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Editor's Choice

Is Heart Disease or Cancer the Leading Cause of Death in United States Women?

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A B S T R A C T

Purpose: This paper compares the mortality burden of heart disease versus cancer among women by age, race, and ethnicity.
Methods: U.S. death and population data for the years 2000 through 2013 were used to calculate heart disease and cancer death rates. Detailed analyses focused on age (15–19 years old to ≥100 years old) and race and ethnicity (Whites, Blacks, Hispanics, Asians and Pacific Islanders (A/PIs), and American Indians and Alaska Natives (AI/ANs)).
Results: Among women aged 15 years and older, there were 289,467 heart disease deaths and 276,716 cancer deaths in 2013. The majority of heart disease deaths (51.6%) occurred among women 85 years or older, compared with 18.9% of female cancer deaths. The age-adjusted death rates (per 100,000 population) were 171 (95% confidence interval [CI], 170–171) for heart disease versus 177 (95% CI, 176–178) for cancer. For all racial and ethnic groups, cancer mortality was significantly higher than heart disease mortality among women younger than 80 years of age. For all ages combined, cancer deaths exceeded heart disease deaths among Hispanics, A/PIs, and AI/ANs. Black non-Hispanic women were the only racial/ethnic group who had a higher age-adjusted death rate for heart disease than for cancer: 224 (95% CI, 222–226) versus 207 (95% CI, 205–209).
Conclusions: Heart disease remains the leading cause of death among all women combined in the United States by a narrow margin. However, cancer predominantly kills middle-aged and young women, whereas heart disease predominantly kills the very old. New research on the overreporting of heart disease on death certificates for elderly women is needed. National summary statistics obscure the fact that cancer is already the overall leading cause of death for Hispanic women, Asian and Pacific Islander women, and American Indian and Alaska Native women.

Cancer has garnered a sizeable share of women's health concerns for many years. A large study of American adults found that the disease women fear most is breast cancer (Wang et al., 2009). Similarly, a recent study of middle-aged adults (ages 55–64 years) in the United Kingdom found that a majority agreed that cancer was their greatest health fear (Vrinten et al., 2014). Women and ethnic minorities had greater prevalence of cancer fear than White men. In addition, research funding for many types of cancer exceeds what would be expected given their population burden (Gross, Anderson, & Powe, 1999; Carter & Nguyen, 2012). Excessive fear of cancer has been offered as an explanation for women underestimating their risk of heart disease incidence and mortality (Rosenbaum, 2014).

Professional and lay interest in the burden of heart disease in women is relatively recent (Miller & Kollauf, 2002). An inaugural workshop on heart disease in women was held at the National Institutes of Health in 1986, followed by the first national conference sponsored by the American Heart Association held in 1989 (Miller & Kollauf, 2002). In 1997, the American Heart Association published an important scientific statement on heart disease in women (Mosca et al., 1997), which helped to generate further discussion and awareness in both the professional and public spheres.

In 2000, the first national atlas of heart disease mortality in women was published by the Centers for Disease Control and

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Prevention (CDC; Casper et al., 2000). This book provided some of the first detailed data on heart disease mortality among Black, Hispanic, American Indian/Alaska Native, and Asian/Pacific Islander women. By way of contrast, the first national atlases of cancer mortality had been published 25 years earlier (Mason, McKay, Hoover, Blot, & Fraumeni, 1975, 1976).

Direct comparisons of the burden of heart disease versus cancer mortality for women are not readily available. There has been one previous study comparing the burden of mortality among women for heart disease versus cancer in the United States (Canto & Kiefe, 2014). This study looked only at breast cancer, and did not report data for racial/ethnic minority groups. This paper examines recent mortality data for the United States with the purpose of comparing the mortality burden of heart disease versus cancer among women aged 15 years and older. Differential patterns of mortality among smaller ethnic groups (e.g., Asians, Pacific Islanders, American Indians, and Alaska Natives) may be obscured in national "all women" data, so this paper presents results for detailed racial/ethnic groups. Finally, it is well-known that underlying cause of death is highly heterogeneous by age. The common practice of solely examining age-adjusted rates or wide age bands can obscure important age differences; therefore, in this study, some results are presented for 5-year age bands ranging from 15 to 19 years of age to 100 years of age and older.

