

Advances in Treatment and Health-Related Quality of Life: A Cohort Study of Older Adult Survivors of Breast Cancer

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OBJECTIVES: To determine whether there are differences in the health-related quality of life (HRQOL) of older adult survivors of breast cancer (BC) diagnosed in different time periods and to gain insight into whether advances in BC treatment have improved HRQOL.

SAMPLE & SETTING: Three cohorts of older adult survivors of BC diagnosed before 1995, from 1996 to 2005, and from 2006 to 2015 were examined using the Surveillance, Epidemiology, and End Results–Medicare Health Outcomes Survey linked databases.

METHODS & VARIABLES: HRQOL was measured using the Veterans RAND 12-Item Health Survey. Mean cohort HRQOL scores were compared using analysis of variance, then multivariate regression models were used to examine the effects of cohort membership and covariates on mental and physical HRQOL.

RESULTS: Adjusted mean HRQOL scores trended significantly lower with each successive cohort. Higher comorbidity count and increased functional limitations were negatively associated with HRQOL, and income, education level, and better general health perceptions were positively associated with HRQOL.

IMPLICATIONS FOR NURSING: Regardless of time since diagnosis, older survivors of BC are at risk for poor HRQOL and should be regularly assessed. Maximizing HRQOL requires consideration of the survivor's resources, comorbidities, and functional limitations when planning care.

KEYWORDS older adults; breast cancer; Medicare Health Outcomes Survey; health-related quality of life
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In 2020, there were 2.3 million women diagnosed with breast cancer (BC) and 685,000 related deaths globally (World Health Organization, 2023). By the end of 2020, there were 7.8 million women alive who had been diagnosed with BC in the past five years, making it the most prevalent cancer in the world (World Health Organization, 2023). In the United States, BC is the second most common cancer diagnosis and the second leading cause of cancer-related mortality in women (American Cancer Society, 2023a). About 90% of survivors of BC will be alive five years after diagnosis (American Cancer Society, 2023b). Advances in treatment have led to improved survival rates for individuals with BC; coupled with the rise in the number of older adults, the number of older adult survivors of BC is predicted to increase significantly in the coming years (Heer et al., 2020). However, the impact of treatment advances on health-related quality of life (HRQOL) in older adult survivors of BC is unclear.

HRQOL is a multidimensional and subjective construct reflecting an individual's overall sense of well-being relative to their health (Bakas et al., 2012). Survivors of BC experience significant impairments to HRQOL (Maly et al., 2015), particularly in the physical domain (Trentham-Dietz et al., 2008); these impairments may persist for at least two to five years postdiagnosis (Maly et al., 2015; Trentham-Dietz et al., 2008). Impairments to HRQOL may be more likely to persist in survivors of later-stage BC (Pat-Horenczyk et al., 2023). In cohorts of older adult survivors of BC, findings related to trajectories of HRQOL over time are mixed. For example, Ganz et al. (2003) found that physical and mental HRQOL declined significantly during the 12-month period following a diagnosis of BC in older adults. In contrast, Jones et al. (2015) found that older adult survivors of BC reported significant declines in physical HRQOL 10 or more years

postdiagnosis but steady improvements in mental HRQOL from the time of diagnosis, although mental HRQOL did not return to precancer levels even 10 years postdiagnosis.

Certain characteristics may place survivors of BC at higher risk for poor HRQOL; negative associations have been found between HRQOL and lower household income (Neuner et al., 2014), higher number of comorbidities (Ganz et al., 2003; Lu et al., 2007; Maly et al., 2015; Neuner et al., 2014; Yeom & Heidrich, 2013), and greater symptom burden (Jones et al., 2015; Reeve et al., 2009; Robb et al., 2007; Stover et al., 2014). Of note, these characteristics are more likely to be present among older adult survivors of BC, placing them at higher risk for experiencing impaired HRQOL. Symptoms may be more significant among older adult survivors because of age-related complications (e.g., functional declines, obesity, falls), the presence of comorbidities, and polypharmacy (Biganzoli et al., 2021; Jones et al., 2020; Kent et al., 2016; Mohamed et al., 2020). In addition, older adult survivors may be at higher risk for experiencing more significant adverse effects related to cancer and its treatments because older adults have reduced functional reserves and are therefore more likely to experience unwanted cancer-related symptoms and toxicities (Bhatt, 2019; Muss et al., 2007; Versteeg et al., 2014).

