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Dyadic quality of life among heterosexual and sexual minority breast cancer survivors and their caregivers

Ulrike Boehmer¹, Jeffrey E. Stokes², Angela R. Bazzi¹, Melissa A. Clark³

¹Department of Community Health Sciences, Boston University School of Public Health, 801 Massachusetts Avenue, Crosstown Center, Boston, MA 02118, USA

²Department of Gerontology, University of Massachusetts, Boston, MA, USA

³Department of Health Services, Policy and Practice, Brown University, Providence, RI, USA

Abstract

Purpose—The number of informal caregivers to cancer survivors is increasing, and limited information is available about caregivers to sexual minority breast cancer survivors. The purpose of this study was to assess dyadic quality of life among sexual minority cancer survivors and their caregivers compared with heterosexual cancer survivors and their caregivers.

Methods—We recruited 167 survivors of non-metastatic breast cancer of different sexual orientations and their caregivers, who were surveyed via telephone after obtaining consent. We used inverse propensity score weighting to account for differences by sexual orientation in age and length of the survivor-caregiver relationship, and simultaneous equation models consistent with the needs for analyzing dyadic data.

Results—About 6–7 years after diagnosis, survivors and caregivers reported quality of life scores consistent with population norms, and there were no differences by survivors' sexual orientation. With few exceptions, caregivers' and survivors' quality of life influenced one another directly, and these effects were stronger among sexual minority dyads than heterosexual dyads.

Conclusions—Because of the strength of sexual minority, survivors' and their caregivers' mutual influence on each other's quality of life, interventions, and clinical care for sexual minority breast cancer survivors should consider their caregivers.

Keywords

Breast cancer; Quality of life; Caregiving; Dyads; Sexual minorities

More than 3.5 million US women have a history of breast cancer [1]. Sexual minority women, defined as lesbian and bisexual women, are likely overrepresented among breast cancer survivors [2, 3]. The overrepresentation of breast cancer among sexual minority

Ulrike Boehmer, boehmer@bu.edu.

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women has been attributed to their greater levels of risk factors including being overweight or obese and drinking more alcohol than heterosexual women [4, 5].

The improvement of cancer survivors' mental and physical quality of life is among the Healthy People 2020 goals for population health and an important outcome for cancer survivorship [6, 7]. Breast cancer survivors' mental and physical quality of life have received much research attention, with studies assessing breast cancer survivors' quality of life along the cancer trajectory from diagnosis to long-term survivorship [8–10]. Yet few studies have examined the quality of life of sexual minority women with breast cancer, finding quality of life of sexual minority women to be similar to those of heterosexual women with breast cancer [11–13].

In addition to the survivors themselves, survivors' informal caregivers are also affected by cancer [14, 15]. Increasingly, research has expanded to measure both survivors' and caregivers' adjustments to cancer [16, 17]. This research is generally limited to heterosexual caregivers who are likely spouses or family members of heterosexual women with breast cancer [18, 19]. Rather than targeting cancer survivors alone, interventions have targeted couples' (survivor-caregiver dyads) adjustment after cancer [20–24]. These interventions have been mostly psychosocial and produced small effects [25] similar to the effects of individual interventions for survivors or caregivers alone [21]. Moreover, survivors and caregivers taking part in existing interventions have had limited diversity, and no known tested interventions have focused on sexual minority women and their caregivers [25].

The limited studies on caregivers to sexual minority women with breast cancer have shown that caregivers of sexual minority women are primarily female spouses/partners or friends, while family members are infrequently caregivers to sexual minority women [26, 27]. Of the few studies examining sexual minority breast cancer survivors and their caregivers, one concluded that caregivers of sexual minority survivors reported less support compared with survivors, while survivors' and caregivers' distress levels were similar [26]. However, disclosure of sexual orientation may play an important role in dyads' psychological adjustment, with more survivor disclosure of sexual orientation being related to lower caregiver distress [26].

