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ORIGINAL RESEARCH

Cardiovascular Disease Mortality Among Hispanic Versus Non-Hispanic White Adults in the United States, 1999 to 2018

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BACKGROUND: Life expectancy has been higher for Hispanic versus non-Hispanic White (NHW) individuals; however, data are limited on cardiovascular disease (CVD) mortality.

METHOD AND RESULTS: Using the Centers for Disease Control and Prevention's Wide-Ranging Online Data for Epidemiologic Research death certificate database (1999–2018), we compared age-adjusted mortality rates for total CVD and its subtypes (ischemic heart disease, stroke, heart failure, hypertensive heart disease, other CVD), and average annual percentage changes among Hispanic and NHW adults. The age-adjusted mortality rate per 100 000 was lower for Hispanic than NHW adults for total CVD (186.4 versus 254.6; $P<0.001$) and its subtypes. Between 1999 and 2018, mortality decline was higher in Hispanic than NHW adults for total CVD (average annual percentage change [AAPC], −2.90 versus −2.41) and ischemic heart disease (AAPC: −4.44 versus −3.82) ($P<0.001$). In contrast, stroke mortality decline was slower in Hispanic versus NHW adults (AAPC: −2.05 versus −2.60; $P<0.05$). Stroke mortality increased in Hispanic but stalled in NHW adults since 2011 (AAPC: 0.79 versus −0.09). For ischemic heart disease (AAPC: −0.80 versus −1.85) and stroke (AAPC: −1.32 versus −1.43) mortality decline decelerated more for Hispanic than NHW adults aged <45 years ($P<0.05$). For heart failure, Hispanic adults aged <45 (3.55 versus 2.16) and 45 to 64 (1.88 versus 1.54) showed greater rise in age-adjusted mortality rate than NHW individuals ($P<0.05$). Age-adjusted heart failure mortality rate also accelerated in Hispanic versus NHW men (1.00 versus 0.67; $P<0.001$).

CONCLUSIONS: Disaggregating data by CVD subtype and demographics unmasked heterogeneities in CVD mortality between Hispanic and NHW adults. NHW adults had greater CVD mortality rates and slower decline than Hispanic adults, whereas marked demographic differences in mortality signaled concerning trends among the Hispanic versus NHW population.

Key Words: cardiovascular mortality ■ epidemiology ■ Hispanics

Despite medical advancements and public health interventions, cardiovascular disease (CVD) remains the leading cause of death in the United States and worldwide.[1] Furthermore, the rate of decline in CVD mortality has been slowing down.[2] Recent data have demonstrated that decline in CVD mortality has decelerated since 2011.[2] Prior studies have shown startling patterns of racial and ethnic disparities in CVD mortality.[1,3] However, the body of evidence exploring CVD mortality predominantly has focused on non-Hispanic racial and ethnic subgroups; less is known about CVD death characteristics among Hispanic/Latino ethnicity individuals—one of the fastest-growing segments of the US population.[4]

According to the US Census Bureau, the Hispanic population is expected to grow by 86% between 2015 and 2050, to a projected 119 million by 2060.[4,5] Hispanic individuals have traditionally faced socioeconomic

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CLINICAL PERSPECTIVE

What Is New?

- Cardiovascular disease (CVD) mortality trends varied among Hispanic and Non-Hispanic White (NHW) adults in the United States.
- NHW adults had greater CVD mortality and slower decline than Hispanic adults. Whereas decline in stroke mortality was slower for Hispanic than NHW adults, heart failure mortality accelerated in Hispanic versus NHW men.

What Are the Clinical Implications?

- Unraveling data by CVD subtype and demographics exposed concerning trends in CVD mortality between Hispanic and NHW adults.
- The reasons for the deceleration in CVD mortality decline among NHW population and diverse trends in Hispanic population need to be explored at a deeper level.

Nonstandard Abbreviations and Acronyms

AAPC	average annual percentage rate change
IHD	ischemic heart disease
NHW	non-Hispanic White

deprivation and carry a disproportionally higher burden of CVD.[4,5] Despite this, preliminary data have shown a lower mortality for Hispanic than non-Hispanic White (NHW) individuals—the so-called Hispanic paradox, by which Hispanic adults would have cardiovascular protective features, such as strong family and social support, genetics, and dietary habits, that would counteract the effect of adverse social determinants of health and attenuate that of certain prevalent CVD risk factors[6–8]

However, the scientific literature is inconsistent with regard to the Hispanic paradox, with some studies supporting the phenomenon[8] while others have opposed its existence,[9,10] showing that Hispanic adults had a similar or even greater mortality than NHW individuals. Whether the Hispanic mortality paradox still exists and whether this is consistent across CVD subtypes and demographic characteristics remain uncertain. To shed light on this matter, we used national CVD mortality data and compared CVD mortality trends in Hispanic with NHW individuals, stratified by age, sex, CVD subtypes, and urbanicity between 1999 and 2018.

METHODS

The Centers for Disease Control and Prevention's Wide-Ranging Online Data for Epidemiologic Research used in this project is publicly available and are easily replicable from the methods described in the article.

Data Source

We reviewed the Centers for Disease Control and Prevention's Wide-Ranging Online Data for Epidemiologic Research database, composed of death certificates in the United States filed in the 50 states and District of Columbia.[11] We identified race and ethnicity on death certificates as NHW adults, non-Hispanic Black adults, and Hispanic adults. We exclusively compared Hispanic adults with NHW adults to provide standard assessment of mortality rates among Hispanic population in relation to a majority NHW population (*control group)*. We excluded non-Hispanic Black individuals from the analysis because the latter are also treated as minority population and would not provide a fair assessment of Hispanic mortality estimates.

Ethnicity and race were reported on the death certificate as per the standards set forth by the Office of Management and Budget.[12] Ethnicity and race information of the decedent is reported by the funeral director as provided by an informant, often the surviving next of kin, or, in the absence of an informant, based on observation. Ethnicity and race information from the census is self-described.[13] Race and Hispanic ethnicity can be inconsistent between these 2 databases; therefore, a degree of bias in mortality rates cannot be ignored. Some death certificates did not mention Hispanic origin and were coded as "not stated." We excluded those death certificates from the analysis.

We identified the natural cause of death according to the World Health Organization statement,[14] attributed to CVD and subtypes among adults (aged ≥18 years). We identified mortality information using the *International Classification of Diseases, Tenth Revision* (*ICD-10*) codes with the underlying cause of total CVD, which comprised subtypes classified as ischemic heart disease (IHD; ICD-10: I20-I25), heart failure (HF, I50), stroke (I60-I69), hypertensive heart disease (I11) and other CVDs (pulmonary heart disease [I26-I28], valvular heart disease [I34-I38], arrhythmia [I47-I49], acute rheumatic fever and chronic rheumatic heart disease [I00-I09], pericardial diseases [I30-I33], acute myocarditis [I40-I46], and complications of the ill-defined description of heart disease [I51]).[15,16] We grouped the later as "Other CVDs" because of low death counts. The population estimates used for this analysis are Census Bureau estimates of US national, state, and county resident populations (Data S1).[13]

This study did not require institutional review board approval since we analyzed government-issued publicly available databases without individually identifiable information.

Data Extraction

We abstracted the number of cause-specific CVD deaths and population sizes for age, sex, and 2013 county-level urban-rural classification for Hispanic and NHW adults from 1999 to 2018. We collapsed urban counties into the large metro (large central metro, large fringe metro) and medium-small metros, whereas rural counties were composed of micropolitan and noncore (nonmetropolitan counties that did not qualify as micropolitan).[17]

Statistical Analysis

We estimated age-adjusted (to the 2000 US standard population)[18] mortality rates for each year per 100 000 population within the county, across the counties within a particular state, and across the entire United States. Using this approach, we suppressed rates for data demonstrating 0 to 9 deaths along with the corresponding denominator population when the population showed <10 persons. For deaths <20, rates were considered unreliable and were not computed during the estimation of age-adjusted rates. Since we aggregated death rates across counties, all counties were included regardless of population size and death counts.

We analyzed temporal trends by fitting log-linear regression models using the Joinpoint Regression Program version 4.7.0.0 (National Cancer Institute). We calculated average annual percentage rate change (AAPC) with 95% CIs in age-adjusted mortality rates for all analyses from 1999 to 2018, further divided into 1999 to 2011 and 2011 to 2018, weighted to account for differences in the number of inflection points.[15,19] We identified the year 2011 as the inflection point in total CVD mortality trends, consistent with prior studies reporting national CVD mortality trends.[2,15] Slopes were considered increasing or decreasing if the estimated slope differed significantly from 0.[19,20] We applied a specific procedure- comparability test to determine whether 2 regression mean functions are parallel because of different intercepts (test of parallelism).[21] Analyses were stratified by age (<45 years, 45–64 years, and ≥65 years), as well as by sex and urbanicity. For all analyses, statistical significance was set at 5%. For additional details please see the Supplementary Methods section.

