NIH Public Access
Author Manuscript
South Med J. Author manuscript; available in PMC 2014 February 01.

Published in final edited form as:
South Med J. 2013 February ; 106(2): 147–154. doi:10.1097/SMJ.0b013e3182804fa4.

Short-Term Trends in Heart Failure-Related Hospitalizations in a High-Risk State

Uchechukwu K.A. Sampson, MBBS, MPH, **Baqar A. Husaini, PhD**, **Van A. Cain, MA**, **Zahid Samad, MD, MPH**, **Eiman C. Jahangir, MD**, and **Robert S. Levine, MD**
Department of Medicine, Vanderbilt University Medical Center, Tennessee State University, and Meharry Medical College, Nashville, Tennessee

Abstract

Objectives—We sought to determine whether there are signs of improvement in the rates of heart failure (HF) hospitalizations given the recent reports of improvement in national trends.

Methods—HF admissions data from the Tennessee Hospital Discharge Data System were analyzed.

Results—Hospitalization for primary diagnosis of HF (HFPD) in adults (aged 20 years old or older) decreased from 4.5% in 2006 to 4.2% in 2008. Similarly, age-adjusted HF hospitalization (per 10,000 population) declined by 19.1% (from 45.5 in 2006 to 36.8 in 2008). The age-adjusted rates remain higher among blacks than whites and higher among men than women. Notably, the rate ratio of black-to-white men ages 20 to 34 years admitted with HFPD increased from 8.5 in 2006 to 11.1 in 2008; similarly, the adjusted odds ratios for HFPD were 4.75 (95% confidence interval 3.29–6.86) and 5.61 (95% confidence interval 3.70–8.49), respectively. There was, however, a significant improvement in odds ratio for HF rates among young black women, as evidenced by a decrease from 4.60 to 3.97 (aged 20–34 years) and 4.21 to 3.12 (aged 35–44 years) between 2006 and 2008, respectively. Among patients aged 20 to 34 and 35 to 44 years, hypertension was the strongest independent predictor for HF. Diabetes and myocardial infarction emerged as predictors for HF among patients aged 35 years and older.

Conclusions—The overall rate of HF hospitalization declined during the period surveyed, but the persistent disproportionate involvement of blacks with evidence of worsening among younger black men, requires close attention.

Keywords

heart failure; prevention; blacks; disparities; risk factors

The United States continues to grapple with the health and economic burden created by the burgeoning epidemic of heart failure (HF), a clinical syndrome that represents a final common path for most forms of heart disease.[1] It is well recognized that the growing burden of HF disproportionately affects certain populations, an observation that can be explained partially by the higher prevalence of risk factors such as hypertension, obesity, diabetes, and adverse socioeconomic status and its multidimensional consequences. Specifically, there are

Reprint requests to Dr Uchechukwu K.A. Sampson, Vanderbilt University Medical Center, 315 Preston Research Building, 2220 Pierce Ave, Nashville, TN 37232. u.sampson@vanderbilt.edu..

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

differences in the epidemiology of HF involving ethnic and minority populations that have long garnered attention[2,3]; however, recent reports have not only served to substantiate this attention but also have led to increasing awareness of the alarming involvement of younger age groups in the HF epidemic. The report by Bibbins-Domingo et al[4] showed that incident HF among young adults (younger than 50 years) was 20 times more likely in blacks compared with whites; their report implicated hypertension and obesity as some of the antecedent risk factors. Another report indicated that incident HF is substantially higher among black than nonblack hypertensive patients even after adjusting for higher prevalence of other HF risk factors in blacks, treatment effects, and other established covariates.[5]

We have reported age, race, and sex differences in HF-related hospitalizations in Tennessee from 1997 to 2006.[6] Overall, we observed a higher prevalence of HF in blacks compared with whites and in men compared with women; however, more disturbing was the higher occurrence of HF hospitalizations among young adults in general, particularly young black men. Our study showed that hypertension was the only independent predictor of HF admissions in black men ages 20 to 34 years.[6] Tennessee is in the southeastern region of the United States, which compared with the rest of the United States has one of the highest prevalences of HF-related risk factors, with an alarming trend and racial differences in hypertension, diabetes, and obesity.[7] Reports indicate an improvement in national and regional trends for HF hospitalizations,[8] perhaps secondary to improved implementation of guideline recommendations for evidence-based preventive measures aimed at combating HF and cardiovascular disease in general.[9–12] In this context, we sought insight on the status of HF management in the southern United States. Therefore, we have analyzed the HF hospitalizations data in Tennessee for 2007 and 2008 with reference to 2006. This article presents our findings and examines the implications for HF management in vulnerable populations.

