

## Original Article

**Cite this article:** Kang D *et al.* (2022). Divorce after breast cancer diagnosis and its impact on quality of life. *Palliative and Supportive Care* 20, 807–812. <https://doi.org/10.1017/S1478951521001711>

Received: 4 September 2021  
Accepted: 26 September 2021

**Key words:**

Breast neoplasm; Change; Divorce  
Marital status; Quality of life

**Author for correspondence:**

Juhee Cho, Department of Clinical Research Design and Evaluation, SAIHST, Sungkyunkwan University, 115 Irwon-ro, Gangnam, Seoul 06335, South Korea.  
E-mail: [jcho@skku.edu](mailto:jcho@skku.edu)

Danbee Kang, PH.D.<sup>1,2</sup>, Nayeon Kim, M.S.N.<sup>1,3</sup>, Gayeon Han, M.S.<sup>2</sup>, Sooyeon Kim, B.S.<sup>1,2</sup>, Hoyoung Kim, M.H.P.<sup>3</sup>, Jihyun Lim, M.S.<sup>2</sup>, Hyunsoo Kim, B.S.<sup>1,2</sup>, Sungkeun Shim, PH.D.<sup>2,4</sup> , Mangyeong Lee, M.S.<sup>2,4</sup>, Jeong Eon Lee, M.D., PH.D.<sup>5</sup>, Seok Jin Nam, M.D., PH.D.<sup>5</sup>, Seok Won Kim, M.D., PH.D.<sup>5</sup>, Jonghan Yu, M.D., PH.D.<sup>4</sup>, Se Kyung Lee, M.D., PH.D.<sup>4</sup> and Juhee Cho, PH.D.<sup>1,2,3,4,6</sup> 

<sup>1</sup>Department of Clinical Research Design and Evaluation, SAIHST, Sungkyunkwan University, Seoul, South Korea;

<sup>2</sup>Center for Clinical Epidemiology, Samsung Medical Center, Sungkyunkwan University, Seoul, South Korea;

<sup>3</sup>Cancer Education Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, South Korea;

<sup>4</sup>Department of Digital Health, SAIHST, Sungkyunkwan University, Seoul, South Korea;

<sup>5</sup>Department of Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, South Korea and

<sup>6</sup>Departments of Epidemiology and Medicine, and Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD

**Abstract**

**Objective.** This study aims to identify factors associated with divorce following breast cancer diagnosis and measures the impact of divorce on the quality of life (QoL) of patients.

**Methods.** We used cross-sectional survey data collected at breast cancer outpatient clinics in South Korea from November 2018 to April 2019. Adult breast cancer survivors who completed active treatment without any cancer recurrence at the time of the survey ( $N = 4,366$ ) were included. The participants were classified into two groups: “maintaining marriage” and “being divorced,” between at the survey and at the cancer diagnosis. We performed logistic regression and linear regression to identify the factors associated with divorce after cancer diagnosis and to compare the QoL of divorced and nondivorced survivors.

**Results.** Approximately 11.1/1,000 of married breast cancer survivors experienced divorce after cancer diagnosis. Younger age, lower education, and being employed at diagnosis were associated with divorce. Being divorced survivors had significantly lower QoL (Coefficient [Coef] =  $-7.50$ ; 95% CI =  $-13.63, -1.36$ ), social functioning (Coef =  $-9.47$ ; 95% CI =  $-16.36, -2.57$ ), and body image (Coef =  $-8.34$ ; 95% CI =  $-6.29, -0.39$ ) than survivors who remained married. They also experienced more symptoms including pain, insomnia, financial difficulties, and distress due to hair loss.

**Conclusion.** Identifying risk factors of divorce will ultimately help ascertain the resources necessary for early intervention.

**Introduction**

According to the family systems theory, a person’s disease can affect the entire family (Broderick, 1993). The diagnosis of a life-threatening disease, such as breast cancer, can significantly impact all family members, particularly the diagnosed individual’s partner, thereby affecting the couple’s relationship (Dorval *et al.*, 2005; Manne and Badr, 2008). In a nationally representative random-digit telephone survey of noninstitutionalized adults aged 18 years or older in the USA, a total of 14.1% of cancer survivors aged 20–39 years were divorced, compared with 9.6% of controls (Kirchhoff *et al.*, 2012). Divorce was suggested as an independent prognostic factor for survival among breast cancer patients (Chen *et al.*, 2015; Li *et al.*, 2015; Qiu *et al.*, 2016). In a recent cohort study, involving patients above 20 years who were diagnosed with stages I–III primary breast cancer and who received surgical treatment from 1992 to 2015, the divorced group ( $N = 3,044$ ) exhibited a higher risk of breast cancer-specific death (HR 1.11, 95% CI: 1.05, 1.18,  $p < 0.001$ ) and all-cause death (HR 1.27, 95% CI: 1.22, 1.32,  $p < 0.001$ ) than the group that remained married ( $N = 17,623$ ) (Ding *et al.*, 2021).