Methods

Death certificate data for 2000 through 2013 were available from the National Vital Statistics System. Deaths were grouped as "heart disease," "cancer," or "all other" based on the underlying cause of death. The underlying cause is the single disease that is judged by the certifying physician to have made the greatest contribution to the death. Therefore, a woman who suffered from both cancer and heart disease at the time of her death might have either disease listed as underlying cause of death, depending on the judgment of her physician.

Underlying cause of death was coded using the *International Classification of Disease*, 10th Edition. Heart disease deaths were defined by underlying cause coded to I00-I09, I11, I13, and I20-I51. Cancer deaths included all malignancies (codes C00-C97). These code groupings conform to the categories which have been used by the National Center for Health Statistics to track leading causes of death (CDC, 2015a). Denominator data for mortality rate calculation (population estimates) were available from the Bureau of the Census for the years 2000 through 2013. All data were obtained from the publicly available website CDC WONDER (CDC, 2015a). CDC WONDER permits calculation of user-specified mortality rates for the United States. Further detailed information about the data sources is available on the CDC WONDER website (CDC, 2015b).

Racial/ethnic groups analyzed were as follows, in descending order by number of decedents: 1) non-Hispanic Whites, 2) non-Hispanic Blacks, 3) Hispanics, 4) Asians and Pacific Islanders (non-Hispanic), and 5) American Indians and Alaska Natives (non-Hispanic).

Death counts were available for 5-year age bands ranging from 15 to 19 years at time of death up to 100 or older years at time of death. However, death rates were available for older women only for the age band "85 and older." This is because census population estimates for the very old are considered less reliable than for younger (and more numerous) populations. Hence death rates are reported for the following age groups: (a) all women (age $\geq$15 years at the time of death); (b) young women (15–44 years old); (c) middle-aged women (45–64 years old); (d) older women (65–84 years old); and (e) oldest women (age $\geq$85 years at the time of death). All age-adjusted death rates were calculated by the direct method using the United States 2000 population as the standard. For all rates, 95% confidence limits based on the standard error of the rate were also calculated (CDC, 2015a, b).

Results

In 2013, among all women 15 years of age and older in the United States there were 289,467 heart disease deaths and 276,716 cancer deaths, which were 22.7% and 21.7%, respectively, of the total 1,276,593 deaths that occurred among these women. The majority of heart disease deaths (51.6%) occurred among women ($\geq$85 years old). In contrast, 18.9% of female cancer deaths occurred in those aged 85 years of age and older. The age-adjusted death rates (per 100,000 population) were 171 (95% CI, 170–171) for heart disease versus 177 (95% CI, 176–178) for cancer.

Figure 1 shows detailed age-specific death rates for heart disease and cancer in 2013, from the ages of 15 to 19 years to ages 85 years of age and older. In Figure 1A, the rates are plotted on a logarithmic scale, in order to highlight the relative differences in the rates. Figure 1A reveals that death rates for cancer were significantly higher than death rates for heart disease for all age groups up to and including 75 to 79 years old. For many age bands, the cancer versus heart disease rate ratio was greater than 2.

For women aged 80 to 84 years old, the rates converged. Although these rates appear nearly identical in Figure 1A, in fact a statistically significantly 15% higher rate of death from heart disease emerged in this age group (heart disease, 1,212 deaths per 100,000 population [95% CI, 1,200–1,223] vs. cancer, 1,058 deaths per 100,000 population [95% CI, 1,047–1,069]). In the oldest age band, mortality from heart disease greatly exceeded the death rate from cancer (relative risk, 2.8).

Figure 1B presents the same data as Figure 1A, but plotted on an arithmetic scale. This plot emphasizes the absolute differences in the rates. Figure 1B reveals an exponential increase in heart disease mortality with age, and a non-exponential increase in cancer mortality with age. The rate difference for heart disease versus cancer mortality was very large for women aged 85 years of age and older (rate difference, 2,423 deaths/100,000).