Previous research indicates the need to (a) examine survivor-caregiver dyads [28, 29], and (b) further explore the role of sexual orientation in shaping dyad experiences. A previous study examining fear of recurrence among survivor-caregiver dyads of diverse sexual orientations found that caregivers' fear of recurrence influenced survivors' fear of recurrence, while the inverse was not true [30]. Another study found that caregivers' perceived stress influenced survivors' stress, but this effect was contingent upon survivors' sexual minority status [31]. Knowing whether survivors and caregivers mutually influence each other can suggest the need for dyadic interventions, or whether and how caregivers should be considered in cancer care to improve survivors' well-being. If differences by sexual orientation in the associations of survivors' and caregivers' well-beings are observed, interventions may need to differ by sexual orientation.

To our knowledge, the quality of life of caregivers to sexual minority women has never been examined. In the current study of heterosexual and sexual minority dyads, we address three questions: (a) Are there differences in survivors' and caregivers' quality of life by sexual orientation? (b) Do survivors' and caregivers' reports of quality of life mutually influence one another? and (c) Do the effects of survivors' and caregivers' quality of life on one another differ by sexual orientation?

Methods

All aspects of this study were approved by the Institutional Review Board of Boston University.

Recruitment

Recruitment focused on sexual minority and heterosexual women with breast cancer first. To obtain a sample of women with breast cancer, we initially recontacted participants from an earlier study [11] who had agreed to participate in future studies. Additionally, we invited sexual minority and heterosexual women who were ineligible for a study of advanced breast cancer for which we recruited concurrently. Eligibility criteria for women with breast cancer were a diagnosis of non-metastatic (stage in situ to III) and non-recurrent breast cancer after age 21. Eligible women were invited to participate in an unpaid telephone survey of 40–45 min. At the end of the survey, we asked each participant about her primary support person or caregiver, specifying that we wanted to speak to the partners or spouses of partnered survivors. Each caregiver was then invited to participate in a similarly unpaid 40–45-min telephone survey. Caregivers were asked the caregiver version of fear of recurrence questions and otherwise the same questions were asked of the breast cancer survivors.

From May to July 2012, we recruited 297 breast cancer survivors of whom 203 (68.4%) provided contact information for their partner or other caregiver, 82 (27.6%) refused to provide contact information, and 12 (4%) indicated that they did not have a caregiver. When we contacted the 203 caregivers for whom we had contact information, 167 (82.3%) participated in the survey, 25 (12.3%) exceeded the number of contact attempts to complete the survey, 7 (3.4%) responded yet were unable to participate before the end of the study period, and 4 (2%) refused participation. For this study, we relied on the 167 dyads where both the breast cancer survivor and the caregiver provided data.

Measures

The SF-12, an abbreviated version of the widely used Medical Outcomes Study Short-Form Health Survey (SF-36), was used to measure quality of life.[32] The SF-12 reproduces the two component summaries, the Physical Component Summary, describing physical quality of life; and the Mental Component Summary, mental quality of life. Physical and mental quality of life are computed using the scores derived from twelve questions that range from 0–100, with zero indicating the lowest level of health and 100 indicating the highest level of health. Both physical and mental quality of life measures were mean-centered for analysis.

The main independent measure, which is sexual orientation, distinguished heterosexual survivors and caregivers from sexual minority survivors and caregivers. Sexual minorities were comprised of lesbian, gay, or bisexual individuals, as well as individuals reporting a preference for same-sex partners.

Demographic data included age, race, education, employment, and income for survivor and caregiver participants. Among survivors, we also assessed marital status, having a partner, living alone, and health insurance. From survivors' addresses, we derived two measures of neighborhood socio-economic status. Using Census 2000 data, we obtained: (a) the percentage of the population in a census block living below the Federal poverty level, and (b) the census block's median household income. In the context of the demographic data, we determined discrimination experiences for both the survivor and caregiver by asking if they ever felt discriminated against because of their age, race/ethnicity, gender, sexual orientation, appearance, income level, or having had cancer (survivors only) [33].

