Brief Report

Mortality From Heart Failure and Dementia in the United States: CDC WONDER 1999−2016

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ABSTRACT

Background: Heart failure and dementia are diseases of the elderly that result in billions of dollars in annual health care expenditure. With the aging of the United States population and increasing evidence of shared risk factors, there is a need to understand the conditions' shared contributions to nationwide mortality. The objectives of this study were to estimate the burden of mortality from heart failure and dementia and characterize the demographics of affected individuals.

Methods and Results: This retrospective study used National Vital Statistics Data from 1999 to 2016 provided by the Centers for Disease Control and International Classification of Diseases (10th edition) codes for heart failure and dementia as defined by the Medicare Chronic Conditions Data Warehouse. From 1999 to 2016, deaths contributed to by both heart failure and dementia totaled 214,706 and constituted 4.00% of all heart failure deaths and 9.04% of all dementia deaths. Women were more affected than men, with higher age-adjusted mortality rates (per 1,000,000 person-years): 38.67 (95% confidence interval [CI] 38.47−38.87) versus 32.90 (95% CI 32.65−33.15; $P < .001$). Whites were affected more than blacks, with age-adjusted mortality rates (per 1,000,000 person-years) of 38.00 (95% CI 37.83−38.16) versus 31.06 (95% CI 30.54−31.59; $P < .001$). However, under the age of 65 years, higher crude mortality rates (per 1,000,000 person-years) were reported in men (0.20, 95% CI 0.18−0.22) compared with women (0.15, 95% CI 0.13−0.16; $P < .001$).

Conclusions: This study provides insight into temporal trends and nationwide mortality rates reported for heart failure and dementia. Our results suggest a disproportionate burden on populations over 85 years of age, whites, and women. (*J Cardiac Fail 2019;25:125−129*)

Key Words: Heart failure, dementia, mortality, epidemiology, women's health, geriatrics, comorbidities, race and ethnicity, aging.

Heart failure and dementia cause substantial morbidity, mortality, and health care expenditure, which are expected to rise further with aging of the population. Currently, nearly 6.5 million[1] Americans are living with heart failure, and although there is no published estimate for all-cause dementia, the national burden is likely more than 5.7 million estimated for Alzheimer dementia alone.[2] By the year 2050, an estimated 88.5 million people in the United States will be over the age of 65 years and at risk for diseases of the elderly, including heart failure and dementia.[3] Research continues to highlight the intricate relationships between heart failure and dementia pathophysiology, management, and respective therapeutic strategies.[4−7] However, the burden of mortality from heart failure with dementia in the US is not known.

The American Heart Association provides yearly updates on heart disease and stroke statistics and mortality with the use of data from the National Vital Statistics System, which

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are highly accessed (>106,500 times in 2017) and cited.[1] But, data on mortality from heart failure with dementia are not included in that report. The present study used death certificate data from the entire US for 1999−2016 from the National Vital Statistics System to: 1) estimate the burden of mortality from heart failure and dementia in the US; and 2) characterize the demographics of affected individuals.

Methods

We analyzed deaths in which both heart failure and dementia are either underlying or contributing causes for the years 1999−2016 in the US. Deidentified records were obtained from the National Center for Health Statistics multiple cause of death public-use data files for 1999−2016 via the CDC WONDER system.[8] Each US standard death certificate lists the underlying cause of death (defined as the disease that directly leads to death) and up to 20 potentially contributing conditions listed as multiple causes of death. Deaths with International Classification of Diseases (10th edition; ICD-10) codes for both heart failure and dementia (see Supplement for specific codes) as either underlying or contributing causes, were included.[9,10] Analysis of unique individuals was ensured by sorting deaths by factors that only appear once on the death record, such as age, race, sex, residence, and year of death. Deaths were categorized by age group (<55 years, 55−64 years, 65−74 years, 75−84, and ≥85 years), sex, year, race, and ethnicity. Deaths were subcategorized as premature heart failure and dementia in populations under the age of 65 years. Trends in the total deaths related to heart failure and total deaths related to dementia were similarly analyzed.

Statistical Analyses

Crude mortality incidence rates (CMRs) were calculated as deaths per 1,000,000 person-years. Age-adjusted mortality rates (AAMR) per 1,000,000 person-years were calculated to a 2000 US standard population as designated by CDC WONDER (see Supplement). We reported CMR and AAMR for heart failure with dementia, dementia alone (dementia), and heart failure alone (heart failure). Where appropriate, 95% confidence intervals (CIs) and standard errors are reported. We included race, sex, and age group demographic proportions for deaths related to both heart failure and dementia, with *P* values as compared with the standard US population in 2000 (from CDC WONDER)[8] for these demographics during this period. Medcalc Statistical Software version 18.9.1 (2018; Ostend, Belgium, www.medcalc.org) was used for comparison of these proportions.