Figure 2 presents the age-specific proportions of all deaths attributable to an underlying cause of heart disease or cancer for women in 2013. This graph reveals the different age structures of heart disease and cancer mortality in women. The percent of all deaths attributable to heart disease increased steadily with age, peaking for women ages 100 years and older (33.8% of all deaths in this age group). In contrast, the percent of all deaths attributable to cancer peaked among women aged 60 to 64 years old, and then declined among older women. Only 3.2% of decedents aged 100 years and older had cancer reported as their underlying cause of death.

Temporal trends in heart disease and cancer death rates for the years 2000 through 2013, by age, are presented in Figure 3. There was a significant relative excess in cancer mortality among young (aged 15–44 years old) and middle-aged (aged 45–64 years old) women, which persisted over the study period. Among older women (aged 65–84 years old), the heart disease death rate was significantly higher than the cancer rate in 2000,

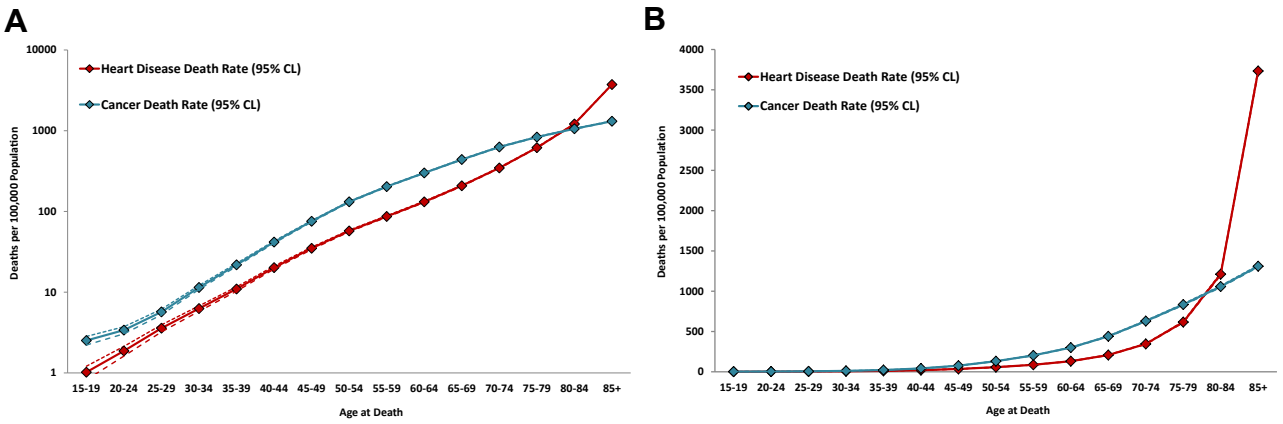

Figure 1. (A) Age-specific death rates for heart disease and cancer women in the United States, 2013 (logarithmic scale emphasizes relative disparities). (B) Age-specific death rates for heart disease and cancer women in the United States, 2013 (numeric scale emphasizes absolute disparities). *Abbreviation*: CL, confidence limit.

but by 2004 a crossover (owing to more steeply declining heart disease mortality) resulted in a significantly higher cancer death rate. This relative excess in cancer mortality has widened over time. Among the oldest women (aged ≥85 years), a large and significant excess in heart disease mortality has narrowed slightly over the years, owing to greater decreases in the heart disease death rates.

In 2013, 80.3% of heart disease deaths and 78.7% of cancer deaths occurred among non-Hispanic White women (Table 1). Non-Hispanic Blacks comprised 11.9% of both heart disease and cancer deaths. Hispanics comprised 6.0% of cancer deaths and 5.1% of heart disease deaths, whereas Asians and Pacific Islanders were 2.7% of cancer decedents and 2.0% of heart disease decedents. Fewer than 1% of deaths occurred among American Indians and Alaska Natives.

