Heart Failure and Long-Term Survival Among Older Women With Breast Cancer

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OBJECTIVES: To evaluate the association between heart failure and overall survival up to 10 years after breast cancer diagnosis.

SAMPLE & SETTING: Women aged 65 years or older diagnosed with invasive breast cancer, with and without self-reported heart failure, were examined for this retrospective cohort study using Surveillance, Epidemiology, and End Results cancer registries in the United States.

METHODS & VARIABLES: Cox proportional hazards regression was used to examine the association between heart failure status and mortality, adjusting for comorbidity and other clinical or sociodemographic differences. Associations were examined overall and stratified by cancer stage.

RESULTS: In adjusted models, having heart failure was associated with increased likelihood of death up to 10 years after cancer diagnosis. In adjusted subanalyses by cancer stage, heart failure was associated with increased likelihood of death up to 10 years after cancer diagnosis in women with stage I or II cancer but not in women with stage III/IV cancer.

IMPLICATIONS FOR NURSING: Although early-stage breast cancer is generally associated with better prognosis, the competing mortality risk of heart failure was greater for this group than for women with advanced cancer. Prevention and management of cardiovascular disease should be prioritized for this patient subgroup.

KEYWORDS breast cancer; heart failure; comorbidities; survivorship; late effects
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The co-occurrence of cancer and cardiovascular disease is a major public health issue that will become more prevalent as the population of older adults in the United States rapidly increases during the next several decades (Hung, Ross, Boockvar, & Siu, 2011, 2012; Smith, Smith, Hurria, Hortobagyi, & Buchholz, 2009). Women with breast cancer aged 65 years or older experience disproportionately high rates of heart failure. Increasing clinician concerns for patients with diagnoses of cancer and heart disease has catalyzed an emerging cross-disciplinary field of cardio-oncology (Moslehi, 2013, 2016). In a cohort study of more than 40,000 women diagnosed with breast cancer aged 66–70 years, the 10-year prevalence of heart failure ranged from 29% in women who received no chemotherapy to 38% in women treated with anthracyclines (Pinder, Duan, Goodwin, Hortobagyi, & Giordano, 2007). Comparatively, overall prevalence of heart failure in American women aged 60–79 years is 5% (Mozaffarian et al., 2016).

A growing body of evidence describes the complex interaction of factors that influence cardiovascular health in aging cancer survivors, including cancer treatment variables, lifestyle behaviors, and comorbid conditions (Leach, Bellizzi, Hurria, & Reeve, 2016; Leach et al., 2015; Patnaik, Byers, Diguiseppi, Denberg, & Dabelea, 2011). Multiple factors account for the high prevalence of heart failure in breast cancer survivors. Cardiovascular disease and breast cancer share many risk factors, including advanced age, obesity, and smoking (Lindenfeld & Kelly, 2010; Schmitz, Prosnitz, Schwartz, & Carver, 2012). The cardiotoxic effects of breast cancer therapies, including anthracyclines, mediastinal radiation, and biologic agents, such as trastuzumab, have been well documented (Lindenfeld & Kelly, 2010; Schmitz et al., 2012). Anthracycline chemotherapy, particularly doxorubicin, is known to cause cumulative,

dose-dependent cardiomyocyte death (Volkova & Russell, 2011). In addition, many older women diagnosed with breast cancer have preexisting comorbidities, such as coronary artery disease, hypertension, and diabetes. Cardiotoxic breast cancer therapies interact synergistically with these cardiovascular risk factors to increase the risk of heart failure (Lindenfeld & Kelly, 2010; Schmitz et al., 2012).

Older adults with cancer have high rates of multimorbidity and increasing multimorbidity in the years following cancer treatment (Kenzik, Kent, Martin, Bhatia, & Pisu, 2016; Leach et al., 2015). On average, breast cancer survivors report 5.8 chronic conditions, including 2.9 conditions that occurred post–cancer diagnosis (Leach et al., 2015). In aging cancer survivors, comorbid conditions often occur in multimorbidity clusters, distinct clusters of two or more conditions. In particular, the prevalence of co-occurring hypertension and diabetes has been found to increase post–breast cancer diagnosis among older women (Kenzik et al., 2016). Additional comorbidities are most likely to occur after breast cancer diagnosis for women who are obese, physically inactive, or more than 10 years post–cancer diagnosis (Leach et al., 2015). Cancer diagnosis may also contribute to more rapid decline in physical function among older adults, particularly those with multimorbidity (Leach et al., 2016; Meneses, Benz, Azuero, Jablonski-Jaudon, & McNees, 2015). Because of the complexity of this patient population, cancer treatment decision making and prioritization of care is a challenge (Leach et al., 2015; Meneses et al., 2015).