Medical information included survivors' cancer-related experiences such as time since diagnosis (calculated from the diagnosis to the survey date), stage, and cancer treatments, from which we derived measures of surgery, radiation, chemotherapy, and receipt of antiestrogen (tamoxifen or aromatase inhibitor) therapy. For both survivor and caregiver participants, we determined comorbidities using a measure developed by Ganz [34].

Consistent with prior studies, we considered psychosocial factors that may be related to the quality of life [10]. We measured survivors' and caregivers' fear of recurrence [35] using both the survivor and caregiver versions of the scale to assess the amount of worry and concern survivors and their caregivers had about the cancer recurring. Perceived stress was measured by a 10-item scale [36] measuring the degree to which a person perceives their life to be unpredictable, uncontrollable, and overloading. As a measure of social support, we used a six-item short form of the Interpersonal Support Evaluation List [37, 38]. For more details on the sources of social support, we used the 12-item Multidimensional Perceived Social Support Scale, which assesses support from family, friends, and a significant other [39]. We assessed the use of cancer-related support groups whether mental health counseling was used prior to breast cancer, and whether mental health counseling was sought to deal with breast cancer.

As dyadic characteristics, we assessed survivor and caregiver's co-residence, the type of survivor-caregiver relationship, and relationship duration, from which we determined the proportion of life they were in this relationship. Finally, we assessed dyadic cohesion using the dyadic assessment scale [40].

Statistical analysis

Survivors' and caregivers' characteristics were compared using *t* tests and chi square tests to examine differences by survivors' sexual orientation. We used propensity scores to account for potential selection biases and confounding that may influence the outcomes, defined as survivors' and their caregivers' mental and physical quality of life. Propensity scores weighted all estimators by their inverse probability and were generated using a multivariable

logistic regression model for the dichotomous outcome (sexual minority vs heterosexual women). Of the significant factors related to sexual orientation in our sample, we used caregiver age and proportion of life in relationship with the survivor to generate inverse probability weights, since both are unmodifiable risk factors and highly unbalanced in our sample.

Due to the relatively small sample size, control variables were selected empirically in the interest of parsimony. Stepwise regression was used to analyze each outcome separately, with all measures reported in Table 1 considered as potential covariates with an inclusion criteria of $p < 0.10$. However, age and relationship time of dyads were excluded, since these variables were used for the inverse probability weights, while caregivers' sexual orientation and gender were excluded due to their almost complete overlap with survivors' sexual orientation. Categorical variables with group sizes of $n < 10$ were recoded to prevent zero-cell problems. We retained all significant covariates detected in these stepwise models in a preliminary simultaneous equation model, which estimated all four outcomes simultaneously and added our predictors of interest (survivors' sexual orientation, dyadic partner's mental/physical quality of life), after which covariates reduced to non-significance were removed. Because the same covariates did not all serve as significant predictors of both survivors' and caregivers' mental and physical quality of life, there were sufficient degrees of freedom to examine "mutual influence," [41] that is, the potentially causal associations between survivors' and caregivers' mental and physical quality of life.

Analyses consisted of simultaneous equation modeling using three-stage least squares estimation to correct for non-independence of dyadic data (i.e., information gathered from survivors and their caregivers) and account for covariation of multiple outcomes [41, 42]. Further, three-stage least squares estimation allows for an outcome of one equation (e.g., survivors' mental quality of life) to be used as a predictor in another equation (e.g., caregivers' mental quality of life), so that mutual influence among dyads could be examined [42].

The majority of cases (74.9%) had complete data for all measures included in the final analysis. The item with the greatest missingness was survivor discrimination, for which 32 (19.2%) of 167 dyads were missing valid data. No clear patterns of missingness were detected, therefore we addressed missing data using multiple imputation by chained equations, with a total of 10 imputed data sets produced [43]. Statistical analysis was performed using the Stata Version 15/SE.