Cancer was the overall leading cause of death for Hispanic, Asian and Pacific Islander, and American Indian and Alaska Native women in 2013 (Table 1). There were racial/ethnic differences in the age-adjusted death rates for heart disease versus cancer. Among non-Hispanic Whites and non-Hispanic Blacks, heart disease was the leading cause of death. However, among non-Hispanic Whites the age-adjusted death rate was significantly higher for cancer (183 per 100,000; 95% CI, 182–183) than for heart disease (171 per 100,000; 95% CI, 170–172). Among non-Hispanic Black women, the age-adjusted death rate was significantly higher for heart disease (224; 95% CI, 222–226) than for cancer (207; 95% CI, 205–209).

Premature mortality (before age 65 years old) is of special concern from both a public health (prevention) and medical (treatment) perspective. Figure 4 contrasts premature heart disease and cancer death rates for women in five race and ethnicity groups in 2013. Death rates for cancer were higher in all groups. The greatest relative disparity was among Asians and Pacific Islanders, with a four-fold higher premature cancer death

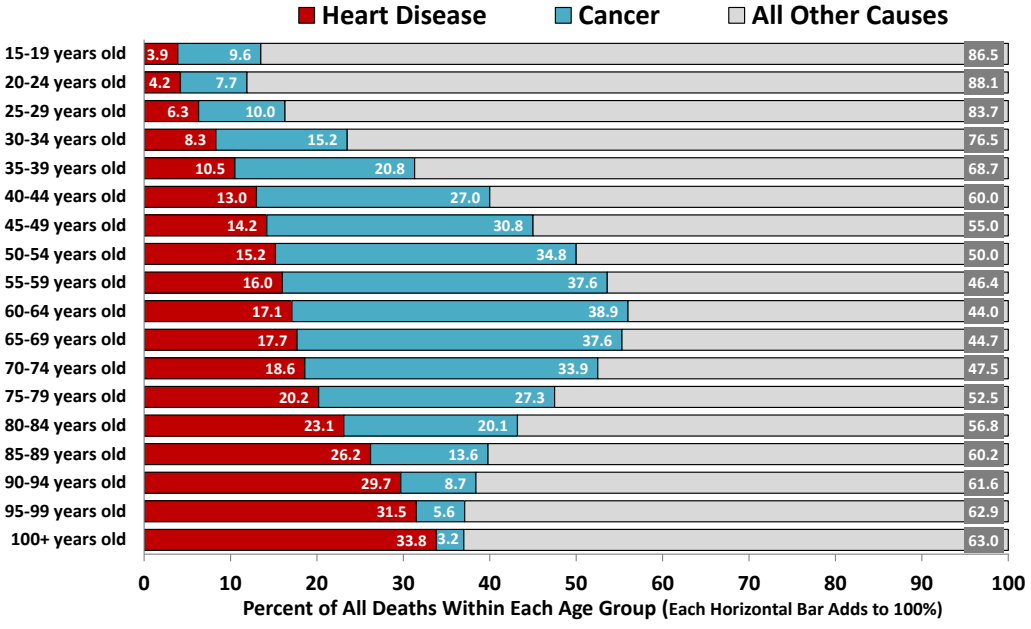

Figure 2. Heart disease and cancer as underlying causes of death for women in the United States 2013.