Although divorce affects many aspects of a couple’s life (Chen *et al.*, 2015; Li *et al.*, 2015; Qiu *et al.*, 2016; Ding *et al.*, 2021), only few empirical studies have found an association between divorce and quality of life (QoL). Previous studies have provided information on marital status soon after the diagnosis of breast cancer, and thus may not reflect the dynamic changes in long-term survival populations or account for marital status changes before or after the cancer diagnosis (Ding *et al.*, 2021). Moreover, research on the relation between marital status and health outcomes among cancer patients has generally used the Surveillance, Epidemiology, and End Results (SEER) cancer database or other national surveys, which elicited limited information

**Table 1.** Characteristics and treatment modalities of breast cancer survivors

| Characteristics                     | Maintaining marriage<br>N = 3,535 | Being divorced<br>N = 40 | P-value         |
|-------------------------------------|-----------------------------------|--------------------------|-----------------|
| Diagnosis                           |                                   |                          |                 |
| Age at diagnosis (years), mean (SD) | 48.31 (7.98)                      | 46.88 (8.15)             | 0.26            |
| Education                           |                                   |                          | <b>0.02</b>     |
| <High school                        | 279 (7.92)                        | 8 (20)                   |                 |
| High school                         | 1,216 (34.54)                     | 13 (32.5)                |                 |
| ≥University                         | 2,026 (57.54)                     | 19 (47.5)                |                 |
| Job status (n = 3,570)              |                                   |                          | <b>&lt;0.01</b> |
| No work, retired, or housewife      | 1,707 (48.36)                     | 9 (22.5)                 |                 |
| Employed or own business            | 1,823 (51.64)                     | 31 (77.5)                |                 |
| Number of children (n = 3,296)      |                                   |                          | 0.26            |
| <3                                  | 2,874 (88.1)                      | 33 (94.3)                |                 |
| ≥3                                  | 387 (11.9)                        | 2 (5.7)                  |                 |
| Psychiatric problem                 | 261 (7.4)                         | 7 (17.5)                 | <b>0.02</b>     |
| Type of surgery                     |                                   |                          | 0.37            |
| Lumpectomy                          | 2,315 (65.49)                     | 23 (57.5)                |                 |
| Mastectomy with reconstruction      | 558 (15.79)                       | 6 (15)                   |                 |
| Mastectomy without reconstruction   | 662 (18.73)                       | 11 (27.5)                |                 |
| Clinical stage                      |                                   |                          | 0.82            |
| DCIS                                | 325 (9.19)                        | 2 (5)                    |                 |
| I                                   | 1,527 (43.2)                      | 17 (42.5)                |                 |
| II                                  | 1,162 (32.87)                     | 14 (35)                  |                 |
| III                                 | 518 (14.65)                       | 7 (17.5)                 |                 |
| IV                                  | 3 (0.08)                          | 0 (0)                    |                 |
| Treatment                           |                                   |                          |                 |
| Chemotherapy                        | 1,827 (51.68)                     | 25 (62.5)                | 0.17            |
| Radiation therapy                   | 2,620 (74.12)                     | 30 (75)                  | 0.98            |
| Hormone therapy                     | 2,802 (79.26)                     | 32 (80)                  | 0.97            |
| Target therapy                      | 517 (14.63)                       | 7 (17.5)                 | 0.86            |
| Current                             |                                   |                          |                 |
| Age at survey (years), means (SD)   | 50.72 (8.04)                      | 49.43 (8.07)             | 0.31            |
| Job status (n = 3,567)              |                                   |                          | <b>&lt;0.01</b> |
| Unemployed                          | 2,103 (59.61)                     | 11 (28.21)               |                 |
| Employed or own business            | 1,425 (40.39)                     | 28 (71.79)               |                 |
| Household monthly income (US\$)     |                                   |                          | <b>&lt;0.01</b> |
| <2,000                              | 647 (18.41)                       | 17 (42.50)               |                 |
| 2,000–<6,000                        | 1,862 (52.97)                     | 18 (45.00)               |                 |

(Continued)