Age and age at diagnosis of BC have been consistently found to be associated with HRQOL, but the nature of these relationships remains unclear. For example, older age and older age at the time of diagnosis of BC have been associated with significantly better mental (Ganz et al., 1998) and overall HRQOL when compared to younger counterparts (Champion et al., 2014; Ferrell et al., 1998; Jones et al., 2015; Kwan et al., 2010; Maly et al., 2015; Pinheiro et al., 2017; Sammarco, 2009). In contrast, older age and older age at the time of diagnosis have also been associated with significantly worse physical HRQOL (Cimprich et al., 2002; Ganz et al., 1998) and, in one study, overall HRQOL (Lu et al., 2009).

Key advances in personalized medicine suggest that HRQOL for survivors of BC may have changed. Prior to 1995, the understanding of BC biology was limited. Radical surgical procedures were standard, and clinical trials for neoadjuvant chemotherapies had just begun (Ades et al., 2017; Keelan et al., 2021). The 1980s brought important advances in supportive care, such as effective antiemetics and analgesics that improved control of adverse effects and sought to improve HRQOL (Hortobagyi, 2020). The 1990s saw the origins of the clinical applications of gene

expression profiling, along with the rapid clinical development of new cytotoxic drugs and bisphosphonates used in symptom management of metastatic BC (Ades et al., 2017; Hortobagyi, 2020). The 2000s brought a shift to less radical surgeries combined with radiation therapy. In addition, the Human Genome Project was completed, which marked the beginning of personalized oncology treatment. In 2005, pharmacologic research began to shift to the development of immunotherapies and targeted therapies. However, these treatments produced different side effects and symptom profiles (Hortobagyi, 2020) that posed new challenges in nursing care.

Although modern clinical therapies aim to enhance the effectiveness of cancer treatment, it is unclear whether these advances have improved or reduced HRQOL in older adult survivors. In addition, older adults are often underrepresented in cancer clinical trials; therefore, little is known about how advances in cancer treatment may interact with comorbidities common to this population (Bluthmann et al., 2016; DeSantis et al., 2019; Versteeg et al., 2014).

Purpose

Older adults may differ from other groups of survivors of BC, and the existing literature is inconclusive about the demographic and clinical factors that may affect HRQOL. In addition, it is unclear how the HRQOL or correlates of HRQOL of this group persist or change over time in relation to recent treatment advances. As such, the purposes of this cohort study were to address these gaps in the literature by determining whether advances in cancer care in the past several decades have resulted in changes in HRQOL or the demographic and clinical factors associated with HRQOL among a national sample of older adult BC survivors. The study aimed to (a) compare HRQOL among three cohorts of older adult survivors of BC diagnosed a decade apart and (b) explore relationships between HRQOL and demographic and clinical variables among these three cohorts of survivors.

Methods

Design, Data Collection, Sample, and Instruments

A retrospective cohort design was used to compare the HRQOL of older adult survivors of BC diagnosed during different time periods. Approval from the Villanova University Institutional Review Board was obtained prior to study onset.

This study used the Surveillance, Epidemiology, and End Results (SEER)–Medicare Health Outcomes Survey (MHOS) linked dataset available from the

National Cancer Institute. Every year since 1998, a random sample of participants with Medicare Advantage plans has been selected to receive the MHOS and has been surveyed again two years later. The MHOS consists of questions about demographics, health diagnoses, functional status, symptoms, health perceptions, and the Veterans RAND 12-Item Health Survey (VR-12) to measure HRQOL. The linked SEER database contains information on cancer type, stage, time since diagnosis, and certain treatments (Kent et al., 2016).