Methods

Data

We obtained inpatient admissions data for 2006 through 2008 from the Hospital Discharge Data System (HDDS) compiled by the Division of Health Statistics of the Tennessee Department of Health. All of the hospitals licensed by the Tennessee Department of Health are required by law to report patient-level discharge information.[13] All of the data are reported on a uniform billing form developed by the National Uniform Billing Committee. Relevant details of the billing form, rationale, and variables have been described elsewhere.[6,13] We used *International Classification of Diseases-9* codes 402, 404, and 428 for HF (Table 1) as previously used by our group and Fang et al.[6,14] For each year, we identified adult cases (aged 20 years and older) with at least one admission in which HF was a primary diagnosis. In each year, more than 450,000 adult patients were hospitalized for various acute and chronic medical conditions, including surgeries. We extracted all of the data for primary diagnosis of HF (HFPD) in blacks and whites because other races, in combination, constituted only 1% of the data and thus were not amenable to stable or robust statistical analysis; data extraction focused on sex, age, and race. Although an individual may appear in more than one year, each individual appears only once in the calculation of prevalence for any one year; otherwise, the entire data on any individual were used in all of the other analyses. Yearly race–sex specific rates also were obtained for hypertension, diabetes, and myocardial infarction among patients with HF. There were no significant changes in the definitions or coding for hypertension and diabetes during the period of observation.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Statistical Analysis

All of the rates (per 10,000) were age standardized by the direct method and indexed to the Year 2000 Standard Population per methodology provided by the US Centers for Disease Control and Prevention.[15] Numerators for hospitalization rates for 2006 through 2008 were the estimated number of hospitalizations according to the Department of Health and Human Services, and denominators were from the 2000 US Census.[16] Age-specific rates and trends in sex and race were evaluated in conjunction with an estimation of relative percentage changes between 2006 and 2008. The Fisher exact test was used for comparison of prevalence of comorbidities by race and sex. Percentages of HF admissions in each period were compared using a Pearson chi-square test with Yates continuity correction and adjusted measures of relative effect were obtained through logistic regression analyses, which controlled for age, hypertension, diabetes, and myocardial infarction. SPSS version 11 (SPSS Inc, Chicago, IL) software was used for all of the analyses. $P < 0.05$ was the accepted threshold for statistical significance.

Results

Overall Trend

In 2006, 20,222 adult patients (aged 20 years and older) were admitted with HF compared with 17,300 in 2007 and 16,889 in 2008. In all three years, more than 54% of patients with HF were women and nearly 18% of patients with HF were black. During the 3-year period, the proportion of patients with HFPD decreased from 4.5% in 2006 to 4.2% in 2008. Similarly, age-adjusted rates for HFPD declined by 19.1% from 45.5/10,000 population in 2006 to 36.8/10,000 in 2008. Comparison of selected characteristics of HFPD hospitalizations for 2006 and 2008 (Table 2) revealed that the average ages were 71 and 72 years in 2006 and 2008, respectively. In addition, the HFPD patients had a high prevalence of comorbid conditions, including hypertension (78.4% in 2006 and 87% in 2008), diabetes (43.9% in 2006 and 49.8% in 2008), and myocardial infarction (9.1% in 2006 and 11.4% in 2008). There was no significant change in the proportion (≈70%) of older adults (aged 65 years and older) with HFPD during the period.

Differences in HF Rates

Figure 1 illustrates that the age-adjusted HF rates were higher for blacks in general compared with whites. The disparities of age-adjusted HF rates persisted within race-sex groups; of note, in 2008, black men demonstrated an increase in HF rates compared with others (Fig 2). These observations are reported in Table 2, which also shows higher rates in blacks compared with whites and in men compared with women in 2008 as in 2006. The unadjusted and adjusted rate ratios for black-to-white hospitalization for HFPD are shown in Table 3, which demonstrates that the black-to-white ratio was clearly >1.0 for all ages younger than 85 years with increasing ratios as the age categories became younger. The highest values for the black-to-white rate ratio were among patients ages 20 to 34, 35 to 44, and 45 to 54 years. In 2008, among patients younger than 65 years, the unadjusted HF rates were at least 3 to 11 times higher in blacks compared with their white peers; after adjusting for covariates (age, hypertension, diabetes, and myocardial infarction) with logistic regression modeling, the odds ratio (OR) for HF rates were two to five times higher in blacks compared with whites. The highest rate was registered in the youngest age category of 20 to 34 years (OR 4.97, 95% confidence interval [CI] 3.59–6.89).

Further analyses by sex showed that the overall pattern of racial disparities in HF rates was preserved (Table 4). Overall, a significant trend in HF rates was noted among black men relative to white men, with unadjusted rate ratios that were 3 to 11 times higher among patients younger than 65 years old (Table 4) in 2008. Essentially, higher black-to-white

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

admission ratios for HFPD were noted among men in the young and middle-age categories, indicating a persistent pattern compared with prior years. An increase in the adjusted OR for HF rates was noted, however, among patients ages 20 to 34 years, with an increase in OR from 4.75 (95% CI 3.29–6.89) in 2006 to 5.6 in 2008 (95% CI 3.70–8.49). This finding suggests an early sign of worsening disparity in this age category. In addition, in 2008, higher adjusted ratios were noted for black women compared with white women among 20 to 34 year olds (OR 3.97, 95% CI 2.34–6.73) and 35 to 44 year olds (OR 3.12, 95% CI 2.28–4.09). Unlike in men, however, we did not observe any sign of worsening disparity among young women; instead, there was significant improvement in OR for HF rates among young black women as evidenced by a decrease from 4.60 to 3.97 (aged 20–34 years) and 4.21 to 3.12 (aged 35–44 years) between 2006 and 2008, respectively. Overall, there were higher rates of HF admission among black women compared with white women, but the pattern is less striking than the observation in men (Table 4).

