

Trends in the Prevalence of Self-reported Heart Failure by Race/Ethnicity and Age From 2001 to 2016

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 Supplemental content

IMPORTANCE Despite recent advances in therapies for heart failure (HF), deaths from HF are increasing, with persistent disparities between Black and White adults. Recent national trends in the prevalence of HF need to be clarified to appropriately allocate resources and develop effective preventive interventions.

OBJECTIVES To examine the prevalence of ambulatory HF overall and by race/ethnicity and age and the temporal changes in HF prevalence between 2001 and 2016.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study of nationally representative data collected biennially through the National Health and Nutrition Examination Survey (NHANES) from January 1, 2001, to December 31, 2016, assessed nonpregnant adults 35 years and older who self-identified as non-Hispanic Black, non-Hispanic White, or Mexican American. Data analysis was performed from November 16, 2019, to April 12, 2020.

EXPOSURES Survey period, race/ethnicity, and age group.

MAIN OUTCOMES AND MEASURES Age-standardized prevalence was calculated within 4-year survey periods (2001-2004, 2005-2008, 2009-2012, and 2013-2016) based on self-report of ambulatory HF overall and by race/ethnicity and age group (35-64 and ≥ 65 years). Weighted multivariable logistic regression was used to examine trends in ambulatory HF prevalence over time by race/ethnicity and age group.

RESULTS A total of 26 097 participants (mean [SD] age, 55.9 [10.7] years; 13 192 [52%] female; 6519 [12%] non-Hispanic Black; and 4906 [7%] Mexican American) were studied. Overall age-standardized prevalence (per 100 000 population) of ambulatory HF was 3184 (95% CI, 2641-3728) from 2001 to 2005 and 3045 (95% CI, 2651-3438) from 2013 to 2016. The prevalence of ambulatory HF was highest among non-Hispanic Black adults: from 2013 to 2016, HF prevalence (per 100 000 population) was 5017 (95% CI, 3755-6279) among non-Hispanic Black adults, 2746 (95% CI, 2313-3179) among non-Hispanic White adults, and 2508 (95% CI, 1154-3862) among Mexican American adults. Differences between White and Black adults in HF prevalence were also present in younger and middle-aged adults (eg, 35-64 years of age in 2013-2016: 3864 [95% CI, 2369-5359] for non-Hispanic Black adults vs 1297 [95% CI, 878-1716] for non-Hispanic White adults).

CONCLUSIONS AND RELEVANCE This study found that a high burden of ambulatory HF persisted between 2001 and 2016 in the US. Disparities were most prominent by age group. Alongside prevention and aggressive management of risk factors, targeted efforts aimed at mitigating racial disparities are needed.

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In the US, more than 6 million adults have heart failure (HF), and this number has been projected to increase to more than 8 million by 2030.^{1,2} Previous analyses,^{3,4} however, have shown conflicting trends regarding changes in the incidence and mortality related to HF. An analysis⁴ from Olmsted County, Minnesota, found that incident HF decreased between 2000 and 2010, whereas data from the Atherosclerosis Risk in Communities study³ found an increase in the incidence of hospitalized HF during the same period. After years of persistent decreases in HF-related mortality, national death rates attributed to HF are now increasing, particularly among younger Black adults.⁵

It is well established that the incidence of HF varies by race/ethnicity, with the differences largely attributable to the disproportionate prevalence and earlier onset of HF risk factors, such as obesity, diabetes, and hypertension, among Black men and women.^{1,6,7} However, the increasing prevalence of particular risk factors (eg, obesity and diabetes) in recent decades in addition to persistently low rates of risk factor control may be associated with changes in HF prevalence in the US.⁸ Therefore, we sought to describe the contemporary burden of HF and examine temporal trends in HF by race/ethnicity and age group using a nationally representative sample.