RESULTS

Between 1999 and 2018, a total of 834 532 total CVD deaths occurred in Hispanic people (955 395 222 person-years), and 14 288 611 deaths in NHW adults (4 193 681 875 person-years). Overall, IHD was the leading cause of CVD death. Hispanic adults had a lower age-adjusted mortality rate (186.4; 95% CI, 186.0–186.8 per 100 000) than NHW adults (254.6; 95% CI, 254.5–254.7 per 100 000) for total CVD (P<0.001), which was consistent for CVD subtypes.

Trends in CVD Mortality

Between 1999 and 2018, mortality decline was higher in Hispanic than NHW adults for total CVD (AAPC, –2.90 versus –2.41) and IHD (AAPC, –4.44 versus –3.82), but not for stroke (AAPC, –2.05 versus –2.60) (P test for parallelism <0.001 for all; Table 1). For hypertensive heart disease, mortality escalated in NHW versus Hispanic patients (AAPC, 3.07 versus 1.87; P<0.001). Between 1999 and 2011, Hispanic adults exhibited a decline in mortality at an AAPC of –3.88 (95% CI, –4.26 to –3.49) for total CVD, –5.20 (95% CI, –6.57 to –3.80) for IHD, and –3.67 (95% CI, –3.95 to –3.39) for stroke, but stagnation for hypertensive heart disease (1.45; 95% CI, –0.51 to 3.46) (Figure 1; Table S1). Similar trends were noted in NHW individuals, except mortality increased because of hypertensive heart disease at AAPC of 1.93 (95% CI, 1.58–2.28). Examining time periods, the mortality slowed down for both Hispanic and NHW adults for total CVD (AAPC, –0.86 and –0.63, respectively) and IHD (AAPC, –3.07 and –2.47, respectively), and increased for hypertensive heart disease (AAPC, 2.60 and 5.04, respectively) between 2011 and 2018. The AAPC showed that mortality attributable to stroke (0.79; 95% CI, 0.03–1.56) has increased in Hispanic adults but has stalled (–0.09; 95% CI, –0.51 to 0.33]) in NHW patients since 2011.

Trends in CVD Mortality by Age

Between 1999 and 2018, decline in AAPC in age-adjusted mortality rates was greater in Hispanic than NHW individuals for total CVD across all age groups (P<0.05 for all; Table 2). Conversely, for IHD (AAPC, –0.80 versus –1.85) and stroke (AAPC, –1.32 versus –1.43) mortality decline slowed down more for Hispanic than NHW adults aged <45 years (P<0.05). For both the study groups, mortality attributable to HF increased for ages <45 years and 45 to 64 years, and across all age groups for hypertensive heart disease. However, AAPC for Hispanic adults aged <45 years (3.55 versus 2.16) and 45 to 64 years (1.88 versus 1.54) showed a greater rise in HF mortality than for NHW patients (P<0.05). Whereas NHW adults showed a greater rise in mortality attributable to hypertensive heart disease than Hispanic adults across all age groups (P<0.001).

After an initial decline, AAPC in total CVD mortality increased in Hispanic patients aged <45 years (1.14, 95% CI, 0.57–1.71), stalled in those aged 45 to 64 years

Table 1. Trends in Cardiovascular Disease Mortality Between Hispanic and Non-Hispanic White adults in the United States, 1999 to 2018

	Hispanic adults				Non-Hispanic White adults				Test for parallelism
	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	
	1999 (n=33 665)	2011 (n=40 794)	2018 (n=56 217)	(1999–2018)	1999 (n=744 329)	2011 (n=581 619)	2018 (n=616 522)	(1999–2018)	*P* value
Total cardiovascular disease	267.7 (264.7–270.7)	166.5 (164.8–168.2)	156.7 (155.4–158.1)	−2.90 (−3.21 to −2.58)	322.7 (322.0–323.5)	211.5 (210.9–212.0)	201.4 (200.9–201.9)	−2.41 (−2.76 to −2.05)	<0.001
Ischemic heart disease	162.2 (159.8–164.5)	84.2 (83.0–85.4)	69.1 (68.2–70.0)	−4.44 (−4.85 to −4.02)	194.3 (193.7–194.9)	111.1 (110.7–111.5)	93.5 (93.1–93.8)	−3.82 (−4.12 to −3.52)	<0.001
Heart failure	11.1 (10.5–11.8)	10.1 (9.6–10.5)	11.8 (11.5–12.2)	0.55 (−0.44 to 1.55)	20.6 (20.4–20.8)	17.5 (17.3–17.7)	21.7 (21.6–21.9)	0.33 (−0.28 to 0.94)	0.16
Hypertensive heart disease	6.9 (6.5–7.4)	7.8 (7.4–8.1)	9.7 (9.4–10.0)	1.87 (0.37–3.38)	6.8 (6.7–6.9)	8.5 (8.4–8.6)	12.1 (11.9–12.2)	3.07 (2.55 to 3.59)	<0.001
Stroke	46.6 (45.3–47.8)	30.7 (30.0–31.4)	32.0 (31.4–32.6)	−2.05 (−2.39 to −1.70)	59.8 (59.5–60.1)	36.7 (36.5–36.9)	35.9 (35.7–36.1)	−2.60 (−3.10 to −2.11)	<0.001
Other cardiovascular diseases	23.4 (22.5–24.2)	20.3 (19.7–20.9)	19.3 (18.9–19.8)	−0.77 (−1.11 to −0.44)	41.2 (40.9–41.4)	37.7 (37.5–37.9)	38.3 (38.1–39.1)	−0.37 (−1.07 to 0.33)	<0.001

AAPC indicates average annual percent change.

(−0.26; 95% CI, −0.70 to 0.19) and slowed down among those ≥65 years (−1.03 95% CI, −1.47 to −0.59]) since 2011. AAPC in total CVD mortality decreased in NHW adults aged <45 years (−0.46; 95% CI, −0.90 to −0.02), increased in those aged 45 to 64 years (0.29; 95% CI, 0.10–0.48), and slowed down in those aged ≥65 years (−0.80; 95% CI, −1.04 to −0.55) since 2011 (Figure 2; Table S2). For IHD, mortality decreased for adults aged 45 to 64 years and ≥65 years between 1999 and 2011, followed by a deceleration since 2011 for both Hispanic and NHW patients. After an initial decrease, stroke mortality flattened in Hispanic adults aged <45 years (AAPC, −0.53; 95% CI, −2.35 to 1.32) and 45 to 64 years (0.48; 95% CI, −2.45 to 1.53) and increased among those ≥65 years (1.06; 95% CI, 0.21–1.91) between 2011 and 2018. Conversely, among NHW patients, stroke mortality increased in those aged<45 years (0.31; 95% CI, 1.77–2.44) and 45 to 64 years (0.59; 95% CI, 0.24–0.94) and stalled in those aged ≥65 years (−0.16; 95% CI, −0.59 to 0.26) since 2011.

Trends in CVD Mortality by Sex

Between 1999 and 2018, AAPCs in age-adjusted mortality rates were greater in Hispanic than NHW adults for total CVD and IHD, except stroke mortality decreased at a slower rate for both sexes (P<0.001; Table 3). Similarly, HF mortality showed an acceleration in Hispanic men versus NHW men (AAPC, 1.00 versus 0.67; P<0.001). For hypertensive heart disease, the rise in mortality was higher in NHW versus Hispanic adults for both sexes (P<0.001).

Between 1999 and 2011, for both study groups, the mortality decreased for total CVD and IHD, followed by slowing down for both sexes since 2011 (Figure 3; Table S3). However, after an initial decline in stroke mortality for both sexes, mortality has stalled in Hispanic women (AAPC, 0.76; 95% CI, −0.01 to 1.53) and increased in men (0.92; 95% CI, 0.27–1.58), but stalled in both NHW sexes between 2011 and 2018.