Associated Comorbidities

Because differences persisted in 2008 despite a decline in overall HF, we evaluated the prevalence of comorbid conditions associated with HFPD. Table 2 demonstrates that black inpatients with HFPD had higher prevalence rates than whites for hypertension (93.8% for blacks vs 85.0% for whites) and diabetes (54.6% vs 48.4%) but lower rates for myocardial infarction (8.5% vs 12.2%). Table 5 delineates the pattern of HF comorbidities by race and sex for each age category. In 2008, across all age categories, more than 90% of all black men admitted for HFPD had hypertension as a comorbid condition. Furthermore, in all age categories, the prevalence of hypertension in black men was higher compared with their white peers. Similar relationships were observed between black women and white women. Of note, black men in the youngest age categories had a higher prevalence of hypertension than white men in all older age categories. The pattern associated with hypertension was not observed for diabetes and myocardial infarction, and the influence of these conditions only became apparent from the middle-age categories onward in both sexes. Collectively, this suggests that hypertension is the primary risk factor linked with the observed HF disparity.

Discussion

In this study, we analyzed the rate of HF hospitalizations in Tennessee in search of signs of improvement in the wake of increasing awareness and guidelines for preventive efforts,[9–12] as well as reports of improvements in national trends.[8] It is encouraging to observe a decline in the overall HF hospitalization rate during the period, given the alarming trends we reported for 1997 through 2006. Any enthusiasm welcoming this decline is tempered, however, by the persistence of high HF admission rates in blacks compared with whites. Furthermore, alarming concern is precipitated by the fact that the highest HF admission rates previously noted among young black men 20 to 34 years old have not only persisted but also are worsening. In general, this scenario is counterintuitive because there is an overall decline in HF hospitalizations, which is discordant with the persistent and worsening disease burden that afflicts young black men in particular; however, it should be recognized that the age group 20 to 34 years constitutes only 1% of all HFPD in both 2006 and 2008 (Table 2).

Our findings are consistent with the report by Chen et al, which indicates a national decline in the HF hospitalization rate, but a lower rate of decline for black men.[8] Although our study is unable to determine causality for declining HF admissions, there are potential mechanisms for this observation that may center on a general increase in awareness and use of treatment guidelines for primary and secondary prevention of HF and cardiovascular disease, thus resulting in a decrease in the trends for HF-related risk factors.[17–20] The persistent or worsening HF hospitalization rates among younger black men suggest that unique approaches are essential for optimal implementation of guidelines in vulnerable populations.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

In this context, we recognize that the term *black* does not denote a homogeneous racial, ethnic, or genetic group.[21–23] In these data, "black race" may simply be a proxy for social vulnerability.

Among blacks, the convergence of etiological factors, pathophysiology, genetics, socioeconomics, and quality of care has been associated with a particular burden of HF. In the black population, there is a higher prevalence of hypertension- and diabetes-related organ damage that provides a reasonable explanation for the greater burden of HF. In general, the prevalence of hypertension in blacks is higher than in the general population; furthermore, blacks have a higher prevalence of severe hypertension and related manifestations of end-organ damage.[24–28] Akin to hypertension, the prevalence of diabetes in blacks also is high. According to the National Health Interview Survey, the age-adjusted prevalence of diabetes in blacks 18 years old and older is 1.6 times higher than in whites,[29] but insights from the Southern Community Cohort Study suggest that race differences in the prevalence of diabetes are remarkably reduced or disappear after adjustment for obesity, physical activity, and other factors.[30,31] Regardless, in the present study, hypertension was the only predictor of HF in patients 20 to 34 years of age and was accompanied by diabetes in patients 35 years old and older. These prevalent risk factors affect the development of HF that involves an intricate and intimate interplay of genetics, environment, and physiology, which creates an adverse hemodynamic milieu exacerbated by disparate health care. Consequently, there should be a mandate for early and aggressive modification of these risk factors according to existing guidelines,[11,32–35] but it should be tailored toward blacks and possibly other vulnerable populations.

Practice Implications

The detrimental impact of HF on blacks, particularly young black men, is a call to action that the Association of Black Cardiologists has responded to via the commissioned consensus statement for the treatment of HF in blacks.[35] This document is designed to provide the practicing healthcare worker with perspectives that may be relevant to black patients and possibly other vulnerable populations, in an effort to optimize care delivery and outcome improvement. It distills and amplifies practice recommendations on the foundation of existing guidelines. Specifically, treatment of stages A and B HF mandates early detection and aggressive modulation of risk factors, with an emphasis on hypertension, strictly adhering to recommendations of the International Society of Hypertension in Blacks and the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[33,34,36] In addition, interventions with diabetic, obese, or overweight individuals are recommended strongly. Optimal use of beta blockers and angiotensin-converting enzyme inhibitors or angiotensin-receptor blocker is emphasized with the recommendation to dispel the concerns about the efficacy of angiotensin-converting enzyme inhibitors because they are indeed efficacious and there is no evidence to support their limited use in blacks. Attention is drawn to the disparate use of statins in patients with dyslipidemia, thus highlighting an area for improvement. Patients with clinical HF (stages C and D) should receive the full benefit of data from clinical trials as exemplified by the African American Heart Failure Trial, which demonstrated the beneficial effects of combined vasodilator therapy in black patients.[37] Of note, in the trial, skin color was just a surrogate, albeit imperfect, for a phenotype of anomalous nitric oxide metabolism that is not restricted to blacks. Emphasis is focused on the disparate use of device therapy in blacks with clinical HF, thus highlighting another area in which there is ample opportunity for improvement. The terminal stage of the disease process (stage D) usually involves palliative care, ventricular replacement strategies, or both and requires cultural competence and exposure to any ongoing clinical trial opportunity.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