Little is known about the association between heart failure and long-term survival among older women with breast cancer. Women with breast cancer with comorbidities, such as heart failure, are typically excluded from oncology clinical trials (Lewis et al., 2003), and clinical studies with limited follow-up time underestimate the long-term survival impact of heart failure in patients with breast cancer (Pinder et al., 2007). In addition, it is unclear how the relative contribution of heart failure to mortality risk varies by breast cancer stage—an important consideration because the competing mortality risk of heart failure must be weighed against the benefits of cancer treatment for each individual.

Therefore, the authors conducted a retrospective cohort study to examine the association between heart failure and long-term survival among older women with breast cancer. The findings have implications for breast cancer survivorship care, including the need for better integration of healthcare services for cancer survivors at risk for cardiovascular complications, particularly during the transition from oncology to primary care.

Methods

Data Source

The authors undertook a population-based approach, using data from the National Cancer Institute's (NCI's) Surveillance, Epidemiology, and End Results (SEER) cancer registries linked to the annual Medicare Health Outcomes Survey (MHOS) for survey years 1998–2013 (Kent et al., 2016). SEER data contain robust clinical information on cancer diagnosis, disease stage, and mortality. The MHOS is a self-administered mailed survey distributed annually to randomly selected enrollees in Medicare managed care plans (i.e., Medicare Advantage) that collects information on health status and self-reported chronic conditions. The authors used the MHOS data to identify individuals in SEER who had self-reported heart failure (yes or no). Self-reported conditions on the MHOS were shown to have acceptable sensitivity and specificity when validated against patient medical records (Miller et al., 2008).

Population

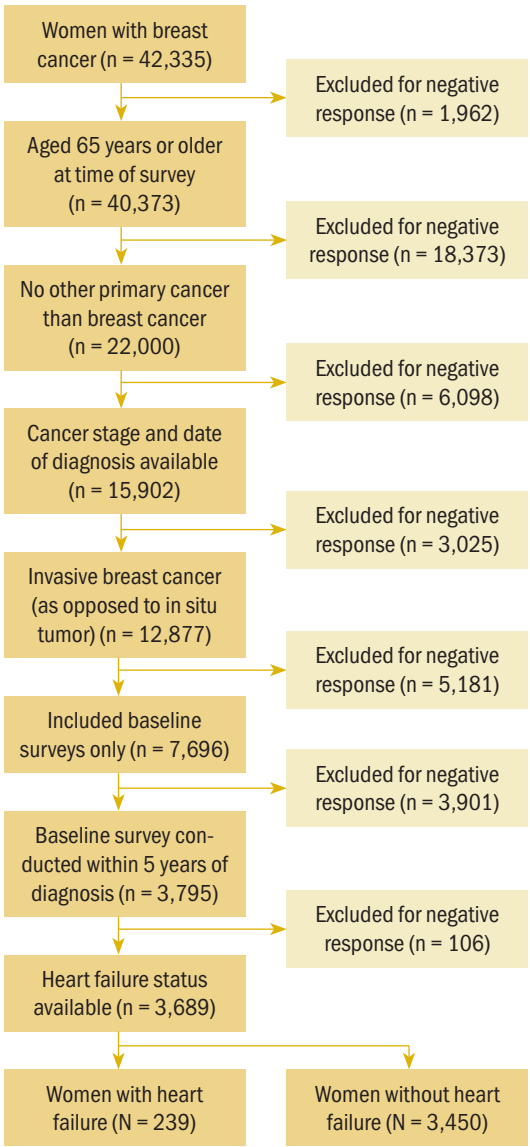
The study population included women aged 65 years or older at the time of survey completion who had a previous diagnosis of invasive breast cancer and completed the MHOS survey within five years of breast cancer diagnosis. Women who had a history of other primary cancers were excluded. Summing across 14 years of SEER-MHOS cohorts, the authors initially identified 42,335 women with breast cancer. Women with in situ tumors (stage 0) and those with missing data for either cancer stage, date of cancer diagnosis, or heart failure status were excluded. The final sample included 3,689 women with invasive breast cancer (239 with self-reported heart failure in the MHOS survey and 3,450 without heart failure) (see Figure 1).