Methods

This cross-sectional study was conducted across 8 cycles of the National Health and Nutrition Examination Survey (NHANES; 2001-2016). NHANES is a nationally representative, cross-sectional study administered biannually by the National Center for Health Statistics (eMethods in the [Supplement](#)).⁹ NHANES was approved by the National Center for Health Statistics Ethics Review Board. All participants provided written informed consent. All data were deidentified; therefore, the current analysis was deemed exempt from institutional review board approval by the National Center for Health Statistics Ethics Review Board.

Nonpregnant adults 35 years or older who identified as non-Hispanic White, non-Hispanic Black, or Mexican American were included in this analysis (eFigure and eTable 1 in the [Supplement](#)). Individuals younger than 35 years were excluded to minimize effects of congenital heart disease. Small sample sizes (Asian American adults) or changes in sampling (eg, Hispanic adults other than Mexican American adults) precluded analysis of other racial/ethnic groups.⁹ Heart failure status was derived from the interviewer-administered question, "Has a doctor or other health professional ever told you that you had congestive heart failure?"

Consecutive survey cycles were grouped into 4-year intervals (January 1 through December 31): 2001 to 2004 (period 1), 2005 to 2008 (period 2), 2009 to 2012 (period 3), and 2013 to 2016 (period 4). Crude and age-standardized estimates of ambulatory HF prevalence were calculated overall and by race/ethnicity. Analyses were stratified by age group based on a significant interaction with age. Further stratification by sex was considered, but no meaningful differences were found.

Key Points

Question Given changing cardiovascular risk factor profiles, were there differences in the prevalence of ambulatory heart failure by race/ethnicity and age in the US from 2001 through 2016?

Findings In this cross-sectional study of 26 097 participants from the National Health and Nutrition Examination Survey, the prevalence of ambulatory heart failure was stable between 2001 and 2016. Heart failure prevalence was higher in Black participants compared with White participants, with the greatest disparities among adults aged 35 to 64 years.

Meaning This study found that the prevalence of heart failure remained unchanged between 2001 and 2016, and large racial disparities persisted particularly by age group.

The Korn and Graubard method¹⁰ was used to estimate the 95% CIs.

Logistic regression models were used to examine trends in HF prevalence. No linear or quadratic trends were noted using Wald tests. In supplementary analyses, trends in HF prevalence overall, by age group, and by race/ethnicity were examined, adjusting for risk factors as well as race/ethnicity and age group when appropriate. Multiple imputation (10 data sets) by fully conditional specification was used to impute missing covariate data. All analyses accounted for the complex sample design, including the use of 4- and 16-year NHANES sampling weights as appropriate.⁹ Data analysis was performed from November 16, 2019, to April 12, 2020. All statistical analyses were conducted using Stata software, version 15.1 (StataCorp LLC).

Results

A total of 26 097 participants (mean [SD] age, 55.9 [10.7] years; 13 192 [52%] female; 6519 [12%] non-Hispanic Black; and 4906 [7%] Mexican American) were studied (eTable 2 in the [Supplement](#)). Risk factors for HF were common, particularly among non-Hispanic Black adults. In the most recent period (2013-2016), prevalence of obesity (43%), diabetes (17%), and hypertension (36%) was higher compared with the prevalence in the first period (2001-2004: obesity, 34%; diabetes, 11%; and hypertension, 28%) for all racial/ethnic groups (Table and eTable 2 in the [Supplement](#)).

Crude and age-standardized prevalence of ambulatory HF did not change between 2001 and 2016. Overall age-standardized prevalence of ambulatory HF was 3184 per 100 000 population (95% CI, 2641-3728 per 100 000 population) from 2001 to 2005 and 3045 per 100 000 population (95% CI, 2651-3438 per 100 000 population) from 2013 to 2016 (Figure 1 and eTable 3 in the [Supplement](#)). In stratified analyses by race/ethnicity, HF prevalence (per 100 000 population) between 2013 and 2016 was 2746 (95% CI, 2313-3179) among non-Hispanic White adults, 5017 (95% CI, 3755-6279) among non-Hispanic Black adults, and 2508 (95% CI, 1154-3862) among Mexican American adults. For all periods between 2005 and 2016, a significant interaction was found between race/ethnicity and age-standardized HF prevalence. Age-