In general, the HF arena is replete with advances in therapeutic options, including pharmaceuticals and device-based strategies, which have led to remarkable improvement in morbidity and mortality rates; however, the growing nature of the epidemic warrants improved efforts at translating these evidence-based therapeutic measures to help the most vulnerable populations. As it relates to blacks, the practice implications discussed above are germane, yet delivery of such management may be aided by an understanding and use of social capital, culture, community participation and engagement, risk engine modification for improved stratification, and health literacy and numeracy. Herein rests the importance of a triangulation model of innovation, public health, and medical care in an effort to achieve the greatest success.[12,38]

Limitations and Strengths

The HDDS files are administrative and do not provide clinical data pertaining to stages of disease, test results, or pharmacologic treatment, thus precluding inferences on association between the observed trend vis-à-vis the awareness and implementation of treatment guidelines; however, these limitations do not compromise the validity or internal accuracy of the data. Furthermore, the HDDS files allow for the estimation of incidence and prevalence of diseases, length of treatment, and cost of services provided. Despite its limitations, the large number of HF cases each year makes these findings highly relevant for future healthcare decisions aimed at reducing disease burden. Of note, the comorbidity analyses would have benefitted from inclusion of obesity but was precluded by evidence that this diagnosis was severely underascertained.

Conclusions

Although overall HF hospitalization rates are declining, they remain high among younger blacks compared with their white peers. Hypertension and diabetes are the significant determinants of HF among blacks and therefore require aggressive treatment efforts to reduce HF disparity. Such efforts should recognize that unique approaches are relevant in the quest to mitigate the high prevalence of predisposing risk factors. In addition to preventive healthcare delivery efforts that must focus on awareness and modification of risk factors, the higher rate of HF among younger blacks with a high rate of hypertension also indicates that we need to evoke personal responsibility, adherence to a medical regimen, and community participation among blacks and possibly other vulnerable populations.

Acknowledgments

U.K.A.S. is supported in part by the Harold Amos Medical Faculty Award of the Robert Wood Johnson Foundation and the Vanderbilt Clinical and Translational Scholars Award. The study was supported by Centers for Disease Control and Prevention grant no. U58CCU422782 to the Tennessee Department of Health (ED-07-20811-00 to Tennessee State University, B.A.H., PI) and National Institutes of Health grant no. P20-MD000516 (National Center on Minority Health & Health Disparity to Meharry Medical College; B.A.H., Hull[A], V.A.C., and R.S.L. are supported in part by this grant).

References

1. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics—2011 update: a report from the American Heart Association. Circulation. 2011; 123:e18–e209. [PubMed: 21160056]
2. Yancy CW. Heart failure in African Americans. Am J Cardiol. 2005; 96:3i–12i.
3. Yancy CW, Strong M. The natural history, epidemiology, and prognosis of heart failure in African Americans. Congest Heart Fail. 2004; 10:15–18. [PubMed: 14872153]

[A]Dr Hull is not part of this authorship. Delete the name?

NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript

4. Bibbins-Domingo K, Pletcher MJ, Lin F, et al. Racial differences in incident heart failure among young adults. N Engl J Med. 2009; 360:1179–1190. [PubMed: 19297571]
5. Okin PM, Kjeldsen SE, Dahlof B, et al. Racial differences in incident heart failure during antihypertensive therapy. Circ Cardiovasc Qual Outcomes. 2011; 4:157–164. [PubMed: 21304095]
6. Husaini BA, Mensah GA, Sawyer D, et al. Race, sex, and age differences in heart failure-related hospitalizations in a southern state: implications for prevention. Circ Heart Fail. 2011; 4:161–169. [PubMed: 21178017]
7. [Accessed March 25, 2011] Tennessee's Behavioral Risk Factor Surveillance System Report. 2009. http://health.state.tn.us/statistics/PdfFiles/BehavioralRskSrvy_2009.pdf.
8. Chen J, Normand SL, Wang Y, et al. National and regional trends in heart failure hospitalization and mortality rates for Medicare beneficiaries, 1998–2008. JAMA. 2011; 306:1669–1678. [PubMed: 22009099]
9. Tennessee Department of Health and Tennessee State University. Center for Health Research. Tennessee Heart Disease and Stroke Prevention and Care Plan 2008–2012. Tennessee Department of Health; Nashville, TN: 2007.
10. Fuster V, Smaha L. AHA's new strategic impact goal designed to curb epidemic of cardiovascular disease and stroke. Circulation. 1999; 99:2360. [PubMed: 10318652]
11. Hunt SA, Abraham WT, Chin MH, et al. ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure): developed in collaboration with the American College of Chest Physicians and the International Society for Heart and Lung Transplantation: endorsed by the Heart Rhythm Society. Circulation. 2005; 112:e154–e235. [PubMed: 16160202]
12. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. Circulation. 2010; 121:586–613. [PubMed: 20089546]
13. [Accessed December 26, 2009] Tennessee Department of Health, Division of Health Statistics: Hospital Discharge Data System User Manual. 2007. http://www.tha-hin.com/files/HDDS-Manual-UB04-1_0307.pdf.
14. Fang J, Mensah GA, Croft JB, et al. Heart failure-related hospitalization in the U.S., 1979 to 2004. J Am Coll Cardiol. 2008; 52:428–434. [PubMed: 18672162]
15. Klein RJ, Schoenborn CA. Age adjustment using the 2000 projected U.S. population. Healthy People 2010 Stat Notes. 2001:1–10. [PubMed: 11676466]
16. Kozak LJ, DeFrances CJ, Hall MJ. National hospital discharge survey: 2004 annual summary with detailed diagnosis and procedure data. Vital Health Stat. 2006; 13(162):1–209.
17. Chen J, Normand SL, Wang Y, et al. Recent declines in hospitalizations for acute myocardial infarction for Medicare fee-for-service beneficiaries: progress and continuing challenges. Circulation. 2010; 121:1322–1328. [PubMed: 20212281]
18. Yeh RW, Sidney S, Chandra M, et al. Population trends in the incidence and outcomes of acute myocardial infarction. New Engl J Med. 2010; 362:2155–2165. [PubMed: 20558366]
19. Wang TJ, Vasan RS. Epidemiology of uncontrolled hypertension in the United States. Circulation. 2005; 112:1651–1662. [PubMed: 16157784]
20. Dunlay SM, Weston SA, Jacobsen SJ, et al. Risk factors for heart failure: a population-based case-control study. Am J Med. 2009; 122:1023–1028. [PubMed: 19854330]
21. Witzig R. The medicalization of race: scientific legitimization of a flawed social construct. Ann Intern Med. 1996; 125:675–679. [PubMed: 8849153]
22. Schwartz RS. Racial profiling in medical research. N Engl J Med. 2001; 344:1392–1393. [PubMed: 11333999]
23. AAA statement on race. Am Anthropol. 1998; 100:712–713.
24. Manolio TA, Burke GL, Savage PJ, et al. Exercise blood pressure response and 5-year risk of elevated blood pressure in a cohort of young adults: the CARDIA study. Am J Hypertens. 1994; 7:234–241. [PubMed: 8003274]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