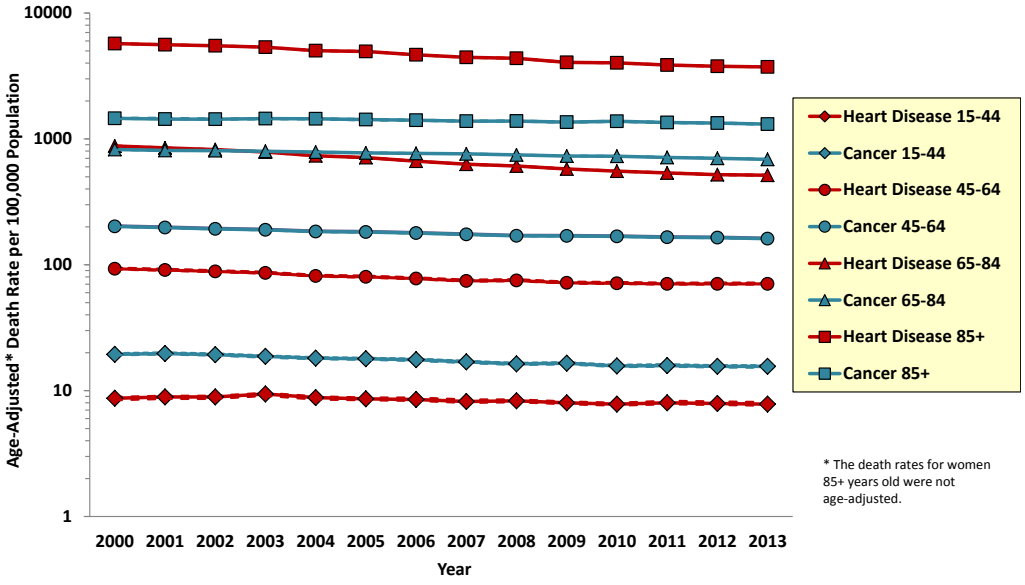

Figure 3. Heart disease and cancer mortality among women in the United States, by age, from 2000 to 2013. Dashed lines represent 95% confidence intervals for the rates.

rate. The greatest absolute disparity was among non-Hispanic White women, with an excess in cancer deaths of 38.9 per 100,000 compared with heart disease. Non-Hispanic Black women experienced the highest rates of premature mortality compared with other racial/ethnic groups. The relative disparity in cancer versus heart disease mortality was narrowest among non-Hispanic Black women, whereas the absolute disparity was narrowest among American Indian and Alaska Native women.

The top 20 specific heart disease codes reported as underlying cause for women aged 85 years and older in 2013 were rank ordered and examined (see Supplementary Data). The three leading codes (atherosclerotic heart disease, acute myocardial infarction unspecified, and congestive heart failure) accounted for 57.8% of the heart disease deaths in this age group. Several of the commonly used codes were vague "unspecified" codes, and together (excluding acute myocardial infarction unspecified) these codes were recorded for 10.6% of the elderly heart disease decedents.

Discussion

In 2013, heart disease was still the leading cause of death for U.S. women aged 15 years and older: 22.7% of deaths were attributed to heart disease versus 21.7% for all cancers combined.

Table 1
Heart Disease and Cancer Mortality in Women Aged 15 Years and Older, by Race and Ethnicity, United States 2013

	Blacks	Hispanics	Asians and Pacific Islanders	American Indians and Alaska Natives	Whites	Total
Number (%) of deaths						
All women (≥15 years)						
Heart disease	34,454 (11.9)	14,814 (5.1)	5,881 (2.0)	1,235 (0.4)	232,393 (80.3)	289,467 (100)
Cancer	32,863 (11.9)	16,623 (6.0)	7,473 (2.7)	1,391 (0.5)	217,875 (78.7)	276,716 (100)
Age-adjusted death rates* (95% CI)						
Young women (15–44 years)						
Heart disease	18 (17–19)	3 (3–4)	2 (2–3)	12 (9–15)	8 (7–8)	8 (8–8)
Cancer	21 (20–22)	13 (12–14)	11 (10–12)	15 (12–19)	16 (15–16)	16 (15–16)
Middle-aged women (45–64 years)						
Heart disease	146 (142–149)	38 (37–40)	24 (22–26)	85 (75–95)	66 (65–67)	71 (70–71)
Cancer	215 (211–218)	107 (104–110)	95 (91–99)	139 (126–151)	165 (164–167)	161 (160–162)
Older women (65–84 years)						
Heart disease	739 (727–751)	401 (391–411)	286 (274–297)	495 (451–538)	509 (506–513)	515 (512–518)
Cancer	770 (758–782)	469 (459–480)	412 (398–426)	614 (568–661)	713 (709–718)	688 (684–691)
Oldest women (≥85 years)						
Heart disease	3,479 (3413–3544)	2,739 (2671–2806)	2,282 (2198–2365)	2,575 (2305–2844)	3,877 (3855–3898)	3,733 (3714–3752)
Cancer	1,327 (1287–1368)	996 (956–1037)	929 (876–983)	1,012 (843–1181)	1,343 (1331–1356)	1,310 (1299–1321)
All Women (≥15 years)						
Heart disease	224 (222–226)	123 (121–125)†	93 (91–96)	151 (142–160)	171 (170–172)	171 (170–171)
Cancer	207 (205–209)	123 (121–125)†	110 (107–112)	154 (146–163)	183 (182–183)	177 (177–178)

* Deaths per 100,000 population.
† This is not a typo. The age-adjusted rates for heart disease and cancer mortality in Hispanic women are identical, despite different death totals.