**Table 1.** (Continued.)

| Characteristics             | Maintaining marriage<br>N = 3,535 | Being divorced<br>N = 40 | P-value         |
|-----------------------------|-----------------------------------|--------------------------|-----------------|
| ≥6,000                      | 1,006 (28.46)                     | 5 (12.50)                |                 |
| Smoking status (N = 3,567)  |                                   |                          | <b>&lt;0.01</b> |
| Never                       | 3,303 (93.65)                     | 29 (72.5)                |                 |
| Past                        | 205 (5.81)                        | 10 (25)                  |                 |
| Current                     | 19 (0.54)                         | 1 (2.5)                  |                 |
| Drinking status (N = 3,569) |                                   |                          | 0.05            |
| Never                       | 1,713 (48.54)                     | 15 (37.5)                |                 |
| Past                        | 1,255 (35.56)                     | 13 (32.5)                |                 |
| Current                     | 561 (15.9)                        | 12 (30)                  |                 |

Bolted numbers represent statistically significant associations ( $P < 0.05$ ).

on QoL (Abdollah et al., 2011; Aizer et al., 2013; Ding et al., 2021). Thus, this study aimed to identify factors associated with divorce after breast cancer diagnosis and examine its impact on QoL.

## Methods

### Participants

We used cross-sectional survey data collected to evaluate factors associated with QoL among breast cancer survivors after the completion of their active cancer treatment. The study participants were recruited at breast cancer outpatient clinics of the Samsung Medical Center in Seoul, South Korea, from November 2018 to April 2019. Survivors aged 20 years or above were eligible if they were recently diagnosed with breast cancer, had received curative intent surgery, and had completed active treatment without cancer recurrence at the time of the survey ( $N = 4,366$ ). Since this study sought to identify factors associated with divorce after cancer diagnosis, we only included women who were married at the time of diagnosis ( $N = 3,612$ ). We excluded participants who were widowed post-diagnosis or did not mention their marital status.

Trained researchers explained the survey's purpose and procedure to the participants. After collecting informed consent from the participants, they were asked to complete the questionnaire. This study was approved by the Institutional Review Board (IRB) of the Samsung Medical Center (SMC: 2018-03-099).

### Measurement

The participants indicated their current marital status at the time of diagnosis as “single,” “married,” “widowed,” or “divorced.” The responses were grouped into two: “maintaining marriage” and “being divorced.”

To identify factors associated with divorce, we collected socio-demographic information, such as education level, working status at diagnosis, and the number of children at the time of diagnosis, as well as marital status, cancer stage, and psychiatric problems at the time of diagnosis, and anticancer treatment (type of surgery, reconstruction, chemotherapy, radiation, hormone therapy, and targeted therapy) using questionnaires and electronic medical records.

To measure QoL, we used the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life

**Table 2.** Odds ratio (95% confidence intervals) for being divorced pertaining to factors at diagnosis

| Characteristics                   | Crude Odds Ratio (95% CI) | Adjusted <sup>a</sup> Odds Ratio (95% CI) |
|-----------------------------------|---------------------------|---|
| Age at diagnosis (years)          | 0.97 (0.94, 1.02)         | <b>0.94 (0.90, 0.99)</b>                  |
| <40                               | 1.54 (0.38, 6.19)         | 3.20 (0.67, 15.21)                        |
| 40–<50                            | 1.4 (0.41, 4.75)          | 2.75 (0.71, 10.61)                        |
| 50–<60                            | 1.31 (0.37, 4.68)         | 1.88 (0.51, 6.95)                         |
| ≥60                               | Reference                 | Reference                                 |
| Education                         |                           |   |
| <High school                      | <b>3.06 (1.33, 7.05)</b>  | <b>6.26 (2.25, 17.42)</b>                 |
| High school                       | 1.14 (0.56, 2.32)         | 1.47 (0.7, 3.08)                          |
| ≥University                       | Reference                 | Reference                                 |
| Job status                        |                           |   |
| No work, retired, or housewife    | Reference                 | Reference                                 |
| Employed or own business          | <b>3.23 (1.53, 6.79)</b>  | <b>3.35 (1.57, 7.14)</b>                  |
| Number of children                |                           |   |
| <3                                | 2.22 (0.53, 9.30)         | 2.55 (0.60, 10.90)                        |
| ≥3                                | Reference                 | Reference                                 |
| Psychiatric problem               |                           |   |
| No                                | Reference                 | Reference                                 |
| Yes                               | <b>2.65 (1.16, 6.05)</b>  | <b>2.64 (1.14, 6.06)</b>                  |
| Type of surgery                   |                           |   |
| Lumpectomy                        | Reference                 | Reference                                 |
| Mastectomy with reconstruction    | 1.08 (0.44, 2.67)         | 1.07 (0.42, 2.7)                          |
| Mastectomy without reconstruction | 1.67 (0.81, 3.45)         | 1.5 (0.7, 3.19)                           |
| Clinical stage                    |                           |   |
| DCIS                              | Reference                 | Reference                                 |
| I                                 | 1.84 (0.42, 8.02)         | 1.84 (0.42, 8.02)                         |
| II                                | 1.96 (0.44, 8.69)         | 1.96 (0.44, 8.69)                         |
| III/IV                            | 2.10 (0.43, 10.20)        | 2.10 (0.43, 10.2)                         |
| History of treatment              |                           |   |
| Chemotherapy                      | 1.56 (0.82, 2.97)         | 1.43 (0.62, 3.31)                         |
| Radiation therapy                 | 1.05 (0.51, 2.15)         | 1.00 (0.47, 2.11)                         |
| Hormone therapy                   | 1.04 (0.48, 2.27)         | 1.14 (0.52, 2.53)                         |
| Target therapy                    | 1.24 (0.54, 2.81)         | 1.13 (0.48, 2.65)                         |