Measures

Heart failure status: The MHOS contains the following question: Has a doctor ever told you that you had congestive heart failure? Respondents check a box to indicate "yes" or "no." Date of heart failure diagnosis is not reported in MHOS data; therefore, the sequence of breast cancer and heart failure was unknown.

Survivorship: SEER-MHOS reports the dates of cancer diagnoses obtained from SEER registries, as well as the month and year of death obtained from the Medicare enrollment database for individuals who have died. Among women who died, survival time was

FIGURE 1. Selection of Sample of Patients With Breast Cancer From SEER-MHOS Database



SEER-MHOS—Surveillance, Epidemiology, and End Results Medicare Health Outcomes Survey

calculated as the number of months from date of cancer diagnosis to date of death reported in the Medicare enrollment database. The date of last follow-up was November 30, 2014; therefore, all women who had not died by that date were censored (i.e., the study follow-up period ended before an event occurred), and survival time was calculated from the date of breast cancer diagnosis.

Covariates: The authors anticipated that women with and without heart failure would differ in regard to breast cancer variables and health status. To be used as potential covariates in the statistical models, information on cancer site, cancer stage, age at diagnosis, and month and year of diagnosis were collected from SEER data and self-reported medical conditions (e.g., hypertension, diabetes) obtained from the MHOS.

Statistical Analysis

Estimated survival was calculated using the Kaplan-Meier Estimator. The authors estimated survival for the entire cohort and by heart failure status (heart failure diagnosis reported as yes or no). Cox proportional hazards regression were then used to examine the association between heart failure status and mortality for up to 10 years after cancer diagnosis overall and by breast cancer stage. Variables in the Cox proportional hazards model included age, race and ethnicity, smoking status, use of a proxy for survey completion, cancer stage, breast tumor estrogen receptor status, diabetes, stroke, and chronic lung disease. Variables were selected based on their association with mortality risk in breast cancer survivors (Cianfrocca & Goldstein, 2004; Klabunde, Legler, Warren, Baldwin, & Schrag, 2007). Because other cardiovascular conditions are likely intermediates in the relationship between heart failure and mortality, the authors did not include such factors as covariates in the statistical models. Analyses were performed in Stata, version 14.0. Two-sided tests with alpha level of 0.05 based on complete case analysis were used for all analyses. Missing values were assumed to be missing completely at random.

Results

Participant Characteristics

Women with heart failure differed from those without heart failure in several ways (see Table 1). For example, women with heart failure were, on average, older (78 years versus 76 years) and more likely to be non-Hispanic Black compared to those without heart failure (15% versus 8%, $p < 0.01$). Women with heart failure were more likely to report comorbidities, including hypertension, diabetes, other cardiovascular conditions, chronic lung disease, and arthritis. The heart failure group also included a greater proportion of patients with advanced stage (III/IV) cancer than women without heart failure (16% versus 10%, $p < 0.01$).

Survival Outcomes by Heart Failure Status

Overall, survival rates were lower among women with heart failure compared to those without heart