25. Cornoni-Huntley J, LaCroix AZ, Havlik RJ. Race and sex differentials in the impact of hypertension in the United States. The National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. Arch Intern Med. 1989; 149:780–788. [PubMed: 2784957]
26. Apostolides AY, Cutter G, Daugherty SA, et al. Three-year incidence of hypertension in thirteen U.S. communities. Prev Med. 1982; 11:487–499. [PubMed: 7156059]
27. Johnson AL, Cornoni JC, Cassel JC, et al. Influence of race, sex and weight on blood pressure behavior in young adults. Am J Cardiol. 1975; 35:523–530. [PubMed: 1119403]
28. Five-year findings of the hypertension detection and follow-up program. II. Mortality by race-sex and age. Hypertension Detection and Follow-up Program Cooperative Group. JAMA. 1979; 242:2572–2577. [PubMed: 490883]
29. The Office of Minority Health. [Accessed March 26, 2011] Diabetes in African Americans. http://minorityhealth.hhs.gov/templates/content.aspx?ID=3017.
30. Buchowski MS, Cohen SS, Matthews CE, et al. Physical activity and obesity gap between black and white women in the southeastern U.S. Am J Prev Med. 2010; 39:140–147. [PubMed: 20621261]
31. Signorello LB, Hargreaves MK, Blot WJ. The Southern Community Cohort Study: investigating health disparities. J Health Care Poor Underserved. 2010; 21:26–37. [PubMed: 20173283]
32. Heart Failure Society of America. Executive summary: HFSA 2006 Comprehensive Heart Failure Practice Guideline. J Card Fail. 2006; 12:10–38. [PubMed: 16500578]
33. Douglas JG, Bakris GL, Epstein M, et al. Management of high blood pressure in African Americans: consensus statement of the Hypertension in African Americans Working Group of the International Society on Hypertension in Blacks. Arch Intern Med. 2003; 163:525–541. [PubMed: 12622600]
34. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003; 42:1206–1252. [PubMed: 14656957]
35. Franciosa JA, Ferdinand KC, Yancy CW. Treatment of heart failure in African Americans: a consensus statement. Congest Heart Fail. 2010; 16:27–38. [PubMed: 20078625]
36. Flack JM, Sica DA, Bakris G, et al. Management of high blood pressure in blacks: an update of the International Society on Hypertension in Blacks consensus statement. Hypertension. 2010; 56:780–800. [PubMed: 20921433]
37. Taylor AL, Ziesche S, Yancy C, et al. Combination of isosorbide dinitrate and hydralazine in blacks with heart failure. N Engl J Med. 2004; 351:2049–2057. [PubMed: 15533851]
38. Rust G, Satcher D, Fryer GE, et al. Triangulating on success: innovation, public health, medical care, and cause-specific US mortality rates over a half century (1950–2000). Am J Public Health. 2010; 100(Suppl 1):S95–S104. [PubMed: 20147695]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Key Points

- Hospitalization rates for heart failure (HF) admissions have declined in the state of Tennessee from 2006 to 2008.
- HF admissions remain higher for blacks than whites and men than women.
- Despite overall decline in HF admissions, the disparity involving younger black men appears to be worsening.
- Hypertension is the strongest risk factor for HF admissions.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