Trends in CVD Mortality by Urbanicity

Between 1999 and 2018, decline in AAPCs in age-adjusted mortality rates were greater in Hispanic people than NHW adults for total CVD and IHD across counties (Table 4). This pattern was not consistent for stroke, where mortality decreased at a slower rate for large (AAPC, −1.71 versus −2.53; P<0.001) and medium/small metro (−2.64 versus −2.70; P<0.001) counties but declined at a greater pace in rural counties (−3.76 versus −2.70; P<0.001) among Hispanic versus NHW adults (Table 4). Similarly, for HF, mortality increased at a higher pace in Hispanic residents of large metros versus the NHW population (1.37 versus 1.08; P<0.001).

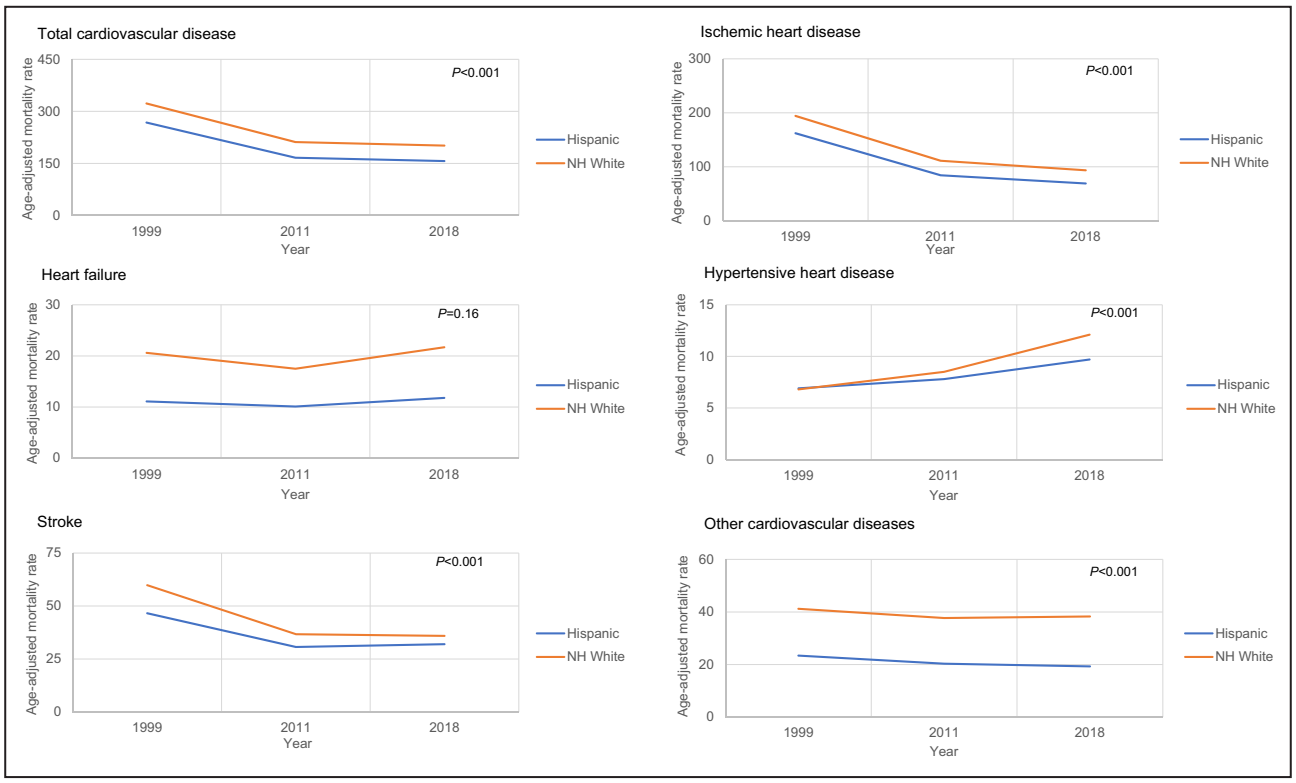

Figure 1. Trends of age-adjusted mortality rates attributable to total cardiovascular disease and its components in Hispanic and Non-Hispanic White individuals in the United States, 1999 to 2018.
AAMR indicates age-adjusted mortality rate; and NH, non-Hispanic.

Between 1999 and 2011, AAPC for total CVD decreased in large metro (–3.80 versus –3.72), medium-small metro (–3.40 versus –3.42), and rural counties (–4.19 versus –2.98), while it has slowed down in all 3 county subtypes for both study groups since 2011 (Table S4). While this pattern was consistent for IHD, for stroke, AAPCs in age-adjusted stroke mortality rates have increased at a higher pace (1.70 versus 0.68) in large metro but reduced at a greater rate in rural counties (–1.67 versus –1.27) in Hispanic versus NHW residents.

DISCUSSION

In this analysis, we document diverging trends in CVD mortality between Hispanic and NHW adults in the United States during the past 2 decades. Between 1999 and 2018, mortality decline was higher in Hispanic than NHW adults for total CVD and IHD. However, stroke mortality decline was greater in NHW than Hispanic adults. For hypertensive heart disease, mortality escalated in NHW versus Hispanic individuals. Analyzing demographic characteristics unmasked critical trends for both study groups. For instance, CVD mortality increased in Hispanic adults aged <45 years after 2011, while it decreased in the same age group in NHW adults. Compared with NHW adults, Hispanic adults aged <45 years exhibited a slow decline in stroke mortality because of flattening after 2011, while among Hispanic people aged ≥65 years, mortality has accelerated since 2011. There were also sex differences in the deceleration of the reduction of stroke mortality in Hispanic versus NHW adults because of stalling in Hispanic women and rise in Hispanic men since 2011. HF mortality has increased in Hispanic adults aged <45 years and 45 to 64 years and Hispanic men compared with the NHW group.

Overall, NHW adults had higher CVD mortality than Hispanic individuals. In certain scenarios, such as hypertensive heart disease, mortality increased compared with the Hispanic population. After decades of increases in life expectancy, a concerning shift representing stagnant CVD mortality statistics in the United States were observed in 2011.[19] CVD mortality rates in many high-income countries, after falling by up to 80% over the past 4 decades, are now either declining at progressively slower rates or even showing concerning acceleration.[22] The heart disease death rate for NHW men declined 19% between 1999 (226.6 per 100 000) and 2009 (184.2 per 100 000) and then increased 4% between 2009 and 2017 (192.3 per 100 000).[23] This concerning shift has been attributed to increasing cardiometabolic risk factors, especially among adults aged 35 to 64 years, including obesity and diabetes

Table 2. Trends in Cardiovascular Disease Mortality Between Hispanic and Non-Hispanic White Adults in the United States Stratified by Age Groups, 1999 to 2018