TABLE 1. Sample Characteristics by HF Status

Characteristic	With HF (N = 239) n	%	Without HF (N = 3,450) n	%	p
Age at time of survey (years)					**< 0.001**
65–74	91	38	1,790	52	
75–84	104	44	1,350	39	
85 or older	44	18	310	9	
Race or ethnicity					**< 0.01**
Non-Hispanic White	159	67	2,528	73	
Non-Hispanic Black	35	15	260	8	
Hispanic or Latino	20	8	282	8	
Other	25	11	380	11	
Proxy for survey completion					**< 0.001**
Yes	50	21	326	10	
No	174	73	2,917	85	
Unknown	15	6	207	6	
Smoking status					**0.8**
Current smoker	16	7	245	7	
Not current smoker	187	78	2,635	76	
Unknown	36	15	570	17	
Comorbidity					
Hypertension	202	85	2,216	64	< 0.001
Angina or CAD	107	45	237	7	< 0.001
Myocardial infarction	81	34	142	4	< 0.001
Other heart conditions	138	58	626	18	< 0.001
Stroke	55	23	266	8	< 0.001
Emphysema, asthma, or COPD	71	30	451	13	< 0.001
Crohn's disease, ulcerative colitis, or IBD	20	8	152	4	< 0.01
Arthritis of hip or knee	128	54	1,593	46	0.03
Arthritis of hand or wrist	113	47	1,423	41	0.07
Sciatica	82	34	818	24	< 0.001
Diabetes	104	44	734	21	< 0.001
Cancer stage					**< 0.01**
I	119	50	2,074	60	
II	83	35	1,029	30	
III/IV	37	16	347	10	
Estrogen receptor status					**0.3**
Positive	172	72	2,634	76	
Negative	36	15	452	13	
Borderline or unknown	31	13	364	11	

CAD—coronary artery disease; COPD—chronic obstructive pulmonary disease; HF—heart failure; IBD—inflammatory bowel disease
Note. P values compare study participants with and without HF using chi-square tests.
Note. Because of rounding, percentages may not total 100.

failure throughout follow-up (see Table 2 and Figure 2). Five-year survival rates in women with heart failure exceeded 70% for women with stage I or II cancer and were 48% for stage III/IV cancer. At 10 years after breast cancer diagnosis, survival rates in women with heart failure and stage I, II, or III/IV cancer fell to 43%, 40%, and 22%, respectively. The contrast in survivorship between participants with and without heart failure was most pronounced at 10 years postdiagnosis. Among all study participants, after adjustment for covariates, heart failure was independently and significantly associated with increased likelihood of death for up to 10 years after cancer diagnosis (adjusted hazard ratio [HR] = 1.62, 95% confidence interval [CI] [1.32, 2]). Other significant predictors of 10-year mortality, in addition to age and cancer stage, were smoking, diabetes, stroke, and chronic lung disease (range of HR = 1.23–1.87, $p < 0.01$ for all) (see Table 3).

In adjusted subanalyses stratified by cancer stage, heart failure was associated with increased likelihood of death in women with stage I (HR = 1.72, 95% CI [1.24, 2.38]) or II (HR = 2.06, 95% CI [1.46, 2.93]) cancer up to 10 years after cancer diagnosis but not in women with advanced stage III/IV cancer (HR = 1.27, 95% CI [0.82, 1.98]).

Discussion

Heart failure was associated with significantly lower short- and long-term survival rates among older women with early-stage cancer but less so among women with more advanced cancer. This finding may seem counterintuitive because early-stage breast cancer is generally associated with better prognosis. However, for this group, the competing mortality risk of heart failure may be greater than cancer. Clinicians should prioritize prevention and management of cardiovascular disease, particularly among women with early-stage breast cancer. As expected, women with heart failure also had greater comorbidity burden that may contribute to mortality risk. These findings have important implications for the clinical care of patients as they are diagnosed with breast cancer, as well as subsequent survivorship care.

Survival among women without heart failure was comparable to postmenopausal women with invasive breast cancer (Howlader et al., 2016). Compared with existing literature, five-year survival among older women with heart failure was longer in the SEER-MHOS breast cancer population (72% versus 54% in a community-based population) (Roger et al., 2004). The shorter survival from prior data may be related to variation in heart failure type (systolic versus diastolic) and/or

heart failure stage, which were unavailable for the participants in this study.

To minimize the cardiovascular risk of cancer treatment, the European Society of Cardiology recommends thorough assessment and optimization of baseline cardiovascular risk factors in patients with cancer (Zamorano et al., 2016). Clinical guidelines vary in regard to recommended frequency of cardiac surveillance in patients with cancer. The European Society of Cardiology recommends baseline echocardiography before treatment and continued surveillance with echocardiography after every four cycles of trastuzumab or 200 mg/m^2 of doxorubicin, or more frequently for patients with cardiac risk factors or abnormal baseline cardiac function (Zamorano et al., 2016). The American Society of Clinical Oncology also recommends routine surveillance with echocardiography for individuals undergoing treatment with cardiotoxic agents (e.g., anthracyclines, trastuzumab, mediastinal radiation), with the frequency of screening at the discretion of providers based on clinical judgment (Armenian et al., 2017). Prophylactic treatment with ACE (angiotensin-converting enzyme) inhibitors and beta blockers benefits patients with preexisting cardiovascular disease, but the benefit for patients with low baseline risk is unclear (Zamorano et al., 2016). Cardiovascular risk stratification may be useful to identify patients in need of more frequent screening and subsequent intervention (Ezaz, Long, Gross, & Chen, 2014; Francis, Cheng, Arteaga, & Moslehi, 2014). Patients with breast cancer with multimorbidity should continue to see their primary provider for comprehensive assessment of functional status, nutritional status, cognition, medications, and psychosocial concerns (Meneses et al., 2015).