Results

Sexual minority and heterosexual survivors were demographically similar, with most survivors being white, highly educated, having relatively high income (> 40% had an income of \$70,000), and residing in low poverty-level neighborhoods (only 25% lived in neighborhoods with low median household income of \$43,846). Compared with the heterosexual survivors, sexual minority survivors were younger, more likely to have never been married, and reported more experiences of discrimination. The majority of survivors reported early stage breast cancer, most were treated with breast conserving surgery,

radiation, and antiestrogen therapy, and both groups shared similar levels of other comorbidities. However, the average number of years, since diagnosis, was seven for sexual minority women compared with six for heterosexual women. There were no sexual orientation differences in survivors' fear of recurrence or stress. Sexual minority women reported receiving more support from friends than did heterosexual women, despite similarity in both groups' overall social support scores. Sexual minority women also reported greater use of cancer support groups and greater use of counseling prior to their breast cancer, while both groups of survivors reported similar use of counseling to cope with breast cancer.

More caregivers to heterosexual women were male and all self-reported as heterosexual, while most caregivers to sexual minority women were female and self-reported as sexual minority. Caregivers to sexual minority women were significantly younger, more likely to be employed, and reported more discrimination experiences compared with caregivers to heterosexual women. With respect to comorbidities, both groups of caregivers reported less than three medical comorbidities on average. Caregivers' fear of recurrence, stress, and social support were similar overall, yet sexual minority women's caregivers reported more support from significant others and friends than heterosexual women's caregivers. Caregivers to sexual minority women were more likely to report having used counseling prior to the survivor's cancer, while the use of support groups and counseling to deal with the survivor's cancer was similar by caregiver group.

Relationship type and length differed by sexual orientation. While both groups of caregivers were most likely to report being a spouse or partner; caregivers to heterosexual women were more likely to be family members, while caregivers to sexual minority women were more likely to be friends. The duration of relationship between caregivers and survivors was longer on average among heterosexual survivors than sexual minority survivors. Dyads of sexual minority survivors and their caregivers were similar to heterosexual survivor-caregiver dyads in cohesion. All groups reported mental and physical quality of life scores just above 50, indicating no difference by sexual orientation.

We used a three step approach to examine survivors' and caregivers' mental and physical quality of life. A first simultaneous equation model included all significant covariates along with survivors' sexual orientation to examine differences in mental and physical quality of life according to sexual orientation. No significant sexual orientation differences in survivors' or caregivers' mental or physical quality of life were found (results not shown). A second simultaneous equation model added dyadic partners' mental/physical quality of life to each of the four equations, in order to examine dyadic partner effects or "mutual influence". No significant dyadic partner effects were detected (results not shown).

In Table 2, we present the third and final simultaneous equation model, which added interaction terms between survivor's sexual orientation and dyadic partner's mental/physical quality of life to each equation. For survivors' mental quality of life, the coefficient for survivors' sexual orientation was not significant, indicating that heterosexual and sexual minority survivors' mental quality of life was similar. However, significant negative associations were found with survivors' own perceived stress, their fear of recurrence, and

receipt of counseling prior to their cancer diagnosis. On the other hand, survivors' use of cancer support groups and caregivers' perceived social support were positively associated with survivors' mental quality of life. Further, dyadic partner's mental quality of life was positive and trend-level significant, while the interaction term was not significant, suggesting a possible link for both heterosexual and sexual minority dyads between caregivers' and survivors' mental quality of life.

For caregivers' mental quality of life, negative associations were found with both caregivers' perceived stress and receipt of counseling before breast cancer. Among survivor covariates, fear of recurrence, individual income, neighborhood median income, and poverty level were significantly associated with caregivers' mental quality of life. Survivors' sexual orientation was not a significant predictor of caregivers' mental quality of life, indicating that heterosexual and sexual minority survivors' caregivers have similar levels of mental quality of life. The main effect of dyadic partner's mental quality of life was positive and significant, indicating a significant influence of survivor's mental quality of life on caregiver's mental quality of life among sexual minority dyads. The interaction term was negative and significant indicating that this dyadic effect was significantly weaker (even null) among heterosexual dyads.