<sup>a</sup>Adjusted for age at diagnosis, education, and clinical stage.

Bolded numbers represent statistically significant associations ( $P < 0.05$ ).

Questionnaire Core 30 (QLQ-C30) and breast cancer-specific module (BR23), which has been translated into Korean and validated (Yun et al., 2004). The EORTC QLQ-C30 and BR23 questionnaires were scored according to the EORTC scoring manual (Fayers et al., 2001), and the data were linearly transformed to yield scores from 0 to 100, where a higher EORTC score represented a better level of global health status and functioning.

### Statistical analysis

We compared the categorical and continuous variables of maintaining marriage and being divorced survivors using  $\chi^2$ -tests and  $t$ -tests, respectively. Univariable and multivariable logistic regression were used to identify the factors associated with divorce

after cancer diagnosis. We also compared the QoL of maintaining marriage and being divorced survivors using multivariable linear regression after adjusting for age, education level, stage, surgery type, and history of cancer treatment (chemotherapy, radiation, hormones, and target therapy).

All significance tests were two-sided, and statistical significance was set at  $p < 0.05$ . All data analyses were performed using STATA version 15 (StataCorp LLC, College Station, TX, USA).

### Results

Among the 3,612 eligible survivors, we excluded 37 who were widowed ( $n = 23$ ) or did not report their marital status ( $n = 14$ ). Finally, 3,575 survivors were included in the analysis.

**Table 3.** Association between being divorced and quality of life

|                                      | Adjusted <sup>a</sup><br>Coefficient (95% CI) |
|--------------------------------------|---|
| Global health status/quality of life |   |
| Global health status/quality of life | <b>-7.50 (-13.63, -1.36)</b>                  |
| Functional scales                    |   |
| Physical functioning                 | -3.90 (-8.28, 0.48)                           |
| Cognitive functioning                | -4.81 (-10.67, 1.04)                          |
| Emotional functioning                | <b>-6.87 (-13.29, -0.46)</b>                  |
| Social functioning                   | <b>-9.47 (-16.36, -2.57)</b>                  |
| Role functioning                     | -5.40 (-11.48, 0.67)                          |
| Symptoms                             |   |
| Fatigue                              | 5.96 (-0.56, 12.48)                           |
| Nausea and vomiting                  | 0.40 (-3.65, 4.46)                            |
| Pain                                 | <b>6.33 (0.09, 12.57)</b>                     |
| Dyspnea                              | 3.79 (-2.42, 10)                              |
| Insomnia                             | <b>9.40 (0.01, 18.80)</b>                     |
| Appetite loss                        | 3.51 (-2.62, 9.64)                            |
| Constipation                         | 7.03 (-0.99, 15.05)                           |
| Diarrhea                             | 5.27 (-0.33, 10.87)                           |
| Financial problem                    | <b>13.66 (6.91, 20.41)</b>                    |
| Breast cancer-specific functioning   |   |
| Body image                           | <b>-8.34 (-16.29, -0.39)</b>                  |
| Sexual functioning                   | -3.52 (-9.84, 2.8)                            |
| Sexual enjoyment                     | -0.34 (-12.01, 11.34)                         |
| Future perspective                   | -0.75 (-9.91, 8.41)                           |
| Breast cancer-specific symptoms      |   |
| Systemic therapy side effects        | 1.82 (-3.43, 7.08)                            |
| Distress due to hair loss            | <b>6.12 (0.97, 11.28)</b>                     |
| Arm symptoms                         | -1.78 (-14.86, 11.29)                         |
| Breast symptoms                      | 5.93 (-1.15, 13.02)                           |

<sup>a</sup>Adjusted for age at diagnosis, clinical stage, education, survival years, type of surgery, chemotherapy, radiation, hormone, and targeted therapy. Bolded numbers represent statistically significant associations ( $P < 0.05$ ).