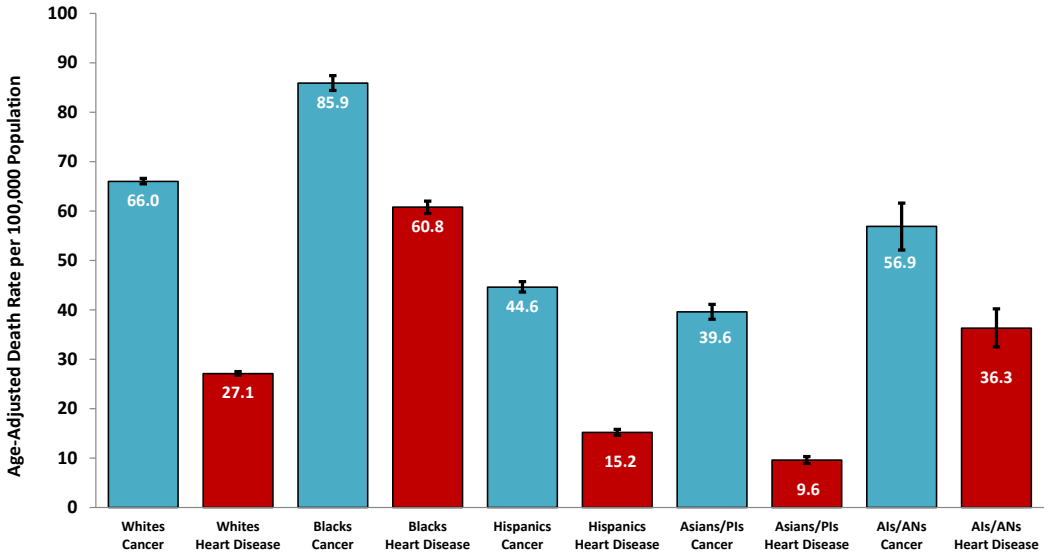

Figure 4. Premature* heart disease and cancer mortality among women by race/ethnicity, United States, 2013. Error bars represent 95% confidence intervals for the rates. *Premature is defined as ages 15–64 years old. *Abbreviations*: AI/AN, American Indians and Alaska natives; PI, Pacific Islander.

However, for women younger than 80 years of age, cancer was the leading cause of death. Middle-aged and young women were at least twice as likely to die from cancer than from heart disease. The results of this study highlight the importance of examination and reporting of mortality surveillance data for multiple age bands in a population. Summary statistics can mask important variations between subgroups.

Temporal trend analysis in this study confirmed that both heart disease and cancer mortality rates have been steadily declining in all age groups of women since 2000. Steeper declines for heart disease mortality among women aged 65 to 84 years old resulted in a crossover in the rates from 2002 to 2004, when the leading cause of death for this age group became cancer.

Significant racial/ethnic variation in the relative importance of heart disease versus cancer mortality for women was identified in this study. Cancer has surpassed heart disease as the leading cause of death for Hispanics, Asians and Pacific Islanders, and American Indians and Alaska Natives. Among non-Hispanic Blacks and Whites, heart disease remains the leading cause of death. Non-Hispanic Black Americans experience the highest rates of both heart disease and cancer mortality compared with other women; at the same time, the disparity between these two leading causes of death is least in Blacks. Future research should further unpack racial/ethnic categories to explore ethnic heterogeneity within the Hispanic (Martinez-Tyson et al., 2009), Asian/Pacific Islander (Hastings et al., 2015), and American Indian/Alaska Native populations.