MHOS respondents through 2015, the most recent year of SEER-MHOS data available to investigators, were sampled. Participants in the sample met the following inclusion criteria: (a) being aged at least 50 years and (b) having been diagnosed with BC prior to at least one MHOS survey. Participants were excluded if they had been diagnosed with another form of cancer (e.g., lung, ovarian) prior to or simultaneously with their diagnosis of BC to maintain the focus on BC survivorship. Although the MHOS began collecting data in 1998, information on cancer diagnosis and treatment was available for earlier time periods through the SEER database, so those who were diagnosed with BC before 1998 were able to be included in this sample.

HRQOL, the outcome measure in this study, was examined using the VR-12. The VR-12 is a 12-item scale with a physical component summary (PCS) and mental component summary (MCS). In addition to measuring physical and mental HRQOL, the VR-12 provides subscale scores for general health, physical functioning, physical role limitations, emotional role limitations, pain, social functioning, and vitality. The VR-12 was initially developed for use in the veteran population and adapted from the SF-36® and SF-12® (Selim et al., 2009). The MCS and PCS scores indicate the individual's mental and physical HRQOL, respectively, with higher scores reflecting better HRQOL. The MCS and PCS raw scores undergo t-score transformation and are normed to the U.S. population to calculate the final MCS and PCS scores. Cronbach's alpha for the VR-12 in this sample was 0.9 for the total scale, 0.85 for the PCS, and 0.84 for the MCS.

Theoretical Framework and Study Variables

The revision by Ferrans et al. (2005) of Wilson and Cleary's Model of HRQOL was used to guide the development of and variable selection for this study. This model posits that characteristics of both the individual and the environment influence biologic function, symptoms, functional status, and general

health perceptions, which culminate to influence overall HRQOL. Individual and environmental characteristics examined in this study were the demographic factors of age at diagnosis, gender, race, income, education level, and marital status. Aspects of biologic function explored in this study were the following cancer-specific data obtained from the SEER database: cancer stage, BC recurrence, cancer diagnosis at another site after BC diagnosis, previous surgical cancer intervention, and previous radiation therapy. Other biologic function variables used in this study were the presence of comorbid conditions; on the MHOS, survivors were asked to identify whether they had been diagnosed with or treated for specific common comorbid conditions (diabetes mellitus, hypertension, cardiovascular disease, stroke, chronic obstructive pulmonary disease, and inflammatory bowel disease). This study also measured symptoms, functional status, and general health perceptions via participant self-report on the MHOS to assess HRQOL. For symptoms, pain and fatigue (vitality) were examined for each cohort as part of physical HRQOL. For function, self-reported functional limitations were examined. General health perceptions were examined using a question on general health perceptions from the MHOS. MCS and PCS scores from the VR-12 were used to measure mental and physical HRQOL, respectively.

Data Analysis

StataMP, version 12.0, was used for all statistical analysis. Descriptive statistics were computed, including frequencies and percentages for binary or categorical variables and means and SDs for continuous variables. Mean scores for mental and physical HRQOL, along with mean scores for general health, physical functioning, physical role limitations, emotional role limitations, pain, social functioning, and vitality, were computed for each cohort. Listwise deletion was used to address missing data because only a small percentage (less than 10%) of data on key outcomes of interest was missing (Allison, 1999). A one-way analysis of variance was conducted to compare the unadjusted mean scores. Finally, multivariate regression models for mental and physical HRQOL were used to explore the effects of cohort membership (i.e., when a participant was diagnosed), demographic characteristics (age, education level, income, marital status, and race), biologic function (cancer stage, surgery, radiation therapy, recurrence, and comorbidity count), functional status, and general health perception on HRQOL.