The mean age (SD) at the time of diagnosis was 48.3 (8.6) years, and 43.2%, 32.9%, and 14.7% were diagnosed with stages I, II, and III breast cancer, respectively (Table 1). Among the survivors, 1.1% ( $n = 40$ ) were divorced post-diagnosis. At the time of diagnosis, compared to survivors who maintaining marriage, those who were being divorced were likely to be younger, have less than high school education, be employed, and be diagnosed with an advanced stage of cancer. While being divorced survivors were also more likely to continue to work, their monthly family income was lower than that of survivors who maintaining marriage. Furthermore, being divorced survivors were more likely to be smokers and alcohol consumers than maintaining marriage survivors (Table 1).

In the multivariable-adjusted model, the factors of younger age, lower education ( $\leq$  high school odds ratio [OR] = 6.26;

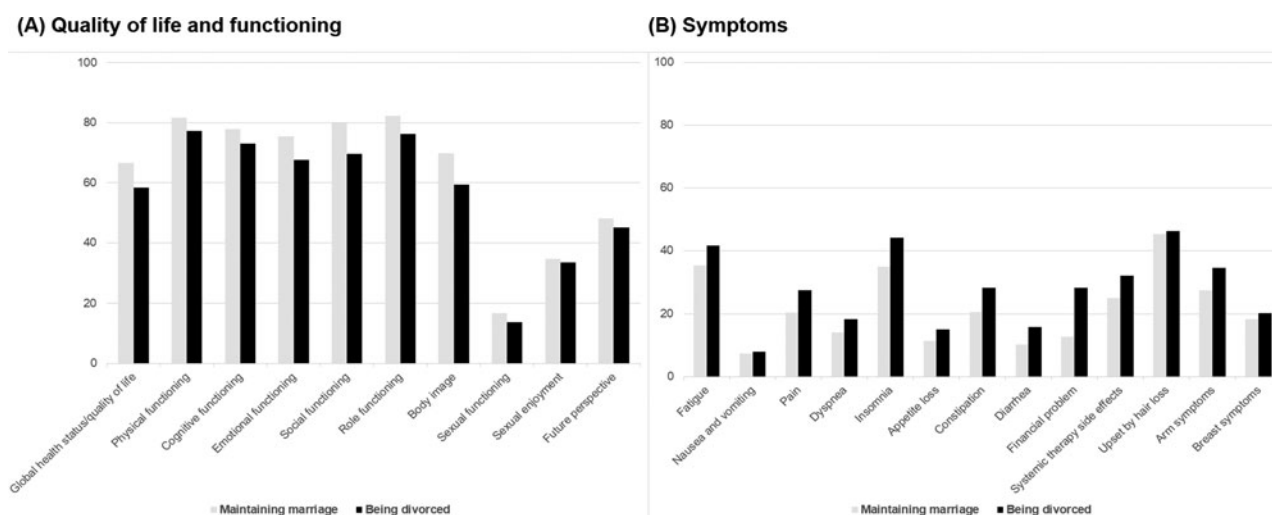
95% CI = 2.25, 17.42), employed at diagnosis (OR = 3.35; 95% CI = 1.57, 7.14), psychiatric problems (OR = 2.64; 95% CI = 1.14, 6.06), and diagnosed with advanced stage of cancer were associated with risk of being divorced (Table 2).

Being divorced survivors had significantly poorer QoL (Coefficient [Coef] = -7.50; 95% CI = -13.63, -1.36) than survivors who maintaining marriage. They also exhibited poorer emotional functioning (Coef = -6.87; 95% CI = -13.29, -0.46), social functioning (Coef = -9.47; 95% CI = -16.36, -2.57), and body image (Coef = -8.34; 95% CI = -6.29, -0.39) than survivors who remained married, and reported experiencing more symptoms, including pain (Coef = 6.33; 95% CI = 0.09, 12.57) and insomnia (Coef = 9.40; 95% CI = 0.01, 18.80), and were more upset by hair loss (Coef = 9.40; 95% CI = 0.01, 18.80) than survivors who maintaining marriage. Additionally, being divorced survivors experienced greater financial difficulties (Coef = 13.66; 95% CI = 6.91, 20.41) than survivors who maintaining marriage (Table 3).

## Discussion

In our study, approximately 1% of married breast cancer survivors experienced divorce after cancer diagnosis. Younger age, lower education, and being employed at diagnosis were associated with risk of divorce. Being divorced survivors had significantly lower QoL, social functioning, and body image than those who maintaining marriage. They also experienced more symptoms, including pain and insomnia, and greater financial difficulties (Figure 1).