For survivors' physical quality of life, the coefficient for survivors' sexual orientation was not significant indicating similar levels of physical quality of life for heterosexual and sexual minority survivors. There were significant associations with survivors' comorbidities, experiences of discrimination, and race indicating that sicker survivors, those with more discrimination experiences, and non-white survivors had worse physical quality of life. Survivors' use of counseling prior to diagnosis and dealing with their diagnosis were both associated with survivors' physical quality of life, indicating that the use of prior counseling related to significantly better physical quality of life, whereas counseling in the context of the breast cancer diagnosis was trend-level associated with worse physical quality of life. The main effect of dyadic partner's physical quality of life was positive and significant, indicating a significant influence of caregiver's physical quality of life on survivor's physical quality of life among sexual minority dyads; the interaction term was negative and trend-level significant, suggesting a weaker association of caregiver's physical quality of life and survivor's physical quality of life among heterosexual dyads.

For caregivers' physical quality of life, survivors' sexual orientation was not significant, again indicating no difference between caregivers of heterosexual and sexual minority women concerning their physical quality of life. There were significant associations with caregivers' own perceived stress, comorbidities, social support, and employment status, as well as with survivors' social support and neighborhood median household income. The main effect of survivors' physical quality of life was positive and significant, indicating a partner effect among sexual minority dyads; the interaction term was negative but not significant, suggesting a somewhat weaker but similar association among heterosexual dyads.

Discussion

To contribute knowledge about sexual minority survivors' and their caregivers' health care needs, we studied individual and dyadic quality of life by survivors' sexual orientation. At first, when only focusing on individual effects, neither mental nor physical quality of life differed by survivors' sexual orientation, consistent with prior research with diverse breast cancer survivors identifying no differences in quality of life by sexual orientation [11–13, 44]. This study contributed additional findings that caregivers' mental and physical quality of life do not differ by survivors' sexual orientation.

This study's major contribution was examining survivor-caregiver dyads' quality of life among dyads of different sexual orientations. We found evidence that mutual influence between survivors and caregivers was stronger among sexual minority than heterosexual dyads. A prior study of sexual minority and heterosexual survivor-caregiver dyads noted similar sexual orientation differences in the dyadic effects, in that caregivers' stress was influential for sexual minority survivors' stress, but not for heterosexual survivors' stress [31]. Collectively, these findings suggest a heightened influence of survivor-caregiver dyadic effects when the survivor is a sexual minority woman. This indicates that improving sexual minority survivors' health after breast cancer may depend more strongly on the integration of sexual minority women's caregivers into programs or interventions than what has typically been done for heterosexual breast cancer survivors.

While the majority of caregivers in this study were partners or spouses to the breast cancer survivors, more than 15% had a relationship other than partner or spouse. It is of note that breast cancer studies that only consider partner/spouse caregivers provide additional support for our finding that caregivers play a larger role for sexual minority women's health outcomes after breast cancer than for heterosexual women. For example, in a qualitative study of sexual minority breast cancer survivors reported that their most valuable support was provided by their female partners [45]. Similarly, previous breast cancer research has found that having a partner was more strongly associated with physical quality of life for sexual minority women compared with heterosexual women, and living with a partner was more strongly associated with anxiety for sexual minority women compared with heterosexual women [12]. Also, comparative assessments of same-sex versus opposite-sex couples who struggle with some type of physical illness concluded that same-sex spouses share similar constructions of illness and show less illness-related disagreement and stress compared with different-sex couples [46]. It is perhaps same-sex partners' similarities in managing illness that leads to stronger dyadic effects among sexual minority than heterosexual dyads.

The predictors of survivor-caregiver dyads' quality of life were mostly consistent with the literature, examining survivors' and caregivers' quality of life [11–13, 28]. However, we have likely encountered multicollinearity for some of the known predictors of quality of life, in that their directions were contrary to expectations. For instance, survivors' fear of recurrence was associated with *better* mental quality of life for caregivers despite being associated with *worse* mental quality of life for survivors themselves, with survivors' mental quality of life being included as the predictor of interest in this equation.