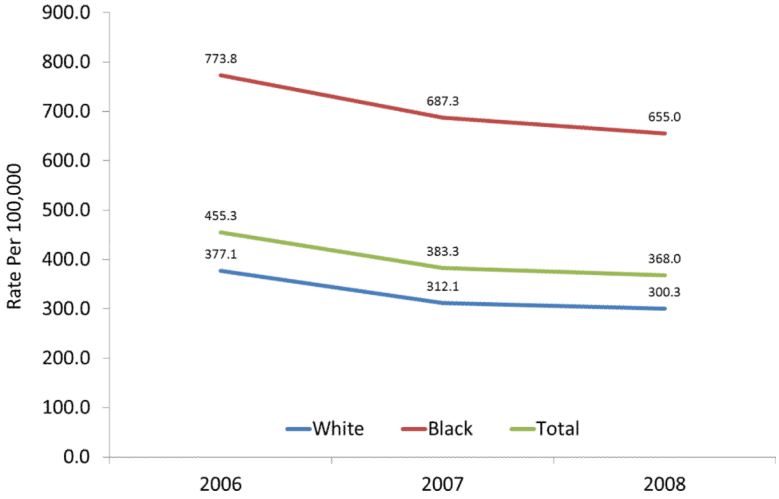

Fig 1.

Age-adjusted black and white hospitalization rates for primary diagnosis of heart failure, 2006–2008 Hospital Discharge Data System.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

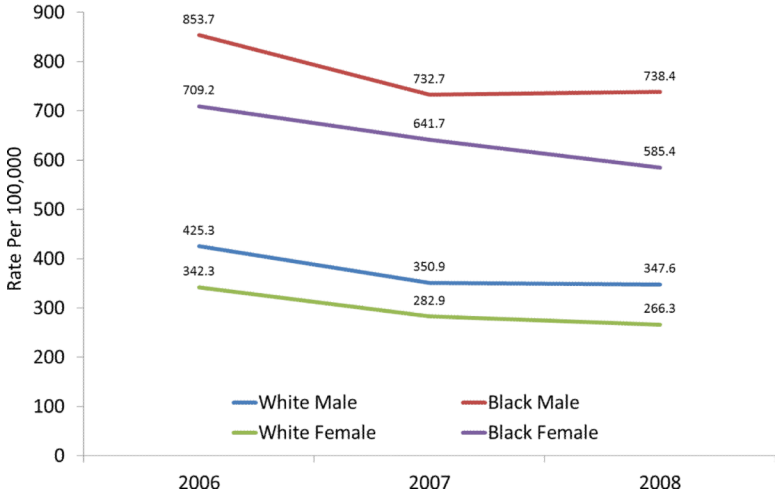

Fig 2.

Age-adjusted intrasex hospitalization rates for primary diagnosis of heart failure by race, 2006–2008 Hospital Discharge Data System.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 1

ACC/AHA heart failure performance measures *ICD-09-CM* diagnostic codes

***ICD-9-CM* code**	**Description**
402.01	Malignant, hypertensive heart disease with heart failure
402.11	Benign, hypertensive heart disease with heart failure
402.91	Unspecified, hypertensive heart and renal disease with heart failure
404.01	Malignant, hypertensive heart and renal disease with heart failure
404.03	Malignant, hypertensive heart and renal disease with heart failure and renal failure
404.11	Benign, hypertensive heart and renal disease with heart failure
404.13	Benign, hypertensive heart and renal disease with heart failure and renal failure
404.91	Unspecified, hypertensive heart and renal disease with heart failure
404.93	Unspecified, hypertensive heart and renal disease with heart failure and renal failure and renal failure
428.00	Unspecified, congestive heart failure
428.01	Left heart failure
428.09	Unspecified, heart failure
428.20	Unspecified, systolic heart failure
428.21	Acute systolic heart failure
428.22	Chronic systolic heart failure
428.23	Acute or chronic systolic heart failure
428.30	Unspecified, diastolic heart failure
428.31	Acute diastolic heart failure
428.32	Chronic diastolic heart failure
428.33	Acute or chronic diastolic heart failure
428.40	Unspecified, combined systolic and diastolic heart failure
428.41	Acute combined systolic and diastolic heart failure
428.42	Chronic combined systolic and diastolic heart failure
428.43	Acute or chronic combined systolic and diastolic heart failure

ACC/AHA, American College of Cardiology/American Heart Association; *ICD-09-CM, International Classification of Diseases-Ninth Revision-Clinical Modification.*

NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript

Table 2

Selected characteristics of hospitalized patients age 20 years old and older with HFPD in 2006 and 2008 (Hospital Discharge Data System)[A]

