group, yr	Age-specific rate (per 100,000 p-y)		% decline	Age-specific rate (per 100,000 p-y)		% decline
75 to 84	461.3	273.0	40.8%	504.3	243.4	51.7%
85	1589.2	975.8	38.6%	1586.6	1063.9	32.9%
All-Cause	2000	2015	% decline	2000	2015	% decline
1	736.7	589.6	20.0%	224.5	110.7	50.7%
1 to 4	32.4	24.9	23.1%	30.0	10.7	64.3%
5 to 14	18	13.2	26.7%	13.9	8.7	36.9%
15 to 24	79.9	69.5	13.0%	46.2	40.1	13.2%
25 to 34	101.4	116.7	-15.1%	48.1	43.8	8.9%
35 to 44	198.9	180.1	9.5%	103.0	75.1	27.0%
45 to 54	425.6	404	5.1%	258.4	183.3	29.1%
55 to 65	992.2	875.3	11.8%	723.4	485.3	32.9%
65 to 74	2399.1	1796.8	25.1%	1899.5	1270.0	33.1%
75 to 84	5666.5	4579.2	19.2%	4766.2	4023.9	15.6%
85	15524.4	13673.9	11.9%	13405.0	13424.6	-0.1%

Unreliable estimate

Clinical Significance

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

Figure.
Decline in age-adjusted mortality rates (% change) from 2000 to 2015, United States versus KPNC. KPNC = Kaiser Permanente Northern California.

Table 1A

Age-adjusted Mortality Rates attributed to Heart disease, Coronary Heart disease, Stroke and All-Cause, the United States, 2000–2015.

USA Year	Heart disease		Coronary heart disease		Stroke		All-Cause	
	Population	Deaths	AAMR ^a	Deaths	AAMR ^a	Deaths	AAMR ^a	Deaths
2000	281,421,906	710,760	257.6	515,204	186.8	167,661	60.9	2,403,351
2001	284,968,955	700,142	249.5	502,189	179.0	163,538	58.4	2,416,425
2002	287,625,193	696,947	244.6	494,382	173.5	162,672	57.2	2,443,387
2003	290,107,933	685,089	236.3	480,028	165.6	157,689	54.6	2,448,288
2004	292,805,298	652,486	221.6	451,326	153.2	150,074	51.2	2,397,615
2005	295,515,599	652,091	216.8	445,687	148.2	143,579	48.0	2,448,017
2006	298,379,912	631,636	205.5	425,425	138.3	137,119	44.8	2,426,264
2007	301,231,207	616,067	196.1	406,351	129.2	135,952	43.5	2,423,712
2008	304,093,966	616,828	192.1	405,309	126.1	134,148	42.1	2,471,984
2009	306,771,529	599,413	182.8	386,324	117.7	128,842	39.6	2,437,163
2010	308,745,538	597,689	179.1	379,559	113.6	129,476	39.1	2,468,435
2011	311,591,917	596,577	173.7	375,295	109.2	128,932	37.9	2,515,458
2012	313,914,040	599,711	170.5	371,469	105.4	128,546	36.9	2,543,279
2013	316,128,839	611,105	169.8	370,213	102.6	128,978	36.2	2,596,993
2014	318,857,056	614,348	167.0	364,593	98.8	133,103	36.5	2,626,418
2015	321,418,820	633,842	168.5	366,801	97.2	140,323	37.6	2,712,630
								733.1

Abbreviations: HD, heart disease; AAMR, age-adjusted mortality rate

^a Age-adjusted mortality rate per 100,000 person-years, directly standardized to the 2000 U.S. population

Table 1B

Age-adjusted Mortality Rates attributed to Heart Disease, Coronary Heart Disease, Stroke and All-Cause, KPNC, 2000–2015.

KPNC Year	Heart disease		Coronary heart disease		Stroke		All-Cause	
	Population	Deaths	AAMR ^a	Deaths	AAMR ^a	Deaths	AAMR ^a	Deaths
2000	2,897,757	4,478	184.9	3,302	136.0	1,436	61.0	17,187
2001	2,996,597	4,743	184.3	3,491	134.9	1,455	57.7	18,397
2002	3,063,695	5,116	186.0	3,691	133.3	1,537	57.2	19,525
2003	3,075,646	4,957	174.0	3,444	120.3	1,506	53.9	20,306
2004	3,054,077	4,769	164.7	3,275	112.7	1,474	52.3	19,684
2005	3,105,150	4,913	164.7	3,348	111.3	1,402	47.9	20,408
2006	3,151,949	4,740	154.8	3,140	101.8	1,273	42.5	20,193
2007	3,179,387	4,519	144.9	2,839	90.5	1,170	37.9	19,679
2008	3,190,576	4,407	137.9	2,775	86.4	1,148	36.4	19,826
2009	3,151,582	4,233	129.0	2,579	78.4	1,062	32.7	19,551
2010	3,158,952	4,306	127.2	2,608	76.5	1,093	32.6	19,698
2011	3,244,152	4,389	125.4	2,679	76.3	1,087	31.4	20,497
2012	3,312,468	4,469	121.6	2,771	75.0	1,092	30.1	20,856
2013	3,349,794	4,477	118.1	2,648	69.6	1,130	29.9	21,409
2014	3,490,317	4,428	112.1	2,528	63.8	1,191	30.3	21,541
2015	3,696,291	4,875	117.7	2,784	66.7	1,357	33.2	23,508

Abbreviations: HD, heart disease; AAMR, age-adjusted mortality rate

^a Age-adjusted mortality rate per 100,000 person-years, directly standardized to the 2000 U.S. population

Age-Specific Decline in Mortality Rates 2000–2015 for Heart Disease, Stroke, and All-Cause within the United States and KPNC, total population.