	Hispanic adults				Non-Hispanic White adults				
	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Test for parallelism
	1999	2011	2018	(1999–2018)	1999	2011	2018	(1999–2018)	*P* value
Total cardiovascular disease									
<45 y	7.8 (7.5–8.2)	6.5 (6.2–6.8)	6.7 (6.4–7.0)	−0.62 (−1.22 to −0.01)	10.7 (10.6–10.9)	10.1 (9.9–10.3)	9.5 (9.3–9.7)	−0.47 (−0.88 to −0.06)	0.01
45–64 y	144.2 (140.7–147.8)	98.0 (96.0–100.1)	96.4 (94.7–98.2)	−2.07 (−2.30 to −1.84)	173.3 (172.1–174.5)	133.5 (132.6–134.4)	136.2 (135.2–137.1)	−1.28 (−1.47 to −1.10)	<0.001
≥65 y	1824.7 (1801.9–1847.5)	1111.7 (1099.0–1124.4)	1036.0 (1026.0–1046.0)	−2.95 (−3.36 to −2.53)	2193.7 (2188.4–2199.0)	1386.9 (1383.0–1390.8)	1305.4 (1301.8–1308.9)	−2.65 (−3.04 to −2.27)	<0.001
Ischemic heart disease									
<45 y	2.2 (2.0–2.4)	1.8 (1.6–1.9)	1.8 (1.7–1.9)	−0.80 (−1.78 to 0.18)	4.9 (4.8–5.0)	4.2 (4.1–4.3)	3.3 (3.2–3.5)	−1.85 (−2.19 to −1.51)	0.02
45–64 y	86.3 (83.5–89.0)	49.8 (48.3–51.3)	46.0 (44.8–47.2)	−3.23 (−3.55 to −2.90)	117.1 (116.1–118.1)	80.4 (79.7–81.1)	75.3 (74.6–76.0)	−2.29 (−2.44 to −2.15)	<0.001
≥65 y	1120.1 (1102.2–1138.0)	569.2 (560.1–578.3)	456.7 (450.0–463.3)	−5.02 (−5.33 to −4.71)	1306.4 (1302.2–1310.5)	716 (713.2–718.8)	590.3 (587.9–592.7)	−4.36 (−4.66 to −4.06)	<0.001
Heart failure									
<45 y	0.1 (0.1–0.3)	0.2 (0.1–0.3)	0.2 (0.1–0.3)	3.55 (1.59–5.55)	0.2 (0.1–0.3)	0.2 (0.1–0.3)	0.3 (0.2–0.4)	2.16 (0.36–3.98)	0.01
45–64 y	2.7 (2.2–3.2)	2.7 (2.4–3.1)	3.7 (3.3–4.0)	1.88 (0.49–3.28)	4.2 (4.0–4.4)	4.0 (3.8–4.1)	6.0 (5.8–6.1)	1.54 (0.91–2.18)	<0.001
≥65 y	82.6 (77.6–87.5)	74.0 (70.7–77.3)	86.0 (83.1–88.9)	0.33 (−0.43 to 1.09)	154.6 (153.2–156.0)	130.4 (129.2–131.6)	160.0 (158.8–161.3)	0.25 (−0.33 to 0.84)	0.24
Hypertensive heart disease									
<45 y	0.4 (0.3–0.5)	0.5 (0.4–0.6)	0.8 (0.7–0.9)	2.79 (1.90–3.69)	0.4 (0.3–0.5)	0.9 (0.8–1.0)	1.1 (1.0–1.2)	5.06 (4.18–5.95)	<0.001
45–64 y	5.5 (4.8–6.2)	7.1 (6.5–7.6)	7.8 (7.3–8.3)	2.07 (0.70–3.46)	4.9 (4.7–5.1)	9.2 (9.0–9.5)	12.2 (11.9–12.5)	5.18 (4.60–5.76)	<0.001
≥65 y	43.3 (39.8–46.9)	46.4 (43.8–49.0)	59.3 (56.9–61.7)	1.81 (0.17–3.47)	43.3 (42.5–44.0)	46.5 (45.8–47.2)	68.5 (67.7–69.3)	2.46 (1.71–3.22)	<0.001
Stroke									
<45 y	1.7 (1.6–1.9)	1.4 (1.2–1.5)	1.3 (1.2–1.5)	−1.32 (−1.71 to −0.93)	1.5 (1.4–1.6)	1.2 (1.1–1.3)	1.2 (1.1–1.3)	−1.43 (−1.86 to −1.00)	0.04
45–64 y	24.3 (22.9–25.8)	18.0 (17.1–18.9)	16.8 (16.0–17.5)	−2.02 (−3.06 to −0.97)	19.9 (19.5–20.3)	15.7 (15.4–16.0)	16.3 (16.0–16.7)	−1.08 (−1.38 to −0.77)	<0.001
≥65 y	316.9 (307.4–326.4)	204.3 (198.9–209.8)	216.9 (212.3–221.5)	−2.04 (−2.43 to −1.66)	430.3 (427.9–432.7)	256.5 (254.8–258.2)	248.9 (247.3–250.4)	−2.82 (−3.47 to −2.16)	<0.001
Other cardiovascular diseases									
<45 y	0.4 (0.3–0.5)	0.3 (0.2–0.4)	0.4 (03–0.5)	0.48 (−5.47 to 6.81)	3.7 (3.6–3.8)	3.6 (3.4–3.7)	3.6 (3.5–3.7)	−0.08 (−0.32 to 0.16)	0.25
45–64 y	3.9 (3.3–4.5)	4.1 (3.7–4.5)	5.1 (4.7–5.5)	1.78 (0.00–3.60)	27.1 (26.6–27.6)	24.1 (23.7–24.5)	26.5 (26.1–26.9)	−0.11 (−0.47 to 0.26)	0.07
≥65 y	43.9 (40.4–47.4)	52.2 (49.4–55.0)	59.1 (56.8–61.5)	1.18 (0.79–1.57)	259.2 (257.3–261.0)	237.7 (236.0–239.3)	237.6 (236.1–239.2)	−0.46 (−1.22 to 0.32)	0.01

AAPC indicates average annual percent change.

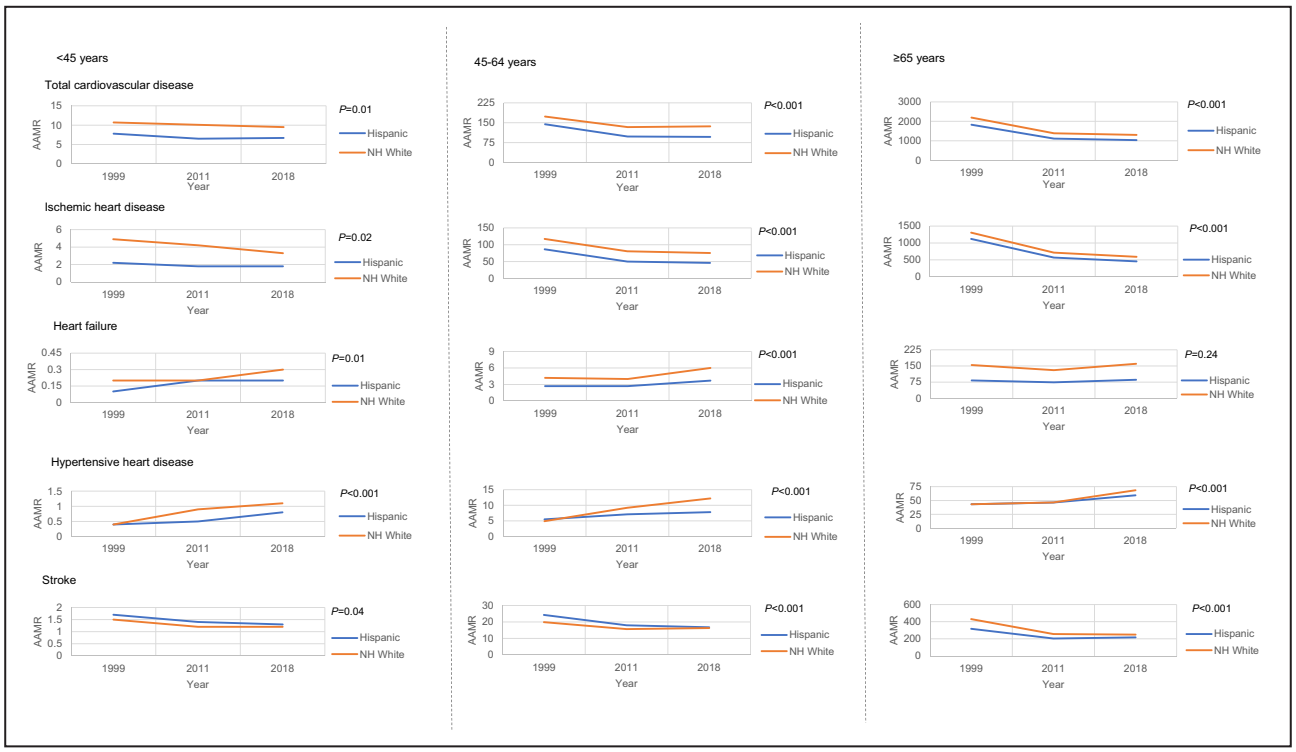

Figure 2. Trends of age-adjusted mortality rates attributable to total cardiovascular disease and its components in Hispanic and Non-Hispanic White individuals stratified by age in the United States, 1999 to 2018.
AAMR indicates age-adjusted mortality rate; and NH, non-Hispanic.

and decline in hypertension control.[2,24–27] In a recent National Health and Nutrition Examination Survey study looking at participants with diabetes, between 2007 and 2018 the glycemic control that was achieved declined from 57.4% to 50.5%, and blood pressure control decreased from 74.2% to 70.4%, while lipid control leveled off.[28]

Hispanic individuals were reported as the most physically inactive ethnic group in the United States.[29,30] The recent Behavioral Risk Factor Surveillance System data showed that physical inactivity, hypertension, diabetes, and obesity remained substantially high among Hispanic men and women.[31] Only 37% of all Hispanic adults had cholesterol levels checked, compared with 66% of NHW people.[32] Mexican Americans also had a higher age-adjusted incidence of hemorrhagic stroke than NHW patients.[33] Suboptimal CVD risk factor profiles explain the current disparities related to CVD mortality, including the stroke mortality gap between NHW and Hispanic adults.