TABLE 1. Sample and Cohort Characteristics

Characteristic	Total Sample (N = 34,706)		Cohort 1 (N = 12,067)		Cohort 2 (N = 16,501)		Cohort 3 (N = 6,138)		p
	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	
Age (years)	76.17	7.73	77.33	7.58	75.81	7.69	74.85	7.85	< 0.0001
Age at diagnosis (years)	65.61	9.99	59.85	9.71	67.69	8.7	71.36	8.06	< 0.0001
Comorbidity count	1.45	1.13	1.4	1.11	1.45	1.12	1.56	1.16	< 0.0001
Characteristic	n	%	n	%	n	%	n	%	p
Diagnosed as older adult (aged 65 years or older)									< 0.0001
Yes	19,926	57	4,010	33	10,761	65	5,155	84	
No	14,780	43	8,057	64	5,740	35	983	16	
Gender									0.108
Female	33,973	99	11,803	99	16,257	99	5,994	99	
Male	198	1	73	1	81	1	44	1	
Race and ethnicity									< 0.0001
American Indian or Alaska Native	161	-	59	-	75	-	27	-	
Asian or Pacific Islander	2,747	8	920	8	1,269	8	558	9	
Black	2,744	8	666	6	1,334	8	744	12	
Hispanic	2,593	7	812	7	1,225	7	556	9	
White	25,889	75	9,443	78	12,315	75	4,131	67	
Other or multiracial	572	2	167	1	283	2	122	2	
Income (\$)									< 0.0001
Less than 30,000	17,340	56	5,953	55	8,207	55	3,180	57	
30,000-49,999	5,667	14	1,943	18	2,746	19	978	17	
50,000 or more	3,958	13	1,277	12	1,934	13	747	13	
Unknown	4,243	13	1,566	15	1,959	13	718	13	
Education level									0.001
No high school diploma	7,328	22	2,528	21	3,496	22	1,304	22	
High school diploma or GED	12,288	36	4,393	37	5,832	36	2,063	35	
Some college	8,869	26	3,010	26	4,294	27	1,565	26	
4-year degree or higher	5,383	16	2,483	16	2,483	15	1,045	17	
Marital status									0.156
Not married	19,695	58	6,877	58	9,281	58	3,537	59	
Married	14,188	42	4,912	42	6,820	42	2,456	41	
Cancer stage									< 0.0001
In situ	5,311	17	1,290	13	2,963	19	1,058	17	
Localized	18,216	57	5,242	51	9,390	61	3,584	58	
Regional	5,964	19	1,849	18	2,835	18	1,280	21	
Distant	337	1	37	-	2,136	1	164	3	
Unstaged	2,105	7	1,906	18	147	1	52	1	
Breast cancer recurrence									< 0.0001
No	30,718	89	10,226	85	14,738	89	5,754	94	
At least once	3,988	11	1,841	15	1,763	11	384	6	

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TABLE 1. Sample and Cohort Characteristics (Continued)

Characteristic	Total Sample (N = 34,706)		Cohort 1 (N = 12,067)		Cohort 2 (N = 16,501)		Cohort 3 (N = 6,138)		p
	n	%	n	%	n	%	n	%	
Cancer diagnosis at another site									<0.0001
No	30,708	88	10,492	87	14,470	88	5,746	94	
At least once	3,998	12	1,575	13	2,031	12	392	6	
Received cancer-directed surgery									<0.0001
Yes	33,258	96	11,237	93	16,150	98	5,871	97	
No	1,448	4	830	7	351	2	267	3	
Received cancer-directed radiation therapy									<0.0001
No	19,562	58	8,264	72	8,315	52	2,983	49	
Yes	14,462	42	3,335	28	7,995	48	3,132	51	
Comorbidities^a									
Cardiovascular disease	10,106	29	3,599	30	4,754	29	1,753	29	0.1
Chronic obstructive pulmonary disease	5,219	15	1,673	14	2,538	16	1,008	17	<0.0001
Diabetes mellitus	8,024	24	2,532	21	3,775	23	1,717	28	<0.0001
Hypertension	22,389	65	7,454	63	10,680	66	4,255	70	<0.0001
Inflammatory bowel disease	1,902	6	656	6	913	6	333	6	0.896
Stroke	2,840	8	1,014	9	1,330	8	496	8	0.533
Functional status									0.171
No limitations in moderate activity performance	12,177	36	4,259	36	5,811	36	2,107	35	
A little limited in moderate activity performance	12,691	37	4,334	36	6,060	37	2,297	38	
Very limited in moderate activity performance	9,266	27	3,293	28	4,346	27	1,627	27	
General health perception									<0.0001
Poor or fair	11,257	33	3,742	31	5,357	33	2,158	36	
Good	14,029	41	5,039	42	6,659	41	2,331	39	
Very good or excellent	8,847	26	3,115	26	4,201	26	1,531	25	

^aParticipants could choose more than 1 response.