Table. National Health and Nutrition Examination Survey Sample Characteristics From Pooled Survey Cycles (2001-2004 and 2013-2016) by Race/Ethnicity^a

Characteristic	2001-2004			2013-2016		
	Non-Hispanic			Non-Hispanic		
	White	Black	Mexican American	White	Black	Mexican American
Individuals, unweighted No.	3862	1326	1301	3186	1700	1254
Age, y	54.2 (11.7)	51.3 (17.5)	48.4 (22.4)	57.1 (10.1)	53.7 (17.8)	50.2 (17.2)
Female, %	51	55	49	52	56	50
Heart failure risk factors						
BP, mm Hg						
Systolic	126 (17)	131 (30)	124 (37)	125 (14)	131 (28)	125 (24)
Diastolic	73 (10)	76 (19)	73 (21)	71 (9)	73 (19)	71 (17)
BMI	28 (5)	30 (9)	29 (11)	30 (5)	31 (11)	31 (9)
Obesity, % ^b	33	42	36	40	52	51
Diabetes, % ^c	9	17	16	15	23	23
Hypertension, % ^d	27	40	18	35	47	26
Educational level less than high school, %	13	33	56	9	20	52

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); BP, blood pressure.

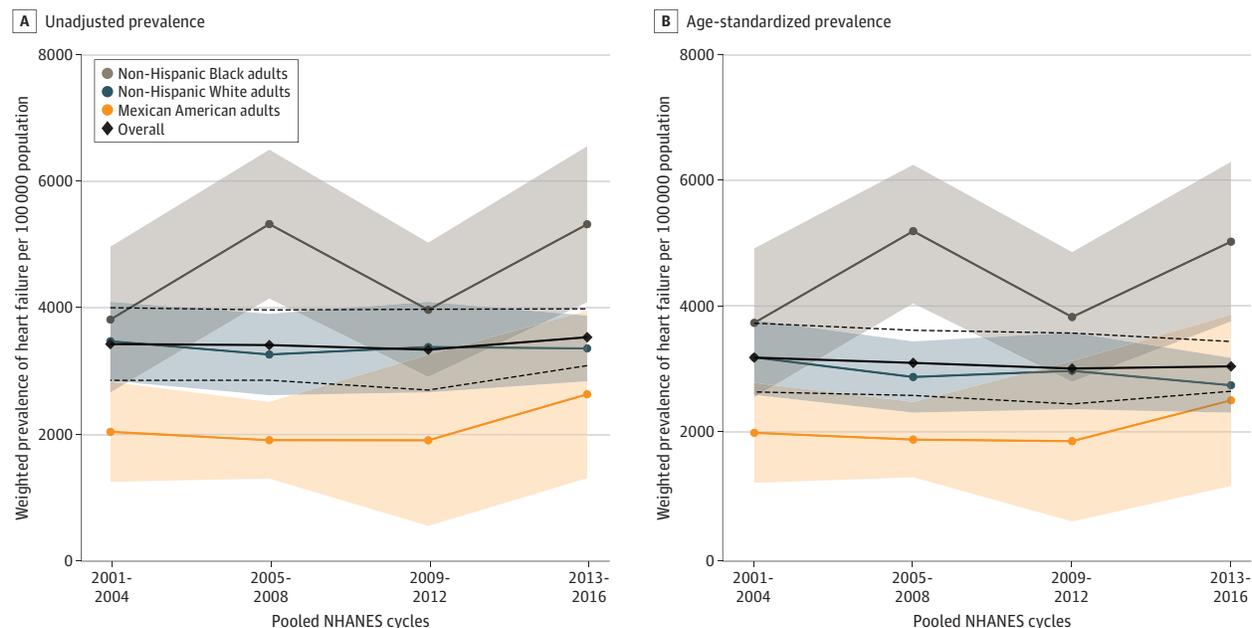
^a Data are presented as weighted percentages and weighted means (SDs).

^b A BMI of 30 or greater.