Stroke mortality decline was slower in Hispanic than NHW adults because of a rise in mortality between 2011 and 2018 in the former. Moreover, these aforementioned trends are further heightened across age groups. We noted deceleration in stroke mortality decline in younger Hispanic adults and increased mortality in older adults than NHW adults. Previously, the Brain Attack Surveillance in Corpus Christi Project demonstrated a >2-fold increased incidence of stroke among Mexican Americans aged 45 to 49 years compared with NHW adults.[33] Among younger Hispanic adults, total CVD mortality and HF mortality was also on the rise compared with NHW individuals. These statistics reflect a growing CVD risk burden among younger Hispanic adults.[34] According to the National Health and Nutrition Examination Survey 2015 to 2016,[35] young Hispanic adults had a relatively higher prevalence of obesity (46.9% versus 38.2%) and diabetes (21.5% versus 13%) than NHW individuals. In the recent Young-MI registry, 18% of young Hispanic adults had possible or definite familial hypercholesterolemia.[36] Hispanic individuals lead the diabetic epidemic and are 1.5 times more likely to die of diabetes than NHW individuals.[37] According to the Behavioral Risk Factor Surveillance System data from 2015 to 2018, younger Hispanic adults had a higher prevalence of physical inactivity (31.7% versus 23.4%) than NHW adults.[31] Childhood adiposity and obesity and young-onset diabetes[38,39] are more prevalent in Hispanic than NHW adults. Besides, smoking was more prevalent in Hispanic youth (28% versus 23.8%) than in NHW adults.[40] These findings carry important public health implications and must be addressed to curb the growing CVD burden in the young Hispanic population.

Recent data have shown widespread urban-rural gaps in CVD mortality across all ethnic and racial

Table 3. Trends in Cardiovascular Disease Mortality Between Hispanic and Non-Hispanic White Adults in the United States Stratified by Sex, 1999 to 2018

	Hispanic adults				Non-Hispanic White adults				
	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Test for parallelism
	1999	2011	2018	(1999–2018)	1999	2011	2018	(1999–2018)	*P* value
Total cardiovascular disease									
Women	227.6 (224.0–231.2)	140.9 (138.8–142.9)	128.1 (126.5–129.7)	−2.97 (−3.38 to −2.56)	271.5 (270.6–272.3)	174.5 (173.9–175.2)	164 (163.4–164.7)	−2.58 (−3.16 to −2.00)	<0.001
Men	320.6 (315.3–325.9)	198.1 (195.2–200.9)	191.6 (189.3–193.9)	−2.70 (−3.00 to −2.39)	389.7 (388.4–391.1)	256.8 (255.8–257.7)	245.7 (244.8–246.6)	−2.37 (−2.67 to −2.07)	<0.001
Ischemic heart disease									
Women	133.1 (130.4–135.9)	65.7 (64.3–67.1)	50.3 (49.3–51.3)	−5.01 (−5.54 to −4.49)	150.8 (150.1–151.4)	81.0 (80.5–81.4)	64.9 (64.6–65.3)	−4.38 (−4.72 to −4.04)	<0.001
Men	200.1 (195.9–204.3)	107.7 (105.5–109.8)	92.9 (91.3–94.5)	−4.18 (−4.64 to −3.71)	253.0 (251.9–254.1)	149.4 (148.6–150.1)	128.6 (128.0–129.2)	−3.51 (−3.86 to −3.15)	<0.001
Heart failure									
Women	10.6 (9.8–11.4)	9.2 (8.7–9.7)	10.4 (9.9–10.8)	0.08 (−1.31 to 1.48)	19.6 (19.3–19.8)	16.2 (16.0–16.4)	19.4 (19.2–19.6)	−0.00 (−0.62 to 0.61)	0.82
Men	11.7 (10.6–12.8)	11.2 (10.5–11.9)	13.8 (13.2–14.4)	1.00 (0.19–1.82)	21.7 (21.4–22.1)	19.3 (19.0–19.5)	24.6 (24.3–24.9)	0.67 (0.24–1.10)	0.01
Hypertensive heart disease									
Women	6.6 (6.0–7.2)	6.6 (6.2–7.0)	7.9 (7.5, 8.2)	1.25 (0.03–2.48)	6.5 (6.4–6.7)	7.3 (7.2–7.5)	10.3 (10.1–10.5)	2.42 (1.95–2.90)	<0.001
Men	7.1 (6.3–7.8)	8.9 (8.3–9.4)	11.8 (11.2, 12.3)	2.32 (−0.13 to 4.83)	6.7 (6.5–6.8)	9.4 (9.3–9.6)	13.7 (13.5–13.9)	3.90 (3.33–4.48)	<0.001
Stroke									
Women	42.2 (40.7–43.7)	29.0 (28.1–29.9)	29.9 (29.1–30.6)	−1.98 (−2.39 to −1.57)	58.4 (58.0–58.8)	36.5 (36.2–36.8)	35.5 (35.2–35.8)	−2.53 (−3.13 to −1.92)	<0.001
Men	52.6 (50.5–54.8)	32.6 (31.5–33.8)	34.2 (33.2–35.1)	−2.19 (−2.51 to −1.88)	60.8 (60.2–61.3)	36.1 (35.8–36.5)	35.6 (35.3–35.9)	−2.78 (−3.27 to −2.28)	<0.001
Other cardiovascular diseases									
Women	19.4 (18.4–20.4)	18.0 (17.3–18.7)	16.9 (16.3–17.5)	−0.60 (−0.82 to −0.38)	36.1 (35.8–36.5)	33.5 (33.2–33.8)	33.8 (33.6–34.1)	−0.29 (−0.75 to 0.17)	0.01
Men	28.7 (27.2–30.2)	23.0 (22.0–23.9)	22.1 (21.3–22.9)	−1.18 (−2.11 to −0.24)	47.6 (47.1–48.0)	42.6 (42.2–43.0)	43.2 (42.8–43.6)	−0.38 (−0.66 to −0.09)	0.01

AAPC indicates average annual percent change.