Patients with multiple chronic illnesses face competing mortality threats. Prospective longitudinal studies can examine the trajectory of cardiovascular disease development in aging cancer survivors, particularly women, while determining the effects of preexisting comorbidities and cancer treatment variables. A greater understanding of the disease trajectories that occur after a cancer diagnosis can inform strategies for risk-adapted surveillance to prevent cardiovascular complications, as well as strategies to better manage preexisting cardiovascular disease in older adults with cancer. Leveraging population-level data to examine these outcomes in cancer survivors is a major research priority identified by the NCI (Shelburne et al., 2014). The NCI has proposed development of a national registry of cardiovascular outcomes in patients with cancer to inform cancer treatment, supportive, and survivorship care (Shelburne et al., 2014).

TABLE 2. Five- and Ten-Year Survival Rates Among Patients With Breast Cancer According to HF Status

Variable	With HF (N = 239) %	Without HF (N = 3,450) %	p
Five-year survival			
All stages	71.81	89.82	< 0.001
Stage I	79.46	93.84	< 0.001
Stage II	71.58	89.43	< 0.001
Stage III/IV	48.24	66.87	0.04
Ten-year survival			
All stages	38.53	68.75	< 0.001
Stage I	42.95	76.09	< 0.001
Stage II	39.92	62.91	< 0.001
Stage III/IV	22.01	41	0.01

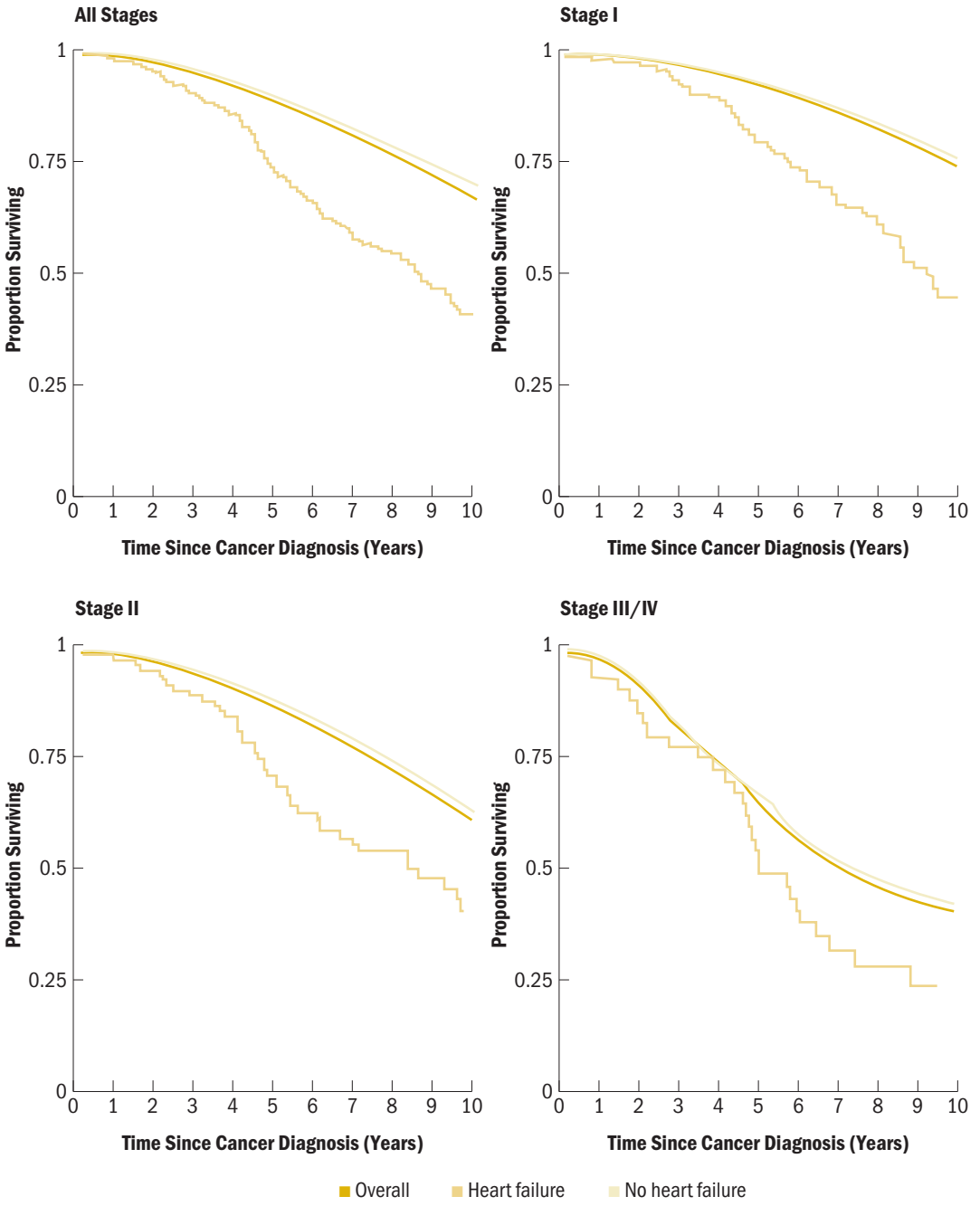
HF—heart failure
Note. P values compare study participants with and without HF using log-rank tests.