Note. P values were calculated using analyses of variance for continuous variables and chi-squares for categorical variables.

Note. Because of rounding, percentages may not total 100.

Note. Not all participants answered all survey questions, so n values for each characteristic may not add up to the total N.

Results

Sample Characteristics

The total sample for this analysis consisted of 34,706 participants, of which 12,067 (35%) received their initial BC diagnosis before 1995 (cohort 1), 16,501 (48%) were diagnosed between 1995 and 2004 (cohort 2), and 6,138 (18%) were diagnosed between

2005 and 2013 (cohort 3). The average age of participants was 76.17 years, and the average age at diagnosis was 65.61 years, and participants had survived for an average of nine years after. More than half of the participants were White (75%), female (99%), had an annual income of less than \$30,000 (56%), had either not finished high school (22%) or

had a high school diploma (36%), or were not married (58%) (see Table 1).

There were demographic differences between the cohorts. In particular, the average age at diagnosis was younger for cohorts 1 (59.85 years) and 2 (67.69 years) than for cohort 3 (71.36 years). This indicates that the members of cohort 1 were more removed from their initial cancer diagnosis at the time of the survey than members of cohorts 2 and 3 ($p < 0.0001$). Correspondingly, the likelihood of being diagnosed as an older adult (age 65 years or older) was much higher for cohorts 2 and 3 than for cohort 1 ($p < 0.0001$). Other trends in the demographic data reflect larger trends in the U.S. population, with increases in racial diversity ($p < 0.0001$) and education level ($p = 0.001$) seen in cohorts 2 and 3 versus cohort 1.

In terms of clinical factors, those in earlier cohorts were more likely to experience BC recurrence or a diagnosis of cancer at another site ($p < 0.0001$). The burden of comorbidity was greater in cohorts 2 and 3, with higher rates of hypertension, diabetes mellitus, and chronic obstructive pulmonary disease compared to cohort 1 ($p < 0.0001$). Overall, general health perception was poorer in cohorts 2 and 3, with

participants in these cohorts more likely to rate their health as poor or fair compared to participants in cohort 1 ($p < 0.0001$).

Comparison of HRQOL Between Cohorts

There were significant differences by cohort in mental and physical HRQOL and all VR-12 subscales ($p < 0.001$) except physical functioning ($p = 0.2012$). HRQOL trended lower with each cohort, which means that the mental and physical HRQOL of cohort 3 were slightly worse than those of cohort 2, which were slightly worse than those of cohort 1 (see Table 2). The regression analysis confirmed that this relationship held true for mental and physical HRQOL even when adjusting for demographic and clinical covariates.

Relationships Between HRQOL and Demographic and Clinical Variables

Tables 3 and 4 detail findings from the multivariate regression analyses for physical HRQOL (PCS scores) and mental HRQOL (MCS scores), respectively. Belonging to cohorts 2 or 3, greater education level, higher comorbidity count, White race, and increased

TABLE 2. Comparison of Mean HRQOL Scores by Cohort

Component Summary	Cohort 1 (N = 12,067)		Cohort 2 (N = 16,501)		Cohort 3 (N = 6,138)		p
	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	
Mental component summary	51.68	11.23	51.16	11.53	50.47	12.02	<0.0001
Physical component summary	38.01	12.3	37.65	12.22	36.94	12.21	<0.0001
Subscale	\bar{X}	SD	\bar{X}	SD	\bar{X}	SD	p
General health	43.79	11.51	43.23	11.67	42.04	12.25	<0.0001
Pain	42.7	11.45	42.15	11.51	41.31	11.71	<0.0001
Physical functioning	37.1	13.7	37.1	13.59	36.75	13.82	0.2012
Role limitations—emotional	46.75	12.45	46.57	12.52	41.31	11.71	0.0005
Role limitations—physical	40.52	12.83	40.16	12.74	39.6	12.51	<0.0001
Social functioning	46.01	12.98	45.39	13.21	44.39	13.49	<0.0001
Vitality	46.06	11.57	45.73	11.58	45.24	11.92	0.0001

HRQOL—health-related quality of life

Note. P values were calculated using one-way analysis of variance.