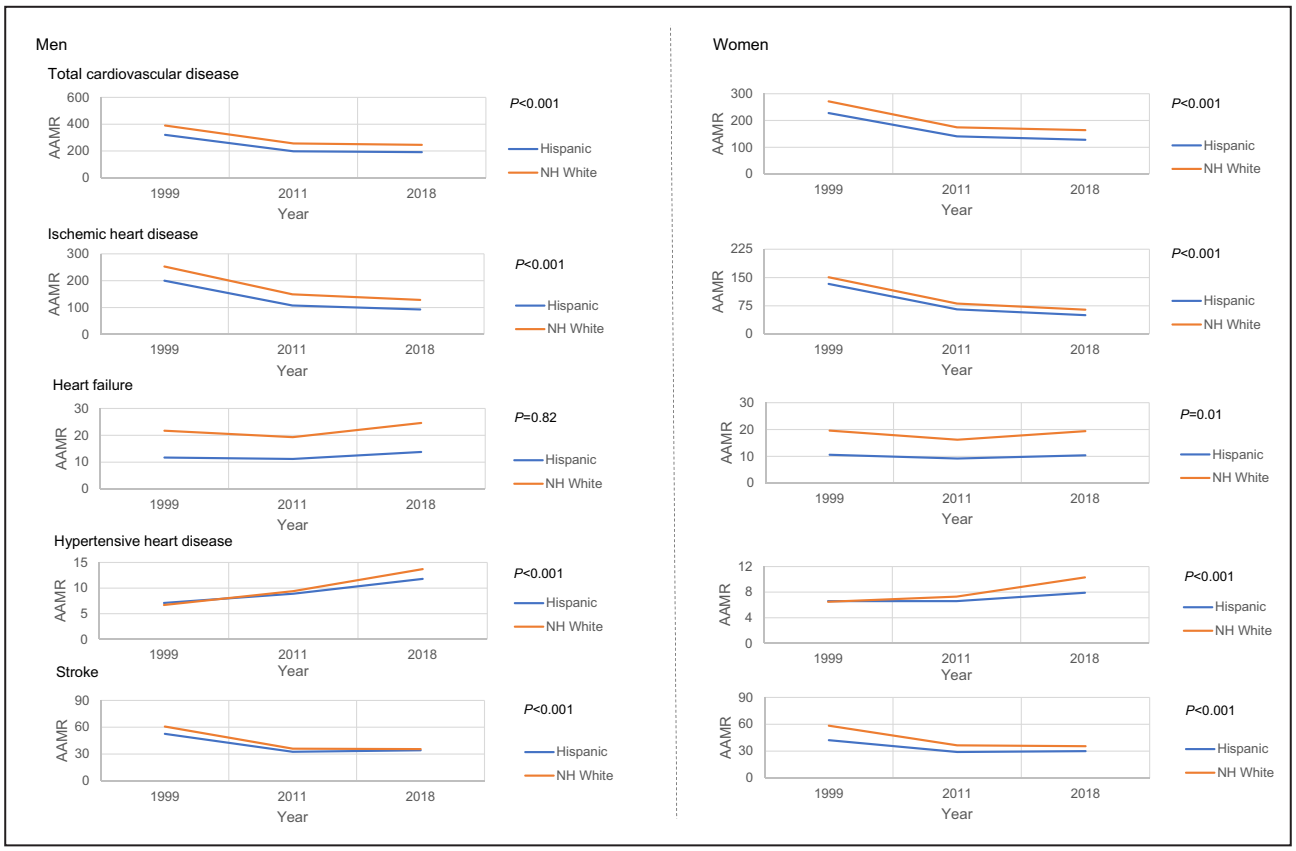

Figure 3. Trends of age-adjusted mortality rates attributable to total cardiovascular disease and its components in Hispanic and Non-Hispanic White individuals stratified by sex in the United States, 1999 to 2018.
AAMR indicates age-adjusted mortality rate; and NH, non-Hispanic.

groups.[41] We also noted disparities between urban and rural counties regarding mortality among both study groups. For instance, large metros showed that stroke mortality has increased at a higher pace in Hispanic versus NHW residents. Given immigration policies, Hispanic immigrants' settlement in urban counties might have influenced these trends.[42] That said, considering that Hispanic ethnicity was not universally recorded on death certificates[41,43] from all states, Hispanic mortality in rural regions could be underestimated.

Hispanic individuals disproportionally face low quality of daily life and health disparities,[4,44] secondary to suboptimal CVD profile and less favorable social determinants of health.[4,45] Between 2011 and 2018, Hispanic individuals demonstrated a rise in financial deprivation, health coverage challenges, unemployment, and limited health literacy.[31] However, despite having a socioeconomically challenged profile, overall Hispanic individuals exhibited better life expectancy than NHW individuals. That said, the controversial Hispanic paradox is an epidemiological observation with potential hazardous implications.[4] Since the Hispanic paradox implies that Hispanic individuals are less susceptible to CVD than the general population, subsequent suboptimal risk assessment and delays in adequate CVD treatments can further compound the existing poor cardiovascular health among the Hispanic population. Moreover, studies have shown that paradoxical mortality trends, even if true, are not consistent across every Hispanic subgroup. For instance, Mexican adults had lower CVD mortality rates than NHW individuals, while Puerto Rican adults had similar mortality patterns to NHW adults.[16] We noted that disaggregating analysis by demographic characteristics and cause-specific CVD revealed considerable heterogeneities, especially regarding stroke and total CVD mortality in young Hispanic adults. Therefore, cardiovascular research that lumps diverse Hispanic populations under 1 classification can mask significant differences in the cardiovascular health spectrum of the Hispanic population.[4]

Our study findings have several shortcomings. This report serves as a "deep dive" comprehensive characterization of CVD mortality trends for the overall Hispanic population in comparison with the NHW population, but we could not analyze according to specific Hispanic subgroups. As discussed before, prior literature has shown variation in CVD mortality across the 3 largest Hispanic subgroups in the United States (Puerto Rican, Cuban,

Table 4. Trends in Cardiovascular Disease Mortality Between Hispanic and Non-Hispanic White Adults in the United States Stratified by Urban-Rural Counties, 1999 to 2018

	Hispanic adults				Non-Hispanic White adults				
	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Age-adjusted mortality rate (95% CI)			AAPC (95% CI)	Test for parallelism
	1999	2011	2018	(1999–2018)	1999	2011	2018	(1999–2018)	*P* value
Total cardiovascular disease									
Large metro	265.4 (261.8–269.0)	164.9 (162.8–166.9)	156.0 (154.4–157.6)	−2.79 (−3.16 to −2.41)	320.0 (318.9–321.0)	202.5 (201.7–203.3)	191.3 (190.5–192.0)	−2.64 (−3.11 to −2.18)	<0.001
Medium-small metro	262.5 (256.4–268.6)	169.4 (166.0–172.7)	158.2 (155.6–160.9)	−2.56 (−3.04 to −2.07)	316.1 (314.8–317.4)	209.7 (208.8–210.7)	201.5 (200.6–202.4)	−2.33 (−2.72 to −1.95)	<0.001
Rural	307.6 (295.7–319.5)	172.6 (166.1–179.1)	158.1 (152.9–163.2)	−3.05 (−3.68 to −2.43)	340.0 (338.3–341.6)	236.7 (235.3–238.0)	227.0 (225.8–228.3)	−2.13 (−2.32 to −1.94)	<0.001
Ischemic heart disease									
Large metro	166.7 (163.8–169.5)	85.7 (84.2–87.2)	68.3 (67.3–69.4)	−4.65 (−5.07 to −4.22)	201.1 (200.3–202.0)	109.2 (108.6–109.7)	89.2 (88.7–89.7)	−4.18 (−4.59 to −3.76)	<0.001
Medium-small metro	146.4 (141.9–150.9)	79.4 (77.1–81.7)	70.6 (68.8–72.4)	−3.78 (−4.36 to −3.20)	182.7 (181.7–183.7)	107.1 (106.4–107.8)	91.3 (90.7–91.9)	−3.63 (−3.95 to −3.31)	<0.001
Rural	171.6 (162.7–180.4)	86.4 (81.8–91.0)	71.7 (68.3–75.2)	−4.21 (−4.93 to −3.47)	196.8 (195.6–198.1)	122.7 (121.8–123.7)	108.3 (107.4–109.2)	−3.15 (−3.36 to −2.94)	<0.001
Heart failure									
Large metro	9.3 (8.6–10.0)	9.6 (9.1–10.1)	11.7 (11.2–12.1)	1.37 (0.87–1.88)	17.5 (17.3–17.7)	16.0 (15.8–16.2)	21.2 (20.9–21.4)	1.08 (0.44–1.72)	<0.001
Medium-small metro	13.1 (11.7–14.6)	10.2 (9.4–11.1)	11.5 (10.8–12.3)	−0.30 (−1.87 to 1.29)	21.2 (20.8–21.5)	17.5 (17.2–17.7)	21.2 (20.9–21.4)	0.04 (−0.50 to 0.58)	0.72
Rural	21.3 (18.0–24.6)	13.9 (12.0–15.8)	15.0 (13.4–16.7)	−1.50 (−5.25 to 2.41)	26.8 (26.4–27.3)	21.1 (20.7–21.5)	24.1 (23.7–24.5)	−0.60 (−1.16 to −0.04)	0.02
Hypertensive heart disease									
Large metro	7.4 (6.9–8.0)	7.9 (7.4–8.3)	10.4 (10.0–10.8)	1.95 (0.56–3.35)	7.4 (7.3–7.6)	9.3 (9.1–9.4)	12.0 (11.8–12.2)	2.62 (2.06–3.18)	<0.001
Medium-small metro	6.2 (5.2–7.1)	8.2 (7.5–9.0)	8.8 (8.2–9.4)	0.96 (0.34–1.59)	6.7 (6.5–6.9)	8.2 (8.0–8.4)	12.4 (12.2–12.7)	2.86 (2.29–3.44)	<0.001
Rural	4.9 (3.5–6.6)	5.0 (4.0–6.3)	6.0 (5.0–6.9)	1.37 (0.16–2.60)	5.6 (5.4–5.8)	7.2 (7.0–7.4)	11.5 (11.3–11.8)	3.94 (3.51–4.36)	<0.001
Stroke									
Large metro	43.4 (42.0–44.9)	29.1 (28.3–30.0)	32.6 (31.8–33.3)	−1.71 (−2.25 to −1.18)	56.2 (55.7–56.6)	33.5 (33.2–33.8)	34.3 (34.0–34.6)	−2.53 (−3.33 to −1.72)	<0.001
Medium-small metro	51.6 (48.9–54.3)	34.5 (32.9–36.0)	31.3 (30.1–32.5)	−2.64 (−3.10 to −2.18)	61.6 (61.0–62.1)	37.9 (37.5–38.3)	36.4 (36.1–36.8)	−2.70 (−3.22 to −2.18)	<0.001
Rural	60.2 (54.9–65.5)	32.8 (30.0–35.7)	29.0 (26.8–31.2)	−3.76 (−5.00 to −2.51)	65.7 (64.9–66.4)	42.5 (42.0–43.1)	38.8 (38.2–39.3)	−2.70 (−3.12 to −2.28)	<0.001
Other cardiovascular diseases									
Large metro	21.8 (20.9–22.8)	19.3 (18.7–20.0)	18.5 (18.0–19.1)	−0.53 (−0.72 to −0.34)	37.7 (37.4–38.1)	34.6 (34.3–34.9)	34.6 (34.3–34.9)	−0.38 (−0.79 to 0.03)	0.02
Medium-small metro	25.6 (23.7–27.4)	22.3 (21.1–23.5)	20.1 (19.1–21.0)	−1.17 (−1.48 to −0.86)	43.9 (43.5–44.4)	39.1 (38.7–39.5)	40.2 (39.8–40.6)	−0.35 (−0.67 to −0.03)	<0.001
Rural	30.1 (26.7–33.5)	22.1 (19.9–24.4)	24.4 (22.4–26.4)	−1.16 (−2.28 to −0.02)	45.0 (44.4–45.6)	43.1 (42.5–43.6)	44.3 (43.7–44.9)	−0.02 (−0.35 to 0.31)	0.09