Given the competing mortality risk associated with heart failure in older women with early-stage breast cancer, providers need to carefully weigh the risks of cardiotoxic cancer therapies against the potential survival benefits. Aggressive, multimodal treatment of early-stage breast cancer may cause more harm than benefit, particularly for older women with increased cardiovascular risk. Many low-risk tumors detected via mammography are treated with unnecessary mastectomies that can lead to complications from surgery (Alvarado, Ozanne, & Esserman, 2012). Based on molecular profiling, women older than age 50 years are more likely to have biologically low-risk tumors that are responsive to endocrine therapy and may not require systemic chemotherapy (Esserman et al., 2011). In addition to molecular profiling of tumors, clinical decision support tools to predict risk of breast cancer recurrence based on tumor characteristics can prevent overtreatment of early-stage disease (Esserman et al., 2011).

Although guidelines have been released for management of breast cancer in older women (Biganzoli et al., 2012), a need exists for clinician education regarding treatment guidelines for patients with early-stage breast cancer with multimorbidity (Jones, Leak, & Muss, 2012). In some cases, breast cancer may not be the patient's primary illness if she has preexisting comorbidities that decrease her life expectancy and increase the risk of treatment

complications (Jones et al., 2012). Compared to younger individuals, older adults tend to emphasize quality of life over survival gains when making cancer treatment decisions (Wedding, Pientka, & Höffken, 2007). Adverse effects of breast cancer treatment can lead to cardiovascular complications, functional loss, and reduced quality of life (Ganz et al., 2002; Harrison et al., 2017; Schmitz et al., 2012).

FIGURE 2. Survival Curves Overall and by Heart Failure Status Among Older Women With Breast Cancer



For this reason, patient–provider communication is important to help older adults make informed decisions regarding cancer treatment.

Substantial challenges exist to optimal management of patients with breast cancer and heart failure. Primary care providers have limited training in cancer survivorship issues and may be less aware of the long-term cardiac risks of anthracyclines and other cardiotoxic breast cancer treatments (Nekhlyudov, Aziz, Lerro, & Virgo, 2012). As survivors transition from oncology to primary care, communication between oncology providers and primary care providers regarding potential long-term effects of cancer treatment is important to promote early recognition and treatment of cardiovascular complications (Dossett et al., 2017; Nekhlyudov et al., 2012). Survivorship care planning may facilitate communication between primary care and oncology specialties (Dossett et al., 2017). Traditional survivorship care plans may also be expanded to develop risk-adapted pathways for supportive care based on individual needs (Daudt et al., 2014).