There were several limitations to this study. The cross-sectional design did not allow for the identification of causal inferences nor how dyad members' quality of life changes over time. While we consider the inclusion of non-partner caregivers a strength of this study, the limited number of non-partner caregivers prevented us from any further exploration of differences between non-partner and partner caregiver dyads. Similarly, we had confounding between sexual orientation and gender, in that the majority of heterosexual survivors were supported by men (essentially their partners or spouses) and similarly, sexual minority survivors were almost exclusively supported by female caregivers, most of whom were their partners or spouses. Finally, the survivors in this study were on average 6 years post-diagnosis, and their physical and mental quality of life was consistent with population norms [32]. While this meets expectations for breast cancer survivors with non-metastatic and non-recurrent breast cancer, we cannot assume survivor-caregiver dyads at other points of the cancer trajectory would show the same dynamics identified in this sample.

Aside from these limitations, strengths of this study included the focus on dyads of diverse sexual orientation, which helps expand a literature that has predominantly focused on spouses and family caregivers to heterosexual breast cancer survivors. Moreover, by applying dyadic methods to quality of life, we identified differences in the dynamics of sexual minority versus heterosexual survivor-caregiver dyads. In this context, it is of note that we initially noticed differences by sexual orientation as we recruited caregivers of sexual minority and heterosexual breast cancer survivors into this study. Caregivers to sexual minority women more frequently agreed to participate in the survey compared with caregivers to heterosexual survivors [27], which signaled a higher engagement of caregivers to sexual minority women. The finding of mutual influence among sexual minority women-caregiver dyads' quality of life builds on prior studies on fear of recurrence and stress, which also pointed to differences in dyadic effects by sexual orientation [30, 31]. While these findings cannot speak affirmatively to the type of interventions that will be most suitable to improve the quality of life of sexual minority breast cancer survivors, we suggest that the accumulation of "mutual influence" findings for sexual minority women and their caregivers call for psychosocial interventions that consider sexual minority women's caregivers. Moreover, the findings are immediately applicable to clinical practice by highlighting the importance of including sexual minority women's caregivers into breast cancer care. Finally, future studies are needed to examine sexual minority women's caregivers' influence on sexual minority women's quality of care.

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Characteristics of the sample

Table 1

	Survivors		Caregivers to		p value
	Heterosexual	Sexual minority	Heterosexual	Sexual minority	
Demographic characteristics					
Gender (<i>n</i> , %)					
Female	43; 100	124; 100	7; 16.3	116; 93.5	<0.01
Male	0	0	36; 83.7	8; 6.5	<0.01
Sexual Orientation (<i>n</i> , %)					
Heterosexual	43; 100	0	43; 100	18; 14.5	<0.01
Sexual Minority	0	124; 100	0	106; 85.5	<0.01
Age at survey, mean (SD)	60.8 (8.4)	56.3 (8.6)	62.4 (8.0)	55.8 (9.3)	<0.01
Race <i>n</i> , %					0.10
White	38; 88.4	114; 91.9	42; 97.7	111; 89.5	
Other	5; 11.6	10; 8.1	1; 2.3	13; 10.5	
Having a partner/spouse (<i>n</i> , %)					0.78
No	7; 16.3	18; 14.5			
Yes	36; 83.7	106; 85.5			
Lives alone (<i>n</i> , %)					0.43
No	37; 86.0	100; 80.6			
Yes	6; 14.0	24; 19.4			
Education (<i>n</i> , %)					0.52
High school/less/technical training	3; 7.0	3; 2.4	3; 7.0	3; 2.4	0.15
Some college	4; 9.3	9; 7.3	6; 14.0	76; 61.3	
Graduated college	16; 37.2	49; 39.5	15; 34.9	31; 25.0	
Completed grad school	20; 46.5	63; 50.8	19; 44.2	76; 61.3	
Currently employed (<i>n</i> , %)					0.13
Yes	24; 55.8	85; 68.5	20; 47.6	90; 73.2	<0.01
No	19; 44.2	39; 31.5	22; 52.4	33; 26.8	
Health insurance (<i>n</i> , %)					1.00
Yes	43; 100	122; 98.4			