Table 2A

	US			KPNC		
	Mortality rate ^a and %decline			Mortality rate and %decline		
	2000	2015	Percentage decline	2000	2015	Percentage decline
Heart Disease						
<45 years	9.9	8.9	10.4	5.2	4.1	21.4
45–64 years	159.8	122.0	23.6	101.9	52.6	48.3
65 years	1706.6	1072.9	37.1	1257.3	817.9	34.9
Total	257.6	168.5	34.6	184.9	117.7	36.3
Coronary Heart Disease						
<45 years	4.7	3.5	25.6	2.5	1.5	41.0
45–64 years	117.4	75.3	35.9	73.0	32.4	55.6
>65 years	1246.9	618.9	50.4	934.7	462.9	50.5
Total	186.8	97.2	47.9	136.0	66.7	51.0
Stroke						
<45 years	2.0	1.6	21.7	1.5	0.7	55.8
45–64 years	25.8	19.1	26.0	20.9	9.2	55.8
65 years	425.9	256.0	39.9	437.8	223.1	44.5
Total	60.9	37.6	38.2	61.0	33.2	45.5
All-Cause						
<45 years	110.1	101.6	7.8	56.0	41.6	25.6
45–64 years	648.2	589.2	9.1	441.1	302.0	31.5
65 years	5168.9	4241.3	17.9	4428.3	3738.5	13.6
Total	869.0	733.1	15.6	681.5	566.7	16.8

^aMortality rate per 100,000 person-years, age-adjusted within age group.

Table 2B

Age-Specific Decline in Mortality Rates 2000–2015 for Heart Disease, Stroke, and All-Cause within the United States and KPNC, males.

	Male					
	US			KPNC		
	Mortality rate ^a and %decline		Percentage change	Mortality rate and %decline		Percentage change
	2000	2015		2000	2015	
Heart Disease						
<45 years	13.6	11.9	12.5	7.2	6.0	17.0
45–64 years	231.1	173.9	24.8	159.9	80.0	50.0
65 years	2056.0	1308.9	36.3	1611.1	1012.3	37.2
Total	320.0	211.8	33.8	243.9	149.6	38.6
Coronary Heart Disease						
<45 years	7.3	5.2	28.4	4.1	2.6	37.8
45–64 years	176.8	112.5	36.4	118.2	51.6	56.3
>65 years	1561.6	813.3	47.9	1205.4	642.4	46.7
Total	241.4	131.2	45.7	181.3	94.3	48.0
Stroke						
<45 years	2.0	1.7	13.4	1.1	0.8	29.1
45–64 years	29.2	22.2	24.0	24.6	12.1	50.8
65 years	432.0	251.1	41.9	467.4	243.0	48.0
Total	62.4	37.8	39.4	65.3	33.2	48.0
All-Cause						
<45 years	141.8	130.3	8.1	69.9	57.1	18.4
45–64 years	813.0	734.6	9.7	539.2	363.8	32.5
65 years	6178.2	4867.3	21.2	5265.6	4196.6	20.3
Total	1053.8	863.2	18.1	830.8	648.4	22.0

^a Mortality rate per 100,000 person-years, age-adjusted within age group.

Table 2C

Age-Specific Decline in Mortality Rates 2000–2015 for Heart Disease, Stroke, and All-Cause within the United States and KPNC, females.

	Female					
	US			KPNC		
	Mortality rate ^a and %decline			Mortality rate and %decline		
	2000	2015	Percentage change	2000	2015	Percentage change
Heart Disease						
<45 years	6.3	5.9	6.6	3.3	2.3	30.3
45–64 years	92.8	72.9	21.5	48.6	27.4	43.7
65 years	1472.9	898.9	39.0	998.2	677.1	32.2
Total	257.6	168.5	36.6	139.1	93.2	33.0
Coronary Heart Disease						
<45 years	2.2	1.8	17.9	1.0	0.4	53.0
45–64 years	61.5	40.0	35.1	31.4	14.6	53.4
>65 years	1039.4	478.2	54.0	731.9	333.6	54.4
Total	146.5	70.5	51.9	100.1	45.7	54.3
Stroke						
<45 years	2.0	1.4	30.6	1.9	0.6	70.5
45–64 years	22.7	16.2	28.4	17.4	6.6	62.2
65 years	417.2	255.9	38.7	416.6	239.9	42.4
Total	59.1	36.8	37.6	57.8	32.1	44.4
All-Cause						
<45 years	78.0	72.4	7.1	42.4	26.6	37.3
45–64 years	493.1	451.4	8.4	350.8	245.2	30.1
65 years	4518.2	3772.2	16.5	3651.7	3392.3	7.1
Total	731.4	624.2	14.7	567.1	500.5	11.7

^a Mortality rate per 100,000 person-years, age-adjusted within age group.