Innovative models of care may promote better integration of healthcare services for patients with cancer and survivors with multimorbidity. The patient-centered medical home, a team-based model of primary care delivery, has shown potential for reducing hospital admissions and improving survival among patients with complex chronic conditions, including cancer (Sweeney, Halpert, & Waranoff, 2007). Proposed models of care for cancer survivors include a "shared care" model to promote collaboration between primary care providers and specialists, a nurse-led model of survivorship care, and specialized survivorship clinics to provide integrated health care. It is unclear which of these models is feasible, efficacious, and acceptable to patients and providers (Institute of Medicine, 2006). Large-scale health policy analyses can examine the effectiveness of different health service delivery models for cancer survivorship outcomes.

Limitations

The sample was limited to women aged 65 years or older enrolled in Medicare Advantage plans, which affects the generalizability of the results. Second, heart failure and other comorbid conditions were self-reported on the MHOS, and temporality of heart failure diagnosis in relation to breast cancer diagnosis was unknown. However, heart failure and other self-reported conditions on the MHOS have been shown to have acceptable sensitivity and specificity (Miller et al., 2008). Third, clinical data regarding heart failure type and stage and details of chemotherapy regimens and hormonal therapies were unavailable. The results are biased toward the null because some women without heart failure had other self-reported heart conditions; however, the authors chose not to exclude these individuals to obtain a representative sample of older women with breast cancer. Participants may have had additional unreported comorbidities. Finally, social determinants of health, such as socioeconomic status, access to care, and physical environment, are major drivers of health disparities in cardiovascular disease outcomes, including racial and geographic disparities (Davis, Gebreab, Quarells, & Gibbons, 2014; Havranek et al., 2015). Future prospective studies should evaluate social determinants that may affect cardiovascular outcomes in cancer survivors. Despite these limitations, strengths of this study included a large national dataset with a representative sample of the U.S. population and detailed cancer data.

KNOWLEDGE TRANSLATION

- Competing mortality risk of heart failure was greater for women with early-stage breast cancer than for women with more advanced cancer.
- Communication between oncology providers and primary care providers regarding potential late effects of cancer treatment is important to promote early recognition and treatment of cardiovascular complications.
- Clinicians should educate women treated for breast cancer regarding the need for continued follow-up care to monitor cardiac function, optimization of cardiovascular risk factors, and recognition of symptoms, such as dyspnea and fatigue, that require further assessment.

Implications for Nursing

Multimorbidity in older adults with cancer complicates coordination of cancer treatment and primary care. In addition to thorough evaluation and treatment of existing comorbidities at the time of breast cancer diagnosis, patients with comorbidity may benefit from routine follow-up with a primary care provider for medical management of existing health issues and comprehensive assessment of health and functional status (Meneses et al., 2015). Survivorship care planning can improve care coordination for cancer survivors at risk for cardiovascular complications, particularly during the transition from oncology to primary care. The majority of survivorship care plans are delivered by oncology nurses or nurse practitioners

TABLE 3. HRs for the Association Between Independent Variables and Death Among Women With Invasive Breast Cancer

	Crude		Adjusted	
Independent Variable	**HR**	**95% CI**	**HR**	**95% CI**
Heart failure	2.62	[2.17, 3.17]	1.62	[1.32, 2]
Age at time of survey (years)	1.08	[1.07, 1.09]	1.07	[1.06, 1.09]
Race or ethnicity				
Non-Hispanic White	1	Reference	1	Reference
Non-Hispanic Black	1.22	[0.98, 1.53]	0.93	[0.74, 1.18]
Hispanic or Latino	1.1	[0.87, 1.37]	1.09	[0.87, 1.39]
Other	0.66	[0.52, 0.83]	0.59	[0.46, 0.75]
Smoking status				
Not current smoker	1	Reference	1	Reference
Current smoker	1.56	[1.27, 1.93]	1.87	[1.51, 2.33]
Unknown	1.02	[0.87, 1.2]	1.05	[0.89, 1.24]
Use of proxy for survey completion				
No	1	Reference	1	Reference
Yes	2.89	[2.46, 3.39]	1.82	[1.53, 2.17]
Unknown	1.4	[1.1, 1.77]	1.3	[1.02, 1.67]
Cancer stage				
I	1	Reference	1	Reference
II	1.64	[1.43, 1.89]	1.64	[1.42, 1.89]
III/IV	3.96	[3.36, 4.68]	3.85	[3.24, 4.57]
Estrogen receptor status				
Positive	1	Reference	1	Reference
Negative	1.14	[0.95, 1.36]	0.97	[0.81, 1.17]
Borderline or unknown	1.11	[0.92, 1.33]	1.03	[0.85, 1.25]
Comorbidity				
Diabetes	1.35	[1.17, 1.55]	1.23	[1.06, 1.42]
Stroke	2.12	[1.78, 2.53]	1.53	[1.28,1.84]
Chronic lung disease (asthma, COPD, or emphysema)	1.44	[1.22, 1.7]	1.48	[1.24, 1.75]