	Survivors		Caregivers to		p value
	Heterosexual	Sexual minority	Heterosexual	Sexual minority	
No	0	2; 1.6			
Individual income (n, %)					0.88
Less than \$30 K	8; 20.0	27; 22.3	5; 12.5	27; 22.1	0.41
\$30 K - < \$70 K	14; 35.0	45; 37.2	18; 45.0	47; 38.5	
\$70 K or more	18; 45.0	49; 40.5	17; 42.5	48; 39.3	
Census poverty level (n, %)					0.78
< 5%	19; 44.2	58; 46.8	--	--	
5% - < 10%	12; 27.9	36; 29.0			
10% - < 20%	10; 23.3	21; 16.9			
20% +	2; 4.7	9; 7.3			
Census median household income (n, %)					0.23
Low \$43,846 or less	20; 46.5	31; 25.0	--	--	
Mid \$43,847 - \$74,313	12; 27.9	74; 59.7			
High > \$74,313	11; 25.6	19; 15.3			
Discrimination, mean (SD)	0.8 (1.1)	1.5 (1.6)	0.5 (0.8)	1.5 (1.5)	< 0.01
Clinical Characteristics					
Years since diagnosis, mean (SD)	5.8 (3.9)	7.3 (3.6)	NA	NA	0.03
Cancer stage at diagnosis (n, %)					0.93
In situ (ductal carcinoma)	8; 19.0	26; 21.0	NA	NA	
Stage I	18; 42.9	46; 37.1			
Stage II	12; 28.6	40; 32.3			
Stage III	4; 9.5	12; 9.7			
Surgical treatment (n, %)					0.14
Lumpectomy	41; 95.3	105; 84.7	NA	NA	
Mastectomy only	0	10; 8.1			
Mastectomy and reconstruction	2; 4.7	9; 7.3	NA	NA	0.23
Radiation (n, %)					
No	11; 25.6	44; 35.5			
Yes	32; 74.4	80; 64.5			
Antiestrogen treatment (n, %)					0.89
			NA	NA	

	Survivors		Caregivers to		p value
	Heterosexual	Sexual minority	Heterosexual	Sexual minority	
No	12; 27.9	36; 29.0			
Yes	31; 72.1	88; 71.0			
Comorbidities, mean (SD)	2.5 (1.6)	2.5 (1.7)	2.5 (1.7)	2.2 (1.5)	0.27
Number of comorbidities (<i>n</i> ; %)					0.34
0	3; 7.1	13; 10.7	5; 11.6	15; 12.4	
1	11; 26.2	18; 14.8	8; 18.6	31; 25.6	
2	8; 19.0	33; 27.0	7; 16.3	29; 24.0	
3+	20; 47.6	58; 47.5	23; 53.5	46; 38.0	
Psychosocial characteristics					
Perceived stress, mean (SD)	12.37 (7.54)	13.27 (6.95)	12.14 (6.17)	11.74 (6.39)	0.72
Fear of recurrence, mean (SD)	73.9 (15.4)	70.9 (16.4)	75.2 (13.6)	71.8 (16.5)	0.23
Interpersonal support Evaluation List mean (SD)	22.3 (2.0)	22.5 (2.3)	21.7 (2.6)	22.5 (1.9)	0.07
Multidimensional perceived					
Social support scale, mean (SD)	6.0 (0.5)	6.0 (0.8)	5.8 (0.8)	6.0 (0.6)	0.25
Ever cancer support group (<i>n</i> ; %)					0.27
No	30; 69.8	60; 48.4	39; 90.7	104; 83.9	
Yes	13; 30.2	64; 51.6	4; 9.3	20; 16.1	
Counseling to deal with breast cancer (<i>n</i> ; %)					0.05
No	32; 74.4	73; 58.9	41; 95.3	103; 83.7	
Yes	11; 25.6	51; 41.1	2; 4.7	20; 16.3	
Counseling before breast cancer (<i>n</i> ; %)					<0.01
No	24; 55.8	34; 27.4	30; 69.8	45; 36.6	
Yes	19; 44.2	90; 72.6	13; 30.2	78; 63.4	
Dyadic					
Relationship to survivor (<i>n</i> ; %)					
Spouse/partner			36; 83.7	106; 85.5	0.02
Child			3; 7.0	0	
Sibling			2; 4.7	3; 2.4	
Parent			1; 2.3	3; 2.4	
Friend			1; 2.3	12; 9.7	