Results

During 1999−2016, heart failure and dementia were reported as contributing causes of death in 214,706 individuals nationwide, compared with 2,375,349 individuals with dementia and 5,362,819 individuals with heart failure. Heart failure and dementia deaths made up 9.04% of all deaths related to dementia and 4.00% of all deaths related to heart failure. The AAMR from heart failure and dementia was 36.80 per 1,000,000 person-years (95% CI 36.64-36.95), compared with 411.21 (95% CI 410.68−411.73) for dementia and 929.78 (95% CI 928.99−930.57) for heart failure.

Consistent with past studies, mortality from heart failure and dementia in this study was primarily reported in the elderly, female, and white populations. Individuals 85 years or older constituted 74.79% of all deaths attributable to comorbid heart failure and dementia, while they constituted only 1.72% of the US population during this period ($P < .0001$). Premature heart failure with dementia (<65 years) constituted only 821 deaths (0.38%). Women constituted a larger percentage of the mortality from heart failure and dementia population than the general US population during this period, with 68.91% of the heart failure and dementia population being women versus 50.85% of the general US population being women ($P < .0001$). Similarly, whites constituted a larger proportion of heart failure and dementia mortality compared with the general US population, 92.15% versus 80.00% ($P < .0001$; Table 1).

Age, Sex, and Race Differences

In general, age, sex, and race parameters for the cohort with mortality from heart failure and dementia were very similar to those with dementia alone and distinct from those with heart failure alone. As presented in Table 2, the AAMR for heart failure and dementia (and dementia alone) was significantly higher in women than in men. However, AAMR for heart failure was higher in men than women.

Heart failure and dementia mortality (and dementia-alone mortality) was also more frequent in older individuals (≥65 years vs <65 years), particularly in older women compared with older men (Table 2). In contrast, a similarly higher CMR was reported for heart failure in men compared with women of ages both <65 and ≥65 years. However, in populations under 65 years of age, men had a higher CMR from heart failure and dementia compared with women (Table 2).

Overall, as presented in Table 2, AAMR from heart failure and dementia (and dementia alone) was highest in whites (38.00, 95% CI 37.83−38.16), followed by blacks (31.06, 95% CI 30.54−31.59), American Indians (26.15, 95% CI 24.13−28.16), and Asian Americans and Pacific Islanders (15.38, 95% CI 14.78−15.99). Hispanics had a lower AAMR than non-Hispanics, with AAMR 23.52 (95% CI 22.97−24.06) and 37.51 (95% CI 37.35−37.67), respectively ($P<.001$). In contrast, AAMR from heart failure was higher in blacks than whites (Table 2).

Temporal Differences

Deaths due to heart failure and dementia increased gradually from 1999, peaked in 2005 (AAMR 41.84, 95% CI 41.10−42.57), and nadired in 2014 (AAMR 30.31, 95% CI 29.75−30.87); a small upward trend in mortality from heart

Table 1. Demographics of Individuals With Mortality From Heart Failure, Dementia, or Both, n (%)

Variable	Both Heart Failure and Dementia	Heart Failure	Dementia	Standard US Population in 2000 (%)
Total	214,706	5,362,819	2,375,349	281,421,906
Sex				
Female	147,949 (68.91%)	2,974,481 (55.46%)	1,629,747 (68.61%)	50.85%
Male	66,757 (31.09%)	2,22,868 (44.54%)	745,602 (31.39%)	49.15%
Race				
American Indian	662 (0.31%)	23,281 (0.43%)	6758 (0.28%)	1.27%
Asian or Pacific Islander	2510 (1.17%)	77,195 (1.44%)	31,940 (1.34%)	5.24%
Black or African American	13,689 (6.38%)	500,107 (9.33%)	161,399 (6.79%)	13.49%
White	197,845 (92.15%)	4,762,236 (88.80%)	2,175,252 (91.58%)	80.0%
Ethnicity				
Hispanic	7,177 (3.34%)	217,063 (4.05%)	93,210 (3.92%)	15.39%
Non-Hispanic	207,196 (96.50%)	5,135,249 (95.76%)	2,278,419 (95.92%)	84.61%
Not stated	333 (0.16%)	10,507 (0.20%)	3,720 (0.16%)	N/A
Age group				
<55 y	128 (0.06%)	177,967 (3.32%)	6065 (0.26%)	75.85%
55−64 y	693 (0.32%)	314,890 (5.87%)	21,632 (0.91%)	10.99%
65−74 y	5970 (2.78%)	699,683 (13.05%)	124,241 (5.23%)	7.11%
75−84 y	47,341 (22.05%)	1,592,341 (29.69%)	669,434 (28.18%)	4.34%
[3]85 y	160,572 (74.79%)	2,577,831 (48.07%)	1,552,945 (65.42%)	1.72%
Not stated	2 (0.00%)	107 (0.00%)	32 (0.00%)	N/A

failure and dementia was evident in 2015 and 2016 (2015 AAMR 34.32, 95% CI: 33.73−34.91; 2016 AAMR 35.33, 95% CI 34.73−35.92; Fig. 1). These temporal patterns were relatively consistent among race and sex subgroups, with women and whites showing consistently higher mortality rates over time.[11]