AAPC indicates average annual percent change.

and Mexican individuals).[16] However, our data are more recent, and we focused on sex and age interactions to demonstrate variations in CVD mortality. We could not measure the influence of migration status, acculturation metrics, or socioeconomic differences on CVD mortality statistics. On the same note, we could not draw a formal correlation between cardiovascular risk factors and mortality because of a lack of clinical variables in this data set. Data were also limited to test the hypothesis of role of any potential protective factors in relation to better survival trends among the Hispanic population. Vital statistics and census population data rely on death certificates, which are subject to miscoding, especially potential misclassification of race and ethnicity may lead to under- or over-reporting of mortality rates.[46] Nevertheless, despite these limitations, this study provides a comprehensive comparative analysis of trends in CVD mortality and its subtypes between Hispanic individuals and NHW adults, overall and stratified by age, sex, and region subgroups.

In summary, between 1999 and 2018, we unmasked some heterogeneities in CVD mortality between Hispanic and NHW adults. Considering that Hispanic ethnicity individuals are the fastest-growing population segment, future research and health endeavors should focus on developing culturally appropriate interventions to prevent modifiable CVD risk factors, adherence to evidence-based treatment strategies, and addressing social and health inequalities to bend the current CVD death trajectories in vulnerable Hispanic subgroups.

ARTICLE INFORMATION

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Supplemental Material

Data S1
Tables S1–S4

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Supplemental Material

Data S1.

Supplemental Methods

The year 1999 population estimates are bridged-race intercensal estimates of the July 1 resident population, based on the year 1990 and 2000 census counts.[18] The year 2000 and year 2010 population estimates are April 1 modified census counts, with bridged-race categories. The 2001-2009 population estimates are bridged-race revised intercensal estimates of the July 1 resident population, based on the year 2000 and the year 2010 census counts (released by NCHS on 10/26/2012). The 2001-2009 archive population estimates are bridged-race postcensal estimates of the July 1 resident population. The 2011-2018 population estimates are bridged-race postcensal estimates of the July 1 resident population.

We estimated age-adjusted (to the 2000 US standard population)[18] mortality rates for each year per 100,000 population within the county, across the counties within a particular state, and across the entire US. Utilizing this approach, we suppressed rates for data demonstrating zero to nine (0-9) deaths along with the corresponding denominator population when the population showed fewer than 10 persons. For deaths less than 20, rates were considered unreliable and were not computed during the estimation of age-adjusted rates. Since we aggregated death rates across counties, all counties were included regardless of population size and death counts.

We analyzed temporal trends by fitting log-linear regression models using the Joinpoint Regression Program version 4.7.0.0 (National Cancer Institute). We calculated average annual percentage rate change (AAPC) with 95% confidence intervals (CIs) in age-adjusted mortality rates for all analyses from 1999 to 2018, further divided into 1999-2011 and 2011-2018, weighted to account for differences in the number of inflection points.[15, 19] We identified the year 2011 as the inflection point in total CVD mortality trends ─ consistent with prior studies reporting national CVD mortality trends.[15, 20] We applied following settings to Joinpoint Regression: (i) Grid search method: 2, 2, 0; (ii) number of joinpoints: 0 to 3; (iii) model selection method: Permutation test; and (iv) annual percent change/AAPC/Tau CIs estimation: Parametric method.[21] Slopes were considered increasing or decreasing if the estimated slope differed significantly from zero.[19, 21] We applied a specific procedure- comparability test to determine whether two regression mean functions are parallel due to different intercepts (test of parallelism)[22]. Analyses were stratified by age (<45 years, 45-64 years, and ≥ 65 years), as well as by sex, and urbanicity. For all analyses, statistical significance was set at 5%.

Table S1. Average annual percent change in age-adjusted mortality rates in Hispanic and Non-Hispanic White adults attributed to cardiovascular diseases.

	Hispanic adults		Non-Hispanic White adults	
	(1999 – 2011)	**(2011 – 2018)**	**(1999 – 2011)**	**(2011 – 2018)**
Total CVD	-3.88 (-4.26, -3.49)*	-0.86 (-1.26, -0.45)*	-3.42 (-3.79, -3.05)*	-0.63 (-0.88, -0.38)*
Ischemic heart disease	-5.20 (-6.57, -3.80)*	-3.07 (-3.67, -2.47)*	-4.52 (-4.89, -4.14)*	-2.47 (-4.89, -4.14)*
Heart failure	-0.86 (-2.05, 0.35)	3.09 (1.93, 4.26)*	-1.31(-2.16, -0.46)*	3.21 (2.53, 3.90)*
Hypertensive heart disease	1.45 (-0.51, 3.46)	2.60 (0.64, 4.60)*	1.93 (1.58, 2.28)*	5.04 (3.77, 6.33)*
Stroke	-3.67 (-3.95, -3.39)*	0.79 (0.03, 1.56)*	-4.10 (-5.00, -3.19)*	-0.09 (-0.51, 0.33)
Other CVD	-0.97 (-1.25, -0.69)*	-0.90 (-2.71, 0.93)	-0.75 (-1.12, -0.37)*	0.30 (-1.59, 2.22)

*indicates that the average annual percent change is significantly different from zero (P<0.05).
CVD = cardiovascular disease

Table S2. Average annual percent change in age-adjusted mortality rates in Hispanic and Non-Hispanic White adults attributed to cardiovascular diseases stratified by age.

	Average annual percent change (95% CI)			
	Hispanic adults		Non-Hispanic White adults	
	(1999 – 2011)	(2011 – 2018)	(1999 – 2011)	(2011 – 2018)
Total CVD				
<45 y	-1.57 (-2.1, -0.96)*	1.14 (0.57, 1.71)*	-0.46 (-0.88, -0.01)*	-0.46 (-0.90, -0.02)*
45-64 y	-3.11 (-3.27, -2.95)*	-0.26 (-0.70, 0.19)	-2.18 (-2.43, -1.93)*	0.29 (0.10, 0.48)*
≥65 y	-4.05 (-4.47, -3.63)*	-1.03 (-1.47, -0.59)*	-3.70 (-4.06, -3.34)*	-0.80 (-1.04, -0.55)*
Ischemic heart disease				
<45 y	-1.49 (-3.67, 0.74)	0.68 (-0.25, 1.63)	-1.30 (-1.77, -0.83) *	-2.76 (-2.93, -2.58)*
45-64 y	-4.43 (-4.57, -4.09)*	-1.31 (-1.90, -0.72)*	-3.11 (-3.32, -2.90) *	-0.99 (-1.15, -0.84)*
≥65 y	-5.56 (-6.10, -5.03)*	-3.18 (-3.75, -2.61)*	-4.91 (-3.07, -2.49) *	-2.78 (-3.07, -2.49)*
Heart failure				
<45 y	1.42 (-1.12, 4.02)	7.53 (3.50, 11.71)*	0.01 (-0.53, 0.54)	5.96 (3.90, 8.06) *
45-64 y	-0.08 (-0.98, 0.82)	5.45 (2.85, 8.11)*	-0.94 (-1.58, -0.29)	5.95 (4.40, 7.52) *
≥65 y	-0.91 (-2.24, 0.45)	2.86 (1.56, 4.18)*	-1.37 (-2.19, -0.54) *	3.09 (2.43, 3.76)*
Hypertensive heart disease				
<45 y	2.83 (-0.19, 5.95)	6.07 (3.36, 8.84)*	6.05 (4.97, 7.14) *	3.60 (3.22, 3.97)*
45-64 y	3.12 (1.06, 5.22)*	0.35 (-0.25, 0.94)	5.86 (5.03, 6.70) *	4.05 (3.72,4.38) *
≥65 y	1.14 (-1.93, 4.31)	3.09 (0.75, 5.49)*	0.76 (0.41, 1.11) *	5.33 (3.17, 7.54)*
Stroke				
<45 y	-1.63 (-2.31, -0.94)*	-0.53 (-2.35, 1.32)	-1.85 (-3.89, 0.24)	0.31 (1.77, 2.44)*
45-64 y	-2.98 (-3.40, -2.57)*	-0.48 (-2.45, 1.53)	-2.24 (-2.52, -1.96)*	0.59 (0.24, 0.94)*
≥65 y	-3.81 (-4.11, -3.50)*	1.06 (0.21, 1.91)*	-4.33 (-5.32, -3.34)*	-0.16 (-0.59, 0.26)
Other CVD				
<45 y	-2.39 (-10.97, 7.02)	5.95 (2.86, 9.13)*	-0.40 (-0.75, -0.05) *	0.75 (-0.20, 1.70)
45-64 y	-0.11 (-2.03, 1.84)	3.53 (2.69, 4.37)*	-0.99 (-1.17, -0.81) *	1.42 (0.67, 2.18) *
≥65 y	1.83 (0.89, 2.77)*	0.75 (0.43, 1.07)*	-0.71 (-1.12, -0.30) *	-0.00 (-2.09, 2.12)