HFPD	Total		White*		Black*		Male*		Female*	
	2006	2008	2006	2008	2006	2008	2006	2008	2006	2008
Columns	1	2	3	4	5	6	7	8	9	10
HFPD (n)	20,222	16,889	15,752	12,968	4,470	3,921	9,337	7,903	11,122	8,986
Rate/10,000[†]	*45.5*	*36.8*	*37.7*	*30.0*	*77.4*[‡]	65.5[‡]	*48.0*[‡]	*39.8*[‡]	*43.7*	*34.4*
Mean age, y	*71.3*	*72.0*	*73.9*	*74.8*	*62.2*	*62.7*	*68.4*	*68.8*	*73.7*	*74.8*
Female, %	54.4	53.2	*54.7*	53.6	*53.4*	*52.1*	—	—	—	—
HFPD % per age category, y										
20–34	*1.0*	1.0	0.5	0.4	3.1	3.1	1.4	1.4	0.7	0.7
35–4	*3.4*	3.5	*1.7*	1.8	9.7	9.0	4.5	4.6	2.6	2.5
45–54	*9.5*	9.3	*6.1*	5.8	21.7	20.7	11.6	11.4	*7.8*	7.4
55–64	16.2	15.9	*14.6*	13.8	21.9	22.7	19.7	18.9	13.3	13.2
65–74	22.7	22.8	*23.7*	*23.6*	19.1	20.2	*24.5*	25.2	21.1	20.7
75–84	*28.2*	27.5	31.5	30.9	*16.5*	16.1	*26.2*	25.8	*29.9*	28.9
≥85	18.9	20.1	22.0	23.7	8.1	8.2	*12.2*	12.7	24.6	26.6
Prevalence of comorbiidities among HFPD patients, %										
HTN	*78.6*	87.0	75.3	85.0	90.0*	93.8	*75.5*	85.8	*81.2%*[‡]	88.1
DM	*43.9*	49.8	42.5	48.4	48.9*	54.6	43.6	50.5	44.2	49.2
MI	9.1	11.4	9.8	12.2	6.9	8.5	9.4	*12.2*	8.9	*10.6*

DM, diabetes mellitus; HFPD, heart failure primary diagnosis; HTN, hypertension; MI, myocardial infarction.

[A]What is the significance of the yellow highlighted numbers (now italics)?

*Within-group differences between 2006 and 2008 are significant at $P < 0.001$.

[†]Rates per 10,000 are age-adjusted, all ages.

[‡]Black versus white differences in 2006 and 2008 (see columns 5 vs 3 and 6 vs 4) and male versus female differences (columns 7 vs 9 and 8 vs 10) in 2006 and 2008 are significant at $P < 0.0001$.

NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript

Table 3

Age–adjusted HF rate per 10,000, ratios, and OR for HFPD by race and sex in 2006 and 2008[A]

Primary diagnosis by race, rate per 10,000						**Unadjusted OR**		**Adjusted OR and 95% CI**		
Age category, y	Black 2006	Black 2008	White 2006	White 2008	B/W ratio 2006	B/W ratio 2008	B/W OR 2006	CI 2006	B/W OR 2008	CI 2008
Column	1	2	3	4	5	6	7	8	9	10
20–34	6.6	5.7	0.8	*0.6*	*8.3*	*9.5*	4.70	3.52–6.29	4.97	3.59–6.89
35–44	31.4	26.1	3.6	3.3	*8.7*	7.9	4.78	4.08–5.60	4.24	3.57–5.04
45–54	68.1	55.2	13.0	10.0	*5.2*	5.5	3.41	3.10–3.74	3.40	3.07–3.77
55–64	121.1	98.5	39.4	29.0	3.1	3.4	2.25	2.08–2.44	2.30	2.11–2.56
65–74	197.7	176.5	102.9	80.1	1.9	*2.2*	1.60	1.48–1.73	1.63	1.50–1.78
75–84	302.9	258.9	215.1	173.3	1.4	1.5	1.31	1.20–1.42	1.28	1.17–1.41
≥85	*350.9*	299.0	397.4	331.6	*0.9*	0.9	0.90	0.80–1.01	0.87	0.77–0.99
All ages	*77.4*	65.5	*37.7*	*30.0*	*2.1*	2.2	1.90	1.83–1.96	1.85	1.78–1.93
Primary diagnosis by sex, rate per 10,000						Unadjusted OR		Adjusted OR and 95% CI		
Age category, y	Male 2006	Male 2008	Female 2006	Female 2008	M/F ratio 2006	M/F ratio 2008	M/F OR 2006	CI 2006	M/F OR 2008	CI 2008
20–34	2.2	*1.9*	1.4	1.1	*1.7*	*1.7*	3.49	2.60–4.67	3.34	2.41–4.62
35–44	*9.5*	*8.5*	6.4	*5.2*	1.5	1.6	2.02	1.72–2.36	2.01	1.69–2.39
45–54	*24.3*	*20.7*	19.0	*14.6*	1.3	1.4	1.45	1.32–1.59	1.53	1.38–1.70
55–64	*56.1*	*45.4*	42.4	*33.3*	1.3	1.4	1.35	1.26–1.45	1.35	1.25–1.46
65–74	*121.6*	*104.9*	*103.8*	*81.9*	1.2	1.3	1.15	1.08–1.22	1.21	1.14–1.30
75–84	*247.4*	*208.8*	*206.6*	*165.1*	1.2	1.3	1.17	1.11–1.24	1.17	1.10–1.25
>85	*431.0*	*374.1*	*376.9*	*324.6*	1.1	*1.2*	1.07	0.99–1.15	1.03	0.95–1.11
All ages	*48.0*	*39.8*	*43.7*	*34.4*	1.1	1.2	1.31	1.26–1.35	1.30	1.26–1.35

For both race and sex differences, in years 2006 and 2008, logistic regression models controlled for hypertension, diabetes, and myocardial infarction. CI, confidence interval; HF, heart failure; HFPD, primary diagnosis of heart failure; OR, odds ratio.

[A]What is the significance of the yellow highlighted numbers (now italics)?

NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript

Table 4

Age–adjusted HF rate per 10,000 and ratios for primary diagnosis by sex across race and age in 2006 and 2008[A]

Male primary diagnosis						**Unadjusted OR**		**Adjusted OR and 95% CI**		
Age category, y	BM 2006	WM 2006	BM 2008	WM 2008	BM/WM ratio 2006	BM/WM ratio 2008	BM/WM OR 2006	CI 2006	BM/WM OR 2008	CI 2008
Column	1	2	3	4	5	6	7	8	9	10
20–34	8.5	1.0	7.8	0.7	8.5	11.1	4.75	3.29–6.86	5.61	3.70–8.49
35–44	39.3	*4.4*	35.7	3.8	*8.9*	9.4	5.10	4.15–6.25	5.10	4.09–6.36
45–54	80.8	*14.7*	65.7	12.3	*5.5*	5.3	3.76	3.32–4.27	3.42	2.98–3.92
55–64	139.7	*46.3*	117.2	34.1	*3.0*	3.4	2.32	2.08–2.59	2.43	2.17–2.73
65–74	211.2	*113.4*	195.2	92.4	*1.9*	2.1	1.67	1.48–1.88	1.72	1.52–1.94
75–84	303.2	*243.4*	268.7	201.5	*1.2*	1.3	1.31	1.14–1.51	1.30	1.12–1.57
≥85	355.5	*441.0*	269.3	372.3	*0.8*	0.7	0.94	0.74–1.18	0.77	0.59–0.99
All ages	*85.4*	*42.5*	*73.8*	34.8	*2.0*	2.1	2.18	2.06–2.30	2.13	2.02–2.21
Female primary diagnosis						Unadjusted OR		Adjusted OR and 95% CI		
Age category, y	BF 2006	WF 2006	BF 2008	WF 2008	BF/WF ratio 2006	BF/WF ratio 2008	BF/WF OR 2006	CI 2006	BF/WF OR 2008	CI 2008
20–34	5.0	0.6	3.8	0.5	9.1	7.6	4.60	2.86–7.41	3.97	2.34–6.73
35–44	24.6	2.8	17.8	2.7	8.8	6.6	4.21	3.28–5.40	3.12	2.38–4.09
45–54	57.3	11.2	46.4	7.7	5.1	6.0	3.01	2.62–3.46	3.35	2.86–3.93
55–64	106.1	32.9	83.3	24.2	3.2	3.4	2.14	1.90–2.40	2.12	1.87–2,41
65–74	188.3	94.0	163.3	69.6	2.0	*2.3*	1.52	1.37–1.70	1.54	1.37–1.73
75–84	303.3	196.7	253.4	155.3	1.5	1.6	1.30	1.16–1.43	1.26	1.13–1.42
≥85	349.4	381.5	308.6	316.5	0.9	1.0	0.90	0.77–1.01	0.90	0.78–1.04
All ages	*70.9*	*34.2*	*58.5*	26.6	2.1	2.2	1.66	1.58–1.75	1.62	1.54–1.71

Logistic regression models in 2006 and 2008 controlled for hypertension, sex, race, age, diabetes, and myocardial infarction. Among 20-to 34-year-old patients, Diabetes and myocardial infarction are unrelated to HF in 2006 and 2008. BF, black female; BM, black male; CI, confidence interval; HF, heart failure; OR, odds ratio; WF, white female; WM, white male.

[A]What is the significance of the yellow highlighted numbers (now italics)?

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 5

Percentage prevalence of comorbid conditions among HFPD in 2008 by age, race, and sex[A]

Condition and age category, y	BM %(N)	WM %(N)	Fisher exact test (*P*)	BF %(N)	WF %(N)	Fisher exact test (*P*)
Hypertension						
20–34	92 (77)	71 (34)	<0.000	74 (43)	46 (*22*)	<0.021
35–44	*94* (224)	77 (136)	<0.000	92 (130)	72 (97)	<0.000
45–54	93 (443)	83 (459)	<0.000	94 (370)	82 (294)	<0.000
55–64	92 (475)	84 (1021)	<0.000	93 (417)	86 (767)	<0.000
65–74	95 (363)	86 (1631)	<0.000	95 (428)	88 (1433)	<0.000
75–84	95 (228)	84 (1812)	<0.000	96 (403)	88 (2195)	<0.000
≥85	94 (70)	80 (930)	<0.001	96 (250)	85 (2137)	<0.000
Diabetes						
20–34	26	29	NS	21	32	NS
35–44	35	46	<0.025	39	43	NS
45–54	43	57	<0.000	52	57	NS
55–64	56	58	NS	68	65	NS
65–74	62	60	NS	75	62	<0.000
75–84	53	48	NS	61	46	<0.000
≥85	39	30	NS	44	28	<0.000
Myocardial infarction						
20–34	3	9	NS	2	9	NS
35–44	5	9	NS	8	9	NS
45–54	6	14	<0.000	8	10	NS
55–64	9	14	<0.001	8	12	<0.027
65–74	10	14	<0.014	10	12	NS
75–84	11	13	NS	11	10	NS
≥85	11	13	NS	11	11	NS

BF, black females; BM, black males; HFPD, heart failure primary diagnosis; WF, white females; WM, white males. N, number of patients; denominator (N) in each cell used for percentage (%) calculations in hypertension are the same for diabetes and myocardial infarction.

[A]What is the significance of the yellow highlighted numbers (now italics)?