Discussion

In this study of 214,706 deaths attributable to heart failure and dementia reported in the US during the years 1999−2016, we found that heart failure and dementia disproportionately affect elderly (>85 years of age), white, and female populations, closely matching demographics of individuals with dementia. The Sweden Heart Failure registry study previously found that heart failure and dementia are diseases of elderly white women,[6] and our results support that finding in a larger and more ethnically diverse US population.

Notably, our results suggest that under the age of 65 years, although infrequent, men bear a greater burden. The differences in reported mortality rates by sex, age, and race may reflect different pathophysiologic etiologies underlying heart failure and dementia in men and women and in blacks and whites. Alternatively, there may be a survival bias, in which men and blacks with heart failure are

Table 2. Age-Adjusted and Crude Mortality Rates, Mean (95% CI), Stratified by Sex, Race, and Age

	Age-adjusted mortality rate (per 1,000,000 person-years)		
	Women (n = 147,949)	Men (n = 66,757)	*P* Value
Dementia + HF	38.67 (38.47−38.87)	32.90 (32.65−33.15)	<.001
Dementia alone	436.86 (436.18−437.53)	360.05 (359.23−360.87)	<.001
HF alone	826.99 (826.04−827.93)	1,076.56 (1,075.18−1,077.94)	<.001
	Whites (n = 197,845)	Blacks (n = 13,689)	*P* Value
Dementia + HF	38.00 (37.83−38.16)	31.06 (30.54−31.59)	<.001
Dementia alone	423.13 (422.57−423.70)	363.54 (361.76−365.32)	<.001
HF alone	936.47 (935.62−937.31)	992.58 (989.77−995.38)	<.001
	Crude mortality rate (per 1,000,000 person-years)		
	Women (n = 147,949)	Men (n = 66,757)	*P* Value
Dementia + HF, <65 y	0.15 (0.13−0.16)	0.20 (0.18−0.22)	<.001
Dementia alone, <65 y	5.60 (5.50−5.69)	6.14 (6.04−6.24)	<.001
HF alone, < 65 y	81.90 (81.6−82.3)	126.80 (126.30−127.30)	<.001
Dementia + HF, >65 y	360.53 (358.69−362.37)	216.57 (214.92−218.21)	<.001
Dementia alone, >65 y	3948.67 (3942.59−3954.74)	2388.51(2383.04−2393.98)	<.001
HF alone, >65 y	6794.25 (6786.29−6802.21)	6822.93 (6813.71−6832.15)	<.001

HF, heart failure. Person-year population estimates obtained from the Centers for Disease Control and Prevention WONDER system.

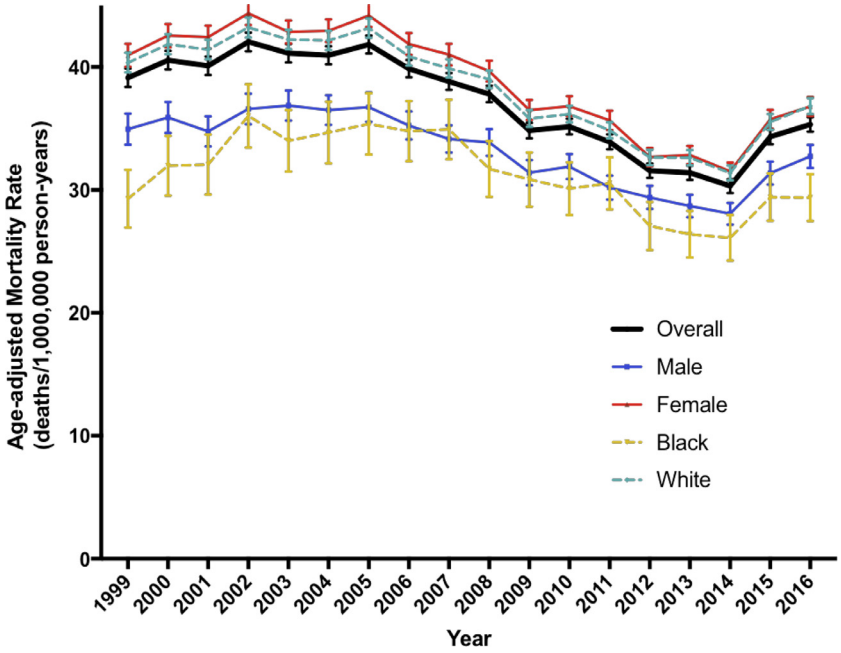

Fig. 1. Temporal trends in age-adjusted mortality rates (AAMRs) for heart failure and dementia. Deaths due to heart failure and dementia peaked in 2005 (AAMR 41.84, 95% confidence interval [CI] 41.10−42.57) and nadired in 2014 (AAMR 30.31, 95% CI 29.75−30.87). A small upward trend in mortality from heart failure and dementia was evident in 2015 and 2016 (2015 AAMR 34.32, 95% CI: 33.73−34.91; 2016 AAMR 35.33, 95% CI 34.73−35.92). These temporal patterns were relatively consistent among race and sex subgroups.