Note. HRQOL was assessed using the Veterans RAND 12-Item Health Survey, which contains mental and physical component summaries that indicate the individual's mental and physical HRQOL, respectively, with higher scores reflecting better HRQOL. Subscale scores measuring specific aspects of HRQOL are also measured. Raw scores undergo t-score transformation and are normed to the U.S. population to calculate the final mental and physical component summary scores.

functional limitations were negatively associated with physical HRQOL, and higher annual income, having undergone cancer-directed surgery, and better general health perception were positively associated with physical HRQOL ($R^2 = 0.7311$). Belonging to cohorts 2 or 3, not being married or partnered, greater comorbidity count, and increased functional limitations were negatively associated with mental HRQOL, and older age at diagnosis (65 years or older), higher annual income, greater education level, experiencing a second cancer diagnosis, absence of current cancer treatment, and better general health perception were positively associated with mental HRQOL ($R^2 = 0.187$).

Discussion

Exploring differences in HRQOL, demographics, and clinical variables among these three cohorts of older adult survivors of BC a decade apart provides a unique view of HRQOL experienced in different time periods. Overall, physical and mental HRQOL differed significantly among the three cohorts of older adult survivors of BC. Of note, being in cohorts 2 or 3 (those more recently diagnosed and treated) was associated with significantly poorer physical and mental HRQOL. Differences in HRQOL scores were more pronounced in the physical domain compared to the mental domain. Demographic characteristics, comorbidities, and functional limitations significantly affected physical and mental HRQOL.

Contrary to expectations, survivors of BC who were diagnosed and treated more recently had lower HRQOL than those diagnosed and treated in earlier decades. This may be related to several factors, such as differences in treatment modalities, age at diagnosis, time since diagnosis, or changes in overall patient profile. Although the effects of treatments like breast surgery (mastectomy or lumpectomy), traditional chemotherapies, and radiation therapy on symptoms and HRQOL have been relatively well studied, the emergence of newer modalities of cancer treatment (e.g., immunotherapy, targeted therapies) that produce different toxicities, adverse effects, and symptom profiles may have longer-term impacts on HRQOL that are currently not well understood. The earlier cohorts were diagnosed at younger ages, on average, and may have experienced greater rebounds in their HRQOL in the longer time since their initial diagnosis. Although this study adjusted for age at diagnosis in the multivariate regression model, there may be an interaction between age at diagnosis and the trajectory of HRQOL following diagnosis and treatment that requires additional exploration.

This study also suggests that broader trends, such as growing obesity and associated comorbidities (e.g., diabetes) among older adults, may affect HRQOL as well. Nurses working with older adult survivors of BC

TABLE 3. Multivariate Regression Models for Physical Health-Related Quality of Life

Variable	Initial Model ^a		Final Model ^b	
	β	p	β	p
Breast cancer recurrence	-0.0028	0.411	-	-
Cancer diagnosis at another site	0.0023	0.493	-	-
Cancer stage	0.0009	0.796	-	-
Cohort 2	-0.0076	0.073	-0.0098	0.004
Cohort 3	-0.0179	<0.0001	-0.0219	<0.0001
Comorbidity count	-0.697	<0.0001	-0.073	<0.0001
Current cancer treatment	-0.0046	0.194	-	-
Diagnosed as older adult (aged 65 years or older)	-0.0094	0.011	-	-
Education level	-0.0149	<0.0001	-0.0164	<0.0001
Functional status	-0.613	<0.0001	-0.6112	<0.0001
Gender	-0.0019	0.011	-	-
General health perception	0.3227	<0.0001	0.3237	<0.0001
Income	0.0155	<0.0001	0.0152	<0.0001
Marital status	0.0011	0.75	-	-
Race (White)	0.04	<0.0001	0.04	<0.0001
Received cancer-directed radiation therapy	-0.0032	0.348	-	-
Received cancer-directed surgery	0.0021	0.541	0.0089	0.004

^a $R^2 = 0.7334$

^b $R^2 = 0.7311$

Note. P values were from the multivariate regression model.