An important clinical and data quality question is raised by this study, with implications for ranking causes of death. Several previous studies have found that heart disease is overreported as the underlying cause of death on death certificates (Agarwal et al., 2010; Coady et al., 2001; Lakkireddy, Gowda, Murray, Basarakodu, & Vacek, 2004). This overreporting can result from physicians falling back on heart disease, cardiac arrest, or heart failure as "default" causes of death when more specific pathophysiologic information is not available (Coady et al., 2001), which may be more common for very elderly patients. In New York City, before a hospital-based intervention to improve death certificate coding, more than 80% of decedents 85 years of age and older had heart disease listed as the underlying cause of death (Al-Samarrai et al., 2013). Post-intervention, this percentage decreased to 39%. Notably, the proportion of these elderly deaths attributable to cancer did not increase appreciably after the intervention (from 4% to 8%), suggesting that overreporting of heart disease on death certificates is not caused by large-scale underreporting of cancer deaths.

The majority (51.6%) of heart disease deaths among US women in 2013 occurred at ages 85 years of age and older. Examination of the specific ICD-10 codes recorded for these women suggests the possibility of overreporting. Several vague "unspecified" codes, such as "heart disease unspecified" were used, together accounting for more than 15,000 deaths. Given that in 2013, the excess number of heart disease versus cancer deaths nationwide was only 12,751, it is reasonable to hypothesize that cancer is already the leading cause of death for all women, masked by the overreporting of heart disease.

Implications for Policy and/or Practice

For better or worse, many aspects of healthcare occur in "disease silos." This approach is increasingly inadequate for understanding and treating chronic diseases in the 21st century. As treatment innovations reduce case fatality rates and lengthen survival times, patients are living longer with multiple comorbidities. Given the overlap in important risk factors (e.g., cigarette smoking and physical inactivity) that contribute to both heart disease and cancer as well as many other diseases, the increase in comorbidity as an important public health problem is not surprising. Multiple comorbidities complicate the clinical process of accurately determining and certifying underlying causes of death, particularly among the elderly (Tinetti et al., 2012).

A recent perspective piece in the *New England Journal of Medicine* (Rosenbaum, 2014) lamented cardiology patients' lack of knowledge that heart disease is the leading cause of death in women, and the generally higher fear of cancer among women. To quote: "The critical question is why women might feel more

fearful of other diseases, particularly breast cancer, despite ample evidence suggesting that heart disease poses a far greater threat."

It is important to consider these statistics from an individual patient perspective. American women aged 60 to 64 years are more than twice as likely to die from cancer than from heart disease. Furthermore, only one in six deaths among women aged 15 to 64 years are caused by heart disease. In light of these facts, the purported reluctance of middle-aged women to believe exhortations about the "killer" status of heart disease seems less unreasonable. As for cancer, it is well-known among health professionals that lung cancer, not breast cancer, is the leading cause of cancer mortality for U.S. women (Kohler et al., 2015). However, this fact may be less well-understood by patients and the general public.

Health communication to patients and the lay public about mortality risks is complicated by the frequent conflation in the media of high relative risk with high absolute risk. For example, in the population of over 9.4 million women aged 60 to 64 years in 2013, there were 12,430 heart disease deaths, a rate of 131.6 deaths per 100,000 persons. This translates to 1 death for every 760 women over the course of a year. There was 1 cancer death for every 333 women aged 60 to 64 years. The relative risk of cancer was greater compared with heart disease, but the absolute risk of death from either cause was relatively low in this age group.

Conclusions

Heart disease remains the leading cause of death among all women combined in the United States by a narrow margin. However, cancer predominantly kills middle-aged and young women, and heart disease predominantly kills the very old. Furthermore, national summary statistics obscure the fact that cancer is already the overall leading cause of death for Hispanic women, Asian/Pacific Islander women, and American Indian/Alaska Native women. The relative mortality burden of heart disease versus cancer in United States women cannot be properly understood without detailed consideration of age and race and ethnicity. In addition, new and rigorous studies on the over-reporting of heart disease on death certificates for elderly women are needed.

Supplementary Data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.whi.2016.08.002.

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Author Descriptions

At the time of this study, Dr. Elizabeth B. Pathak, PhD, MSPH, FAHA, was an Associate Professor in the Department of Internal Medicine at the University of South Florida. Dr. Pathak's research focuses on health disparities by race, ethnicity, gender, socioeconomic position, and geography.