* indicates that the average annual percent change is significantly different from zero (P<0.05).
CVD = cardiovascular disease, y = year

Table S3. Average annual percent change in age-adjusted mortality rates in Hispanic and Non-Hispanic White adults attributed to cardiovascular diseases stratified by sex.

	Average annual percent change (95% CI)			
	Hispanic adults		Non-Hispanic White adults	
	(1999 – 2011)	(2011 – 2018)	(1999 – 2011)	(2011 – 2018)
Total CVD				
Women	-3.84 (-4.29, -3.38)*	-1.27 (-1.68, -0.85)*	-3.61 (-4.26, -2.96)*	-0.77 (-1.34, -0.20)*
Men	-3.73 (-4.60, -2.86)*	-0.82 (-1.19, -0.45)*	-3.37 (-3.64, -3.11)*	-0.61 (-0.79, -0.43)*
Ischemic heart disease				
Women	-5.64 (-6.18, -5.10)*	-3.78 (-4.33, -3.22)*	-4.99 (-5.43, -4.54) *	-3.20 (-3.71, -2.68)*
Men	-5.04 (-5.66, -4.42)*	-2.30 (-2.96, -1.63)*	-4.28 (-4.66, -3.90) *	-2.15 (-2.41, -1.90)*
Heart failure				
Women	-1.33 (-2.62, -0.03)*	2.73 (1.75, 3.72)*	-1.65 (-2.49, -0.80) *	2.80 (2.18, 3.42)*
Men	-0.24 (-0.75, 0.28)	3.20 (1.42, 5.02)*	-1.20 (-1.64, -0.76) *	3.95 (2.91, 5.01)*
Hypertensive heart disease				
Women	0.74 (-0.79, 2.30)	2.47 (0.46, 4.52)*	1.19 (0.70, 1.69) *	4.57 (3.90, 5.24)*
Men	2.87 (-0.40, 6.24)	3.20 (1.41, 5.01)*	3.09 (2.64, 3.55) *	5.27 (3.97, 6.59)*
Stroke				
Women	-3.18 (-4.17, -2.19)*	0.76 (-0.01, 1.53)	-3.91 (-4.74, -3.07) *	-0.10 (-0.63, 0.44)
Men	-3.95 (-4.18, -3.72)*	0.92 (0.27, 1.58)*	-4.33 (-5.01, -3.65) *	-0.05 (-0.32, 0.21)
Other CVD				
Women	-0.89 (-1.38, -0.40)*	-0.31 (-0.61, -0.02)*	-0.68 (-1.08, -0.27) *	0.28 (-1.70, 2.29)
Men	-1.40 (-1.68, -1.12)*	-0.42 (-3.56, 2.81)	-0.84 (-1.17, -0.50) *	0.44 (0.18, 0.69) *

* indicates that the average annual percent change is significantly different from zero (P<0.05).
CVD = cardiovascular disease.

Table S4. Average annual percent change in age-adjusted mortality rates in Hispanic and Non-Hispanic White adults attributed to cardiovascular diseases stratified by urbanicity.

	Average annual percent change (95% CI)			
	Hispanic adults		Non-Hispanic White adults	
Cardiovascular disease subtype	**(1999 – 2011)**	**(2011 – 2018)**	**(1999 – 2011)**	**(2011 – 2018)**
Total CVD				
Large metro	-3.80 (-4.34, -3.26)*	-1.00 (-1.36, -0.64)*	-3.72 (-4.13, -3.30) *	-0.71 (-1.00, -0.42) *
Medium-small metro	-3.40 (-3.82, -2.98)*	-1.02 (-1.39, -0.66)*	-3.42 (-3.75, -3.09) *	-0.43 (-0.61, -0.24) *
Rural	-4.19 (-4.52, -3.85)*	-0.94 (-1.62, -0.26)*	-2.98 (-3.53, -2.43) *	-0.43 (-0.73, -0.12) *
Ischemic heart disease				
Large metro	-5.35 (-5.81, -4.88)*	-3.40 (-3.97, -2.83)*	-4.95 (-5.23, -4.68) *	-2.82 (-3.30, -2.34)*
Medium-small metro	-4.65 (-6.42, -2.84)*	-2.21 (-2.97, -1.44)*	-4.36 (-4.80, -3.93) *	-2.36 (-2.62, -2.10) *
Rural	-5.41 (-5.78, -5.05)*	-1.99 (-2.73, -1.25)	-3.86 (-4.25, -3.48) *	-1.75 (-1.96, -1.55)*
Heart failure				
Large metro	0.19 (-0.13, 0.52)	3.48 (2.57, 4.41)*	-0.68 (-2.06, 0.72)	3.97 (3.35, 4.59)*
Medium-small metro	-1.60 (-2.56, -0.63)*	1.12 (-6.26, 9.08)	-1.81 (-2.51, -1.10) *	3.30 (2.52, 4.08)*
Rural	-3.26 (-8.80, 2.62)	1.72 (-0.16, 3.64)	-2.09 (-2.56, -1.62) *	1.84 (0.49, 3.20) *
Hypertensive heart disease				
Large metro	1.36 (0.44, 3.19) *	3.02 (1.22, 4.85)*	2.22 (1.59, 2.84) *	3.31 (2.33, 4.30) *
Medium-small metro	0.91 (0.34, 1.48)*	0.91 (0.34, 1.48)*	1.25 (0.82, 1.69) *	5.59 (4.39, 6.81) *
Rural	1.39 (0.34, 2.46)*	1.39 (0.34, 2.46)*	2.46 (2.11, 2.81) *	6.89 (5.28, 8.52)*
Stroke				
Large metro	-3.66 (-4.09, -3.22)*	1.70 (0.49, 2.91)*	-4.34 (-5.58, -3.08) *	0.68 (0.11, 1.26)*
Medium-small metro	-3.58 (-4.05, -3.12)*	-1.00 (-2.13, 0.14)	-4.08 (-4.74, -3.42) *	-0.28 (-0.69, 0.13)*
Rural	-4.47 (-6.17, -2.73)*	-1.67 (-2.44, -0.88)*	-3.52 (-3.93, -3.10) *	-1.27 (-1.51, -1.03)*
Other CVD				
Large metro	-0.65 (-0.92, -0.37)*	-0.85 (-1.96, 0.27)	-0.73 (-1.06, -0.40) *	0.14 (-1.75, 2.07)
Medium-small metro	-1.14 (-3.58, 1.37)	-0.72 (-1.03, -0.41)*	-0.79 (-1.18, -0.39) *	0.41 (0.10, 0.71) *
Rural	-1.91 (-3.34, -0.46)*	0.64 (0.12, 1.16)*	-0.43 (-0.88, 0.02)	0.70 (0.33, 1.06)*

* indicates that the average annual percent change is significantly different from zero (P<0.05).
CVD = cardiovascular disease.