Note. Physical health-related quality of life was assessed using the physical component summary of the Veterans RAND 12-Item Health Survey.

are treating sicker and more complex patients today than in previous years (Vissers et al., 2013). The difference in physical HRQOL scores across the three cohorts was clinically relevant, suggesting that even

nine years after a BC diagnosis, clinicians must assess for substantial impairments to HRQOL in the physical domain. This finding is consistent with Jones et al. (2015), who also found that older adult survivors of BC reported significant declines in physical HRQOL 10 or more years postdiagnosis.

Physical HRQOL scores were lower than mental HRQOL scores, consistent with previous research, suggesting that older adult survivors maintain mental resilience when facing physical declines. However, those with fewer external and internal resources, such as survivors with a lower income and education level or those with greater functional limitations, are at higher risk for experiencing poor HRQOL in both dimensions. This is consistent with the findings of Neuner et al. (2014), as well as Lu et al. (2007), who also reported a positive association between household income and physical and mental HRQOL. Nurses should assess for financial stress among older adult survivors of BC and consider how it might affect the plan of care. Education level is likely to influence income and may also be associated with health literacy, which should be taken into consideration when planning nursing care.

A higher number of comorbidities was associated with reduced physical and mental HRQOL in this study, which supports the existing literature (Durá-Ferrandis et al., 2017; Ganz et al., 2003; Lu et al., 2007; Maly et al., 2015; Neuner et al., 2014). Older adult survivors of BC are likely to present with multiple comorbidities; these comorbidities and associated treatments can negatively affect HRQOL and interact with cancer-related treatment and symptoms. Similarly, functional impairment, which is more common among older adults, was linked to worse physical and mental HRQOL. Holistic assessments and individualized treatment plans are necessary for these older adult survivors. A geriatrician or geriatric nurse practitioner can be an invaluable resource in planning care.

Older adult survivors from cohorts 1 and 2 were more likely to experience BC recurrence or receive a diagnosis of another type of cancer. It is unclear why experiencing a diagnosis of another type of cancer was associated with higher mental HRQOL. This may be related to post-traumatic growth or to receiving treatment for the secondary cancer diagnosis that improves overall symptom burden. Health anxiety is very common among cancer survivors, with many reporting significant anxiety associated with check-ups (Lovelace et al., 2019). It is possible that when “the worst” has happened, anxiety levels decrease.

TABLE 4. Multivariate Regression Models for Mental Health–Related Quality of Life

Variable	Initial Model ^a		Final Model ^b	
	β	p	β	p
Breast cancer recurrence	0.0088	0.137	-	-
Cancer diagnosis at another site	0.0305	< 0.0001	0.0308	< 0.0001
Cancer stage	-0.0089	0.151	-	-
Cohort 2	-0.0399	< 0.0001	-0.0341	< 0.0001
Cohort 3	-0.0497	< 0.0001	-0.0459	< 0.0001
Comorbidity count	-0.0479	< 0.0001	-0.0449	< 0.0001
Current cancer treatment	0.0471	< 0.0001	0.0458	< 0.0001
Diagnosed as older adult (aged 65 years or older)	0.0851	< 0.0001	0.0805	< 0.0001
Education level	0.0593	< 0.0001	0.0612	< 0.0001
Functional status	-0.0546	< 0.0001	-0.056	< 0.0001
Gender	-0.0053	0.364	-	-
General health perception	0.3407	< 0.0001	0.3445	< 0.0001
Income	0.0227	< 0.0001	0.023	< 0.0001
Marital status	-0.034	< 0.0001	-0.0319	< 0.0001
Race (White)	-0.0118	0.048	-	-
Received cancer-directed radiation therapy	0.0105	0.075	-	-
Received cancer-directed surgery	-0.0145	0.014	-	-

^aR² = 0.1889

^bR² = 0.187

Note. P values were from the multivariate regression model.

Note. Mental health–related quality of life was assessed using the mental component summary of the Veterans RAND 12-Item Health Survey.

Additional research is needed to explore the experiences and HRQOL of survivors who are experiencing a secondary cancer diagnosis.