^c Self-reported history of diabetes, current use of oral glucose-lowering

medications or insulin, or a hemoglobin A_{1c} level of 6.5% or higher (to convert to proportion of total hemoglobin, multiply by 0.01).

^d Systolic blood pressure of 140 mm Hg or higher, diastolic blood pressure of 90 mm Hg or higher, or use of antihypertensive therapy.

Figure 1. Overall Weighted Estimates of Prevalence of Heart Failure, 2001-2016

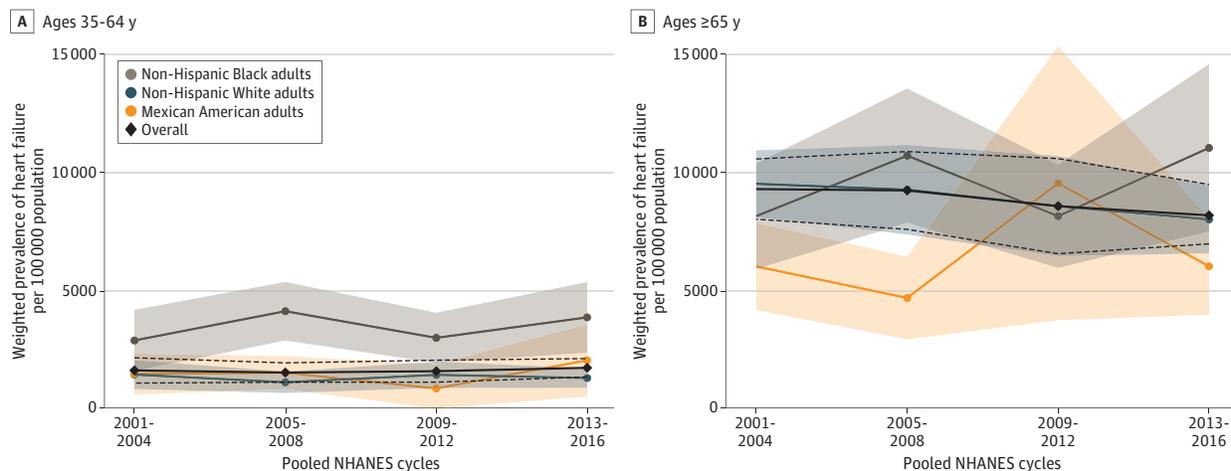
Trends in heart failure prevalence were not significant for crude (A) or age-standardized (B) prevalence of heart failure. Black solid and dashed lines represent the prevalence estimates and 95% CIs, respectively, for the overall sample. Solid lines and shaded areas represent heart failure prevalence

estimates and 95% CIs, respectively, for racial/ethnic groups. Global *P* values for test for race interaction × time are as follows: logistic regression dummy *P* = .14, linear trend *P* = .26 (Wald test), and quadratic trend *P* = .51 (Wald test). NHANES indicates National Health and Nutrition Examination Survey.

standardized rates of HF were stable for non-Hispanic White adults and Mexican American adults, but rates of HF were higher in the last period compared with the first period for non-Hispanic Black adults (3733 [95% CI, 2556-4910] in 2001-2004 vs 5017 [95% CI, 3755-6279] in 2013-2016).

The prevalence of HF was higher among those older than 65 years compared with those 35 to 64 years of age for all racial/ethnic groups (Figure 2 and eTable 4 in the Supplement). For example, between 2013 and 2016, the prevalence (per 100 000 population) of HF among adults 35 to 64 years

Figure 2. Weighted Estimates of Prevalence of Heart Failure Stratified by Age Group, 2001-2016



Trends in heart failure prevalence in younger (35-64 years of age) adults (A) and older (65 years or older) adults (B) were not significant overall and when stratified by race/ethnicity. Black solid and dashed lines represent prevalence estimates and 95% CIs, respectively, for the overall sample. Solid lines and shaded areas represent heart failure prevalence estimates and 95% CIs, respectively, for racial/ethnic groups. Global *P* values for test for age

interaction \times time are as follows: logistic regression (dummy) *P* = .75, linear trend *P* = .37 (Wald test), and quadratic trend *P* = .61 (Wald test). Global *P* values for test for race and age interaction \times time are as follows: logistic regression (dummy) *P* = .33, linear trend *P* = .29 (Wald test), and quadratic trend *P* = .68 (Wald test). NHANES indicates National Health and Nutrition Examination Survey.