The divorce rate among the participants in this study was approximately 11.1/1,000, which is much higher than the figure in the general population of Korea of 2.1/1,000 persons (<https://www.statista.com/statistics/642501/south-korea-divorce-rate/>). In a Swedish register-based study, women diagnosed with breast cancer showed a significant increase in the risk of divorce at almost 25% (Socialstyrelsen, 2006). In a Turkish study, 3.6% of breast cancer survivors were divorced, higher than the rate in the general population in Turkey (0.159%) (Yildiz and Alagüney, 2020). It might be hypothesized that a major life event, such as cancer diagnosis, has a considerable effect on the quality of marriage, and that cancer patients thus face an increased risk of divorce (Carlsen et al., 2007). In addition, the treatment of breast cancer might affect sexual life (Boswell and Dizon, 2015) and perceived body image (Wu et al., 2019), leading to marital disharmony and a higher risk of divorce (Meltzer and McNulty, 2010). However, studies conducted before the early 2000s reported that breast cancer diagnosis and divorce are not associated (Dorval et al., 1999; Carlsen et al., 2007). A Canadian study conducted between 1984 and 1992 found no difference in the frequency of divorce among patients with nonmetastatic breast cancer from the general population (Dorval et al., 1999). A study that compared the risk of divorce between early stage breast cancer patients who were diagnosed in 1981–2000 and the general population in Finland found that diagnosis at early stages of breast cancer does not pose a risk for divorce (Carlsen et al., 2007). This finding might be related to feminism and other movements that have substantially boosted women's rights and their ability to leave poor marriages. The improved economic status of women may increase marital stress as women's bargaining power within the household is enhanced (Mammen and Paxson, 2000), making divorce a more affordable and acceptable choice for women in an unsatisfactory marriage (Lee, 2006). Moreover, rising individualism in globalized and developed Asian economies has helped create a social climate more open to divorce (Jones, 2012).



**Fig. 1.** Quality of life, functioning, and symptoms score of the being divorced group. Scores range from 0 to 100, where higher scores indicate better general health status/quality of life and better functioning but more symptoms.

In terms of factors associated with being divorced, younger age was associated with divorce. Swedish and Danish studies also found that younger age at the time of diagnosis was associated with higher risk of divorce (Christoffersen, 2002; Carlsen et al., 2007). Younger patients may be less resilient to the stressors of cancer treatment and recovery and face competing burdens from having young children or lower job security, which are more common circumstances among these patients. For younger cancer survivors, increased emotional and financial burdens from cancer may impact their marriages in ways not seen in other survivor populations (Kirchhoff et al., 2012). Lower educational qualifications were also associated with being divorced. As less educated individuals have more limited human capital and fewer socioeconomic resources at their disposal, the consequences of heightened divorce risk and low remarriage rates will certainly have a considerable impact on their life outcomes, because they lack the extra safety net of family support (Cheng, 2016). Furthermore, we found that those who were employed at the time of diagnosis were more likely to be divorced. In fact, a positive relationship has been reported between women's working hours and the number of divorces (Poortman and Kalmijn, 2002), and the risk of being divorced among working women is 16% higher than among those who do not work (Poortman, 2005). According to previous studies, a wife's employment increases her financial independence, making it easier for her to consider divorce (Poortman, 2005). Furthermore, husbands may more easily consider divorce when their wives are financially independent. From a sociological perspective, wives' employment might be contrary to traditional role expectations emphasizing women's role as homemakers (Poortman, 2005). In this study, we also found psychiatric problems at diagnosis to be associated with divorce. Mental problems are known to be a strong risk factor for divorce (Christoffersen, 2002; Socialstyrelsen, 2006). Psychiatric problems may negatively affect people's ability to maintain marital relationships, which may, in turn, lead to divorce (Breslau et al., 2011). In addition, there is some evidence of a joint effect of multiple co-occurring disorders on divorce (Breslau et al., 2011). Thus, patients with mental problems need early intervention to reduce the negative impact of psychiatric problems.

In this study, survivors who were being divorced were more likely to report poor emotional and social functioning than those who remained married. According to the previous study, married patients received more social and emotional support from marriage (Chang and Barker, 2005; Reyes Ortiz et al., 2007; Zhai et al., 2019). Divorce can also disrupt the social network of survivors, reducing their socioeconomic status and overall QoL (Kornblith et al., 2001; Lehto et al., 2005), as well as increasing the risk of an unhealthy lifestyle, including increased consumption of alcohol and tobacco smoking. In fact, in our study, divorced survivors were more likely to be smokers and drinkers than survivors who remained married. Unhealthy lifestyles might be associated with lower QoL among being divorced survivors. In our study, divorced patients also had lower QoL and overall health status. Thus, there is a need to proactively provide single and divorced individuals with appropriate social and psychological support.