	Survivors		Caregivers to		p value
	Heterosexual	Sexual minority	Heterosexual	Sexual minority	
Spouse/partner caregiver (<i>n</i> , %)			36; 83.7	106; 85.5	0.78
Survivor-caregiver co-residence (<i>n</i> , %)			36; 83.7	97; 78.2	0.44
Years in relationship with survivor, mean (SD)			31.6 (13.1)	18.6 (12.0)	< 0.01
Proportion of life with survivor mean (SD)			0.5 (0.2)	0.3 (0.2)	< 0.01
Dyadic cohesion mean (SD)	17.5 (2.6)	18.1 (3.0)	17.5 (2.9)	18.2 (2.5)	0.10
Outcome variables					
Mental quality of life, mean (SD)	51.6 (9.9)	50.8 (8.3)	54.4 (6.2)	53.6 (6.8)	0.50
Physical quality of life, mean (SD)	51.1 (8.6)	50.8 (9.9)	50.3 (8.5)	52.1 (8.7)	0.24

SD standard deviation

Table 2
 Simultaneous equation models concerning survivors' and caregivers' quality of life ($N = 167$ dyads)

Predictors of interest	Survivors' mental quality of life	Caregivers' mental quality of life	Survivors' physical quality of life	Caregivers' physical quality of life
	B (SE)	B (SE)	B (SE)	B (SE)
Survivor's sexual orientation ^a	0.43 (1.06)	-0.49 (0.77)	1.49 (1.34)	-1.77 (1.07)
Dyadic partner's mental quality of life	0.25 (0.14)	0.36*** (0.09)	-	-
Dyadic partner's physical quality of life	-	-	0.50* (0.19)	0.27* (0.12)
Interaction terms				
Dyadic partner's mental quality of life × survivor's sexual orientation ^a	-0.01 (0.18)	-0.24** (0.09)	-	-
Dyadic partner's physical quality of life × survivor's sexual orientation ^a	-	-	-0.36 (0.19)	-0.09 (0.14)
Survivor covariates				
Perceived stress	-0.57*** (0.08)	-	-	-
Cancer support group	2.28* (0.93)	-	-	-
Counseling before breast cancer	-2.85** (1.04)	-	4.18** (1.31)	-
Fear of recurrence	-0.18*** (0.04)	0.12*** (0.03)	-	-
Census median household income	-	-1.39* (0.60)	-	2.85*** (0.74)
Census poverty level	-	-0.74 (0.44)	-	-
Individual income	-	1.52** (0.47)	-	-
1 comorbidity ^b	-	-	-1.97 (1.96)	-
2 comorbidities ^b	-	-	-1.73 (1.98)	-
3+ comorbidities ^b	-	-	-6.48** (1.89)	-
Discrimination score	-	-	-0.95* (0.43)	-
Non-white ^c	-	-	-5.18** (1.80)	-
Counseling to deal with breast cancer	-	-	-2.32 (1.28)	-
Multidimensional Perceived Social Support Scale	-	-	-	-1.63* (0.72)
Caregiver covariates				

	Survivors' mental quality of life	Caregivers' mental quality of life	Survivors' physical quality of life	Caregivers' physical quality of life
Multidimensional Perceived Social Support Scale	1.30* (0.56)	-	-	-2.41*** (0.66)
Perceived stress	-	-0.55*** (0.06)	-	-0.26** (0.10)
Counseling before breast cancer	-	-1.90** (0.73)	-	-
1 comorbidity ^b	-	-	-	-1.19 (1.62)
2 comorbidities ^b	-	-	-	-2.68 (1.72)
3+ comorbidities ^b	-	-	-	-3.93* (1.66)
Unemployed ^d	-	-	-	-5.99*** (1.09)

$p < 0.10$,

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

^aReference group is sexual minority

^bReference group is no comorbidities

^cReference group is white

^dReference group is employed