of age was 1297 (95% CI, 878-1716) among non-Hispanic White adults, 3864 (95% CI, 2369-5359) among non-Hispanic Black adults, and 2047 (95% CI, 518-3576) among Mexican American adults; the prevalence of HF among adults 65 years and older was 8006 (95% CI, 6572-9439) among non-Hispanic White adults, 11 038 (95% CI, 7491-14584) among non-Hispanic Black adults, and 6022 (95% CI, 3971-8072) among Mexican American adults. Across all periods, among those 35 to 64 years of age, HF prevalence was higher among non-Hispanic Black adults compared with non-Hispanic White adults (3864 [95% CI, 2369-5359] in non-Hispanic Black adults vs 1297 [95% CI, 878-1716] in non-Hispanic white adults in 2013-2016). The prevalence of HF in Mexican American adults and non-Hispanic White adults 35 to 64 years of age was similar. No significant trends were found in the prevalence of HF when stratified by age group (Figure 2). Furthermore, the prevalence of HF adjusted for educational level and HF risk factors in more recent survey periods was not significantly different than the prevalence in 2001 to 2004 overall, by age group, and by race/ethnicity (eTables 5 and 6 in the Supplement).

Discussion

In this nationally representative analysis of more than 25 000 individuals, both the crude and age-standardized prevalence of ambulatory HF remained largely stable between 2001 and 2016, indicating no improvements in the high burden of HF in the US. Although age-standardized HF prevalence was similar for Mexican American adults and non-Hispanic White adults over time, the age-standardized HF prevalence was generally higher among non-Hispanic

Black adults. In the most recent period, HF prevalence was 3-fold higher among younger non-Hispanic Black adults compared with younger non-Hispanic White adults between 2013 and 2016.

The current analysis contrasts with prior projections anticipating increases in HF prevalence.² Furthermore, the finding of a stable crude HF prevalence in the context of an aging US population is noteworthy.¹¹ Of importance, these estimates are based on self-report rather than adjudicated HF, which likely underestimates true HF prevalence, particularly among non-Hispanic Black adults, as has been reported previously.¹² Although this study was unable to determine the underlying factors associated with the stagnation of HF prevalence or the differing contributions from HF subtypes or origins, the findings are coincident with increasing HF mortality trends.⁵ The confluence of these trends underscores the importance of determining the underlying factors, from individual-level health behaviors to national policies (eg, Hospital Readmissions Reduction Program).

These results, in general, revealed a higher HF prevalence in younger Black adults and a similar prevalence in older Black adults compared with younger and older White adults, respectively, but there were changes in the prevalence estimates across periods that were likely attributable to sampling variability. These findings are consistent with and expand on prior studies.¹³⁻¹⁵ The higher rates of HF among younger non-Hispanic Black adults may be associated with a number of factors, including disparities in prevalence and control of risk factors as well as upstream socioeconomic factors.¹⁷ These factors are of particular concern given the morbidity associated with the diagnosis of HF and the unique financial and social consequences of an early diagnosis.

Strengths and Limitations

Strengths of this analysis include the use of a large, nationally representative data set with objective data collected during 16 years. Limitations include the lack of detailed phenotyping for different subtypes of HF (preserved or reduced ejection fraction), classification of HF symptoms (New York Heart Association), or degree of severity of HF (advanced HF that requires mechanical support).

Conclusions

This nationally representative analysis found that the prevalence of HF in the US remained stable between 2001 and 2016 and disparities persisted by race/ethnicity and age. Public policies and programs with substantial investments in HF prevention, such as the Million Hearts Initiative, appear to be needed to prevent the emerging trends of increasing disparities in HF.

ARTICLE INFORMATION

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