### Study limitations

This study has several limitations. First, we were not able to include potential risk factors for divorce, such as satisfaction with marriage. Second, as we did not ask why they were divorced, those who had divorces not related to cancer were included in the group of divorced patients. Third, the results of our study might not be generalizable to other cancer survivors in different settings. Studies investigating the relationship between cancer diagnosis and divorce generally include heterogeneous patient groups with all types of cancer. In a population-based study conducted in the Danish population, no difference was found between survivors other than cervical cancer and the general population in terms of divorce risk (Carlsen et al., 2007). Similarly, a study of approximately 1.5 million people in Norway found that types of cancer other than testicular and cervical did not affect divorce (Syse et al., 2010).

With early diagnosis and medical advancements, 93.2% breast cancer patients have survived for more than 5 years (Kang et al., 2020). On account of their high incidence and survival rates, breast cancer survivors represent one of the largest groups among cancer survivors, and their survivorship care is a vital issue. For an increasing proportion of cancer patients, the disease becomes a chronic disorder, as illustrated by the term



“survivorship” (Ayanian and Jacobsen, 2006). Although their marital relationship is likely to be strained due to cancer diagnosis, some couples with the resources to meet this challenge (Dorval et al., 2005) experience a strengthening of their relationship (Dorval et al., 2005; Hinnen et al., 2008). Thus, identifying risk factors of divorce will ultimately help healthcare professionals ascertain the resources necessary for early intervention.

### Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Institutional Review Board (IRB) of Samsung Medical Center approved this study (SMC: 2018-03-099). Written informed consent was obtained from all participants.

**Consent for publication.** All authors give consent to publication.

**Author contributions.** DK, NK, JC, and SKL conceived and designed the study; DK, GH, HK, JL, HK, SS, JEL, SJM, SWK, and SKL constructed the data; DK, GH, HK, JL, and HK contributed to the analysis; DK, SK, and NK wrote the manuscript. All authors have read and agreed to the published version of the manuscript.