more likely to die at an earlier age and do not survive to develop dementia at old age. Both possibilities warrant further investigation.

Dementia and heart failure share several risk factors and potential pathophysiologic links, offering avenues for combined risk screening and novel modifying therapies. Atherogenic vascular risk factors have traditionally been linked with ischemic heart disease and vascular dementia, and even Alzheimer dementia.[12−14] Proteotoxicity is emerging as a common pathophysiologic theme for heart failure and dementias, with recent report of myocardial dysfunction and intramyocardial deposits of Aβ in patients with Alzheimer dementia.[7] This finding, combined with reported higher risks of Alzheimer disease[6,15] and heart failure with preserved ejection fraction in women,[12,16] may contribute to the higher incidence of combined heart failure and dementia mortality among women. Therefore, understanding the demographics of individuals affected by combined heart failure and demographic risk factors as well as risk factor differences among demographic subgroups will aid in driving future hypotheses of shared pathophysiology and developing therapeutic strategies targeting both conditions simultaneously.

Because our data indicate a substantial coincidence of heart failure and dementia in mortality among the elderly populations, we propose that preventive strategies at younger ages may be valuable to promote healthy aging. Our study shows a decline in heart failure and dementia mortality since 2005, with a reversal of trend and an increase in mortality since 2014; similar trends for heart failure mortality, with a gradual decrease followed by an increase in mortality since 2012, were reported by the CDC.[11] Findings from the Framingham Heart Study[5] and the Cardiovascular Health Study[17] suggest that the current advancements in treatment of cardiovascular health may have contributed to the gradual decline in incidence of dementia from the late 1970s to 2010[5] but no substantial change in mortality from heart failure from 1990 to 2009.[17] One study showed that low systolic blood pressure in heart failure is associated with increased cognitive impairment and suggested that early heart failure intervention may limit cognitive decline in the elderly.[18] In another study, mini−cognitive examinations predicted rehospitalization risk in patients hospitalized with heart failure.[19] Theoretical concerns about the potential impact of neprilysin inhibition on amyloid-beta deposition in the brain[20] have raised concerns about the possibility of accelerated dementia progression in patients treated with neprilysin inhibitors; although the linkage between neprilysin inhibition and dementia has not been substantiated by the clinical experience to date, more deliberate investigations are ongoing, highlighting the need for vigilance in heart failure patients receiving this therapy. Therefore, cognitive screening in individuals with heart failure as well as optimization of cardiovascular health may be important management strategies for improving outcomes.

Study Limitations

This study has several limitations. First, this analysis was conducted with the use of vital statistics data, so there is potential for deaths to be missed or wrongly allocated.

Second, because dementia is a largely clinical diagnosis, there may also be inherent coding biases between study subgroups, such that the diagnosis of dementia may be more likely given at a specific age or to white women that for other demographic subgroups. In addition, the transition to the 10th revision[9] of ICD-10 in 2014 could have potentially affected the findings of increasing mortality for heart failure and dementia since 2014. However, because heart failure mortality has been historically trending downward, the similar reversal of trends in mortality for heart failure alone suggests that this may be a real change that warrants monitoring. In addition, there may be a selection bias for more severe cases of heart failure and dementia, because the conditions must be deemed substantial enough to be included as contributing causes of death. The potential for undercoding is particularly likely for diagnoses of dementia. As such, the actual burden of heart failure and dementia in the US may be underestimated in this study. This underestimation may also not be uniform across age groups, sex, or race.

Conclusion

Overall, this study identifies important aspects about the racial, sexual, and temporal distribution of mortality from dementia and heart failure in the US that have implications for future studies. The recognition that older and white women are disproportionately affected suggests that these groups may benefit from additional screening for both conditions. Our study also raises the concern that heart failure and dementia may have different prevalence among the races and sexes. Future studies are needed to evaluate whether pathophysiologic differences contribute to these observed differences. These demographic data, if confirmed in prospective longitudinal studies, would highlight the need to develop novel preventative strategies in patients with combined heart failure and dementia to improve outcomes.

Disclosures

None.

Supplementary Data

Supplementary data related to this article can be found at doi:10.1016/j.cardfail.2018.11.012.

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