CI—confidence interval; COPD—chronic obstructive pulmonary disease; HR—hazard ratio
Note. HRs were adjusted for age, race or ethnicity, smoking status, use of proxy for survey completion, cancer stage, breast tumor estrogen receptor status, heart failure, diabetes, stroke, and lung disease.

during clinic visits (Daudt et al., 2014). Care plans should summarize the patient's cancer treatment history, including potential late effects of cancer treatment, preventive measures to maintain long-term health, and the timing and specific details of recommended follow-up care (Institute of Medicine, 2006). Nurse-led survivorship care–planning initiatives can help to ensure that older adults receive follow-up care consistent with evidence-based guidelines (Lester, Wessels, & Jung, 2014). In particular, guideline-recommended cardiac surveillance to promote early identification and treatment of left ventricular dysfunction is important to prevent development of chronic heart failure (Armenian et al., 2017; Zamorano et al., 2016). The expansion of traditional survivorship care planning to encompass the entire trajectory from cancer diagnosis through survivorship may improve the patient experience while preventing treatment complications (Daudt et al., 2014). Risk-adapted pathways that address individual risk factors and

comorbidities may be useful to guide supportive care from the time of cancer diagnosis through survivorship (Daudt et al., 2014).

To improve outcomes for this vulnerable population, nurses caring for patients with invasive breast cancer should assess for risk factors that predispose women to cardiotoxic heart failure, including advanced age, obesity, comorbidity, and lifestyle factors, such as smoking (Lindenfeld & Kelly, 2010; Schmitz et al., 2012). Clinicians need to educate women treated for breast cancer and their family members about the need for continued follow-up care to evaluate cardiac function, as well as the importance of addressing cardiovascular risk factors, such as tobacco use, hypertension, and hypercholesterolemia (Mozaffarian et al., 2016). Women at higher risk would benefit from educational interventions and continued evaluation for new symptoms. In planning care for these patients, nurses should consider obtaining referrals for cardiology or cardio-oncology clinics for requisite diagnostic testing. In addition, patients should be able to identify signs and symptoms, such as dyspnea and fatigue, that should alert them to contact their provider for further assessment. Symptoms such as fatigue in women with subclinical cardiovascular disease may be mistaken for lingering cancer-related symptoms (Schünemann, Anker, & Rauchhaus, 2008). Should a diagnosis of cardiotoxic heart failure be made, ongoing assessment and monitoring for functional deficits should warrant referrals to physical and occupational therapy. In the literature review, the authors found no evidence-based nursing interventions for women at risk for cardiotoxic heart failure following a diagnosis of invasive breast cancer. The intervention with the highest level of evidence but lowest uptake in this population is moderate exercise to ameliorate lingering fatigue and activity intolerance (Mason et al., 2013; McNeely et al., 2006; Schmitz et al., 2010). Given the rising prevalence and symptom burdens, this patient population has a growing need for intervention development and evaluation.

Conclusion

The authors found that heart failure is associated with significantly worse prognosis for older women with early-stage breast cancer. Prevention and management of cardiovascular comorbidities and other chronic conditions in this population should remain a priority after cancer diagnosis. Prospective research can inform strategies for supportive care coordination and risk-adapted cardiac surveillance in breast cancer survivors, and development of innovative healthcare delivery models can improve patient outcomes among the growing population of older adults with cancer and cardiovascular comorbidity.

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