**Funding.** This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and Future Planning (2017R1E1A1A0107764214).

**Conflict of interest.** The authors declare no competing interests.

### References

- Abdollah F, Sun M, Thuret R, et al. (2011) The effect of marital status on stage and survival of prostate cancer patients treated with radical prostatectomy: A population-based study. *Cancer Causes & Control* 22(8), 1085–1095.
- Aizer AA, Chen MH, McCarthy EP, et al. (2013) Marital status and survival in patients with cancer. *Journal of Clinical Oncology* 31(31), 3869–3876.
- Ayanian JZ and Jacobsen PB (2006) Enhancing research on cancer survivors. *Journal of Clinical Oncology* 24(32), 5149–5153.
- Boswell EN and Dizon DS (2015) Breast cancer and sexual function. *Translational Andrology and Urology* 4(2), 160–168.
- Breslau J, Miller E, Jin R, et al. (2011) A multinational study of mental disorders, marriage, and divorce. *Acta Psychiatrica Scandinavica* 124(6), 474–486.
- Broderick CB (1993) *Understanding Family Process: Basics of Family Systems Theory*. Thousand Oaks, CA: Sage Publications.
- Carlsen K, Dalton SO, Frederiksen K, et al. (2007) Are cancer survivors at an increased risk for divorce? A Danish cohort study. *European Journal of Cancer* 43(14), 2093–2099.
- Chang SM and Barker 2nd FG (2005) Marital status, treatment, and survival in patients with glioblastoma multiforme: A population based study. *Cancer* 104(9), 1975–1984.
- Chen DN, Song CG, Ouyang QW, et al. (2015) Differences in breast cancer characteristics and outcomes between Caucasian and Chinese women in the US. *Oncotarget* 6(14), 12774–12782.
- Cheng Y-h (2016) More education, fewer divorces? Shifting education differentials of divorce in Taiwan from 1975 to 2010. *Demographic Research* 34, 927–942.
- Christoffersen MN (2002) *Dissolved families: A prospective longitudinal cohort study of family strain before parental separation following schoolchildren born in Denmark 1973*. In: Carling J (ed.) *Nordic demography: Trends and differentials*. *Scandinavian Population Studies* 13, 231–250. [Oslo: Unipub/Nordic Demographic Society].
- Ding W, Ruan G, Lin Y, et al. (2021) Dynamic changes in marital status and survival in women with breast cancer: A population-based study. *Scientific Reports* 11(1), 5421.
- Dorval M, Maunsell E, Taylor-Brown J, et al. (1999) Marital stability after breast cancer. *Journal of the National Cancer Institute* 91(1), 54–59.
- Dorval M, Guay S, Mondor M, et al. (2005) Couples who get closer after breast cancer: Frequency and predictors in a prospective investigation. *Journal of Clinical Oncology* 23(15), 3588–3596.
- Fayers PM, Aaronson NK, Bjordal K, et al. (2001) *The EORTC QLQ-C30 Scoring Manual*. Brussels, Belgium: European Organization for Research and Treatment of Cancer.
- Hinnen C, Hagedoorn M, Ranchor AV, et al. (2008) Relationship satisfaction in women: A longitudinal case-control study about the role of breast cancer, personal assertiveness, and partners' relationship-focused coping. *British Journal of Health Psychology* 13(Pt 4), 737–754.
- Jones GW (2012) Changing family sizes, structures and functions in Asia. *Asia-Pacific Population Journal* 27(1), 83–102.
- Kang SY, Kim YS, Kim Z, et al. (2020) Breast cancer statistics in Korea in 2017: Data from a breast cancer registry. *Journal of Breast Cancer* 23(2), 115–128.
- Kirchhoff AC, Yi J, Wright J, et al. (2012) Marriage and divorce among young adult cancer survivors. *Journal of Cancer Survivorship: Research and Practice* 6(4), 441–450.
- Kornblith AB, Herndon 2nd JE, Zuckerman E, et al. (2001) Social support as a buffer to the psychological impact of stressful life events in women with breast cancer. *Cancer* 91(2), 443–454.
- Lee Y-J (2006) Risk factors in the rapidly rising incidence of divorce in Korea. *Asian Population Studies* 2(2), 113–131.
- Lehto US, Ojanen M and Kellokumpu-Lehtinen P (2005) Predictors of quality of life in newly diagnosed melanoma and breast cancer patients. *Annals of Oncology* 16(5), 805–816.
- Li Q, Gan L, Liang L, et al. (2015) The influence of marital status on stage at diagnosis and survival of patients with colorectal cancer. *Oncotarget* 6(9), 7339–7347.
- Mammen K and Paxson C (2000) Women's work and economic development. *The Journal of Economic Perspectives* 14(4), 141–164.
- Manne S and Badr H (2008) Intimacy and relationship processes in couples' psychosocial adaptation to cancer. *Cancer* 112(11 Suppl), 2541–2555.
- Meltzer AL and McNulty JK (2010) Body image and marital satisfaction: Evidence for the mediating role of sexual frequency and sexual satisfaction. *Journal of Family Psychology* 24(2), 156–164.
- Poortman A-R (2005) Women's work and divorce: A matter of anticipation? A research note. *European Sociological Review* 21(3), 301–309.
- Poortman A-R and Kalmijn M (2002) Women's labour market position and divorce in the Netherlands: Evaluating economic interpretations of the work effect. *European Journal of Population/Revue européenne de Démographie* 18(2), 175–202.
- Qiu M, Yang D and Xu R (2016) Impact of marital status on survival of gastric adenocarcinoma patients: Results from the Surveillance Epidemiology and End Results (SEER) database. *Scientific Reports* 6, 21098.
- Reyes Ortiz CA, Freeman JL, Kuo YF, et al. (2007) The influence of marital status on stage at diagnosis and survival of older persons with melanoma. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* 62(8), 892–898.
- Socialstyrelsen (2006) *Social Rapport 2001*. Stockholm: Socialstyrelsen. pp. 140–141.
- Syse A, Loge JH and Lyngstad TH (2010) Does childhood cancer affect parental divorce rates? A population-based study. *Journal of Clinical Oncology* 28(5), 872–877.
- Wu TY, Chang TW, Chang SM, et al. (2019) Dynamic changes of body image and quality of life in breast cancer patients. *Cancer Management and Research* 11, 10563–10571.
- Yildiz F and Alagüney M (2020) Is early-stage breast cancer a risk for marital-dissolution? *Medical Science and Discovery* 7, 566–569.
- Yun YH, Bae SH, Kang IO, et al. (2004) Cross-cultural application of the Korean version of the European Organization for Research and Treatment of Cancer (EORTC) Breast-Cancer-Specific Quality of Life Questionnaire (EORTC QLQ-BR23). *Supportive Care in Cancer* 12(6), 441–445.
- Zhai Z, Zhang F, Zheng Y, et al. (2019) Effects of marital status on breast cancer survival by age, race, and hormone receptor status: A population-based study. *Cancer Medicine* 8(10), 4906–4917.