Limitations

One of the primary strengths of this study is that it capitalizes on the availability of a nationally representative database. As with any secondary data analysis, the study plan was limited to the data collected. A limitation of the SEER-MHOS dataset is that it contains data only from Medicare Advantage plan participants and excludes Medicare fee-for-service participants. Medicare Advantage plan participants have been shown to be healthier on average than Medicare fee-for-service participants and to report higher HRQOL on average (Riley, 2000). In addition, the SEER-MHOS dataset does not include complete treatment variables. For example, chemotherapy data are not included, so this study was unable to account for chemotherapy as a treatment variable in analyses. In addition, certain relevant symptoms, such as pain and vitality, were measured using the VR-12 and as such were highly correlated with HRQOL scores, which prevented the inclusion of these symptoms in the regression analyses.

Implications for Nursing Practice and Nursing Research

HRQOL is a key person-centered clinical outcome that may not be regularly or thoroughly assessed in clinical practice. Nurses should assess HRQOL regularly across the survivorship trajectory. Findings from this study underscore the importance of nursing assessments of HRQOL in the physical domain nearly 10 years postdiagnosis of BC. Nurses should also assess demographic and clinical factors in survivors who are at risk for poor HRQOL outcomes and should use valid and reliable instruments to do so. In this study, the VR-12 questionnaire was used to assess mental and physical HRQOL; this tool is available in electronic and paper forms and has been translated into multiple languages to increase accessibility. Nurses can use the VR-12 to facilitate assessments of HRQOL in the clinical setting, which can enable them to focus on areas of concern, such as functional limitations, pain, fatigue, or depression.

When assessing HRQOL and creating a plan of care, the nurse should also consider assessing factors that are related to mental and physical HRQOL. For example, this study found that education level was associated with HRQOL among older adult survivors of BC. Although education level may be relatively

KNOWLEDGE TRANSLATION

- Older adult survivors of breast cancer (BC) who were diagnosed and treated more recently experience poorer health-related quality of life than cohorts treated in previous decades.
 - Nursing professionals should evaluate the resources, comorbidities, and functional limitations among older adult survivors of BC and address these in care planning to ensure the best possible health-related quality-of-life outcomes.
 - More recently diagnosed older adult survivors of BC experience greater symptom burden (e.g., pain, fatigue), greater comorbidity burden, and more functional impairments, which should be considered in survivorship care planning.
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static in the older adult population, the nurse should consider assessing for health literacy and adjusting teaching materials to ensure patient understanding. Similarly, the nurse should assess the effects of comorbidities, which are highly prevalent in the older adult population. Comorbidities may be triggered by cancer treatment (e.g., cardiovascular or lung disease following intensive radiation therapy or chemotherapy regimens) but may also be preexisting or associated with common risk factors (e.g., smoking). Comorbid conditions are likely to worsen symptoms related to cancer or its treatments (e.g., fatigue, pain) and may complicate symptom management, which warrants additional research.

It is essential for nursing professionals to evaluate comorbidities, functional limitations, and resources among older adult survivors of BC in care planning to ensure the best possible HRQOL outcomes. Future research is needed to determine the effects of current oncology treatment regimens on HRQOL. Prospective exploration of the trajectory of HRQOL and its correlates over time is necessary to provide a more detailed view of changes in these relationships to fully understand this phenomenon. This knowledge would inform the development and testing of evidence-based management protocols to address less-studied adverse effects and symptoms associated with existing and newer cancer treatments (e.g., immunotherapies, targeted therapies).

Conclusion

Despite advances in oncology treatment regimens in the past few decades, significant improvements were not observed in the HRQOL of more recently diagnosed cohorts of older adult survivors of BC in this study after adjusting for demographic and

clinical variables. In fact, mental and physical HRQOL trended significantly lower in each successive cohort in this study, suggesting that more recently diagnosed survivors of BC experience worse HRQOL. Cohort membership (e.g., when a participant was diagnosed), education level, comorbidity count, functional limitations, and general health perception were significantly associated with mental and physical HRQOL. Findings from this study suggest that HRQOL must be regularly assessed in older adult survivors of BC. To maximize HRQOL, nurses should perform holistic assessments that include survivor income and financial security, education, comorbidities, functional limitations, and previous and current cancer treatments, and they should tailor survivorship care plans to each survivor's specific needs.

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