Marital status and survival analysis of patients with pure mucinous breast carcinoma: A SEER Population-Based Retrospective study

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Abstract

Background The present study was conducted to investigate the influence of marital status on survival of pure mucinous breast carcinoma based on surveillance, epidemiology, and end results (SEER) databases.

Methods Data were extracted from the SEER database on eligible patients diagnosed with pure mucinous breast carcinoma between 1998 and 2015. Patients were divided into married groups and the not married groups. Survival curves were generated by the Kaplan-Meier method, and survival differences were estimated by using the Log-Rank test. Multivariate Cox Proportional Hazards Models was used to assess independent risk factors for survival.

Results A total of 14972 eligible pure mucinous breast carcinoma patients were enrolled from the SEER database, including 7462 (49.84%) married and 7510 (50.16%) not married patients. The OS and CSS were significantly greater in married patients than not married patients (79.27 vs 62.49% for OS and 96.07 vs 93.34% for CSS, both $P = 0.000$). Among patients older than 75, there were significantly more unmarried patients than married patients (21.5% vs. 44.1%). Compared to the not married patients, cancer stage were even lower (stage I) (69.6% vs. 62.6%), (stage II) (28.6% vs. 33.9%), (stage III) (0.6% vs. 0.9%), (stage IV) (1.3% vs. 2.5%), and more patients received breast conserving surgery (67.4% vs. 62.9%), chemotherapy (15.3% vs. 11.0%) and radiation therapy (54.3% vs. 43.1%). Compared with the not married group, the proportion of non-recurrent lymph node metastasis was (82.8% vs. 74.6%) (All $P = 0.000$). The Multivariate Cox Proportional Hazards Models showed that marriage is an independent protective factor for OS (HR =1.356, 95% CI: 1.271-1.446, $P = 0.000$) and CSS (HR =1.942, 95% CI: 1.681–2.644, $P = 0.000$).

Conclusion Marital status was an independent prognostic indicator in pure mucinous breast carcinoma patients. Research data showed that married pure mucinous breast carcinoma patients can obtain better OS and CSS than the not married patients.

Background

Pure mucinous breast carcinoma (PMBC), also known as colloid carcinoma, is a rare malignancy of the breast. According to the data reported, mucinous carcinoma (MC) account for between 1% and 6% of all breast cancers[1], while pure mucinous breast carcinoma account for only 0.9% to 2.2% of all breast cancers[2-3]. MC was first defined and described in 1826[4], and Silverberg et al.[5] were the first to quantify the number of diseased cells as the method of classifying the two groups, and MC was defined as having a mucinous component of at least 50%. Since then, Rosen[6] developed diagnostic criteria of PMBC that lesions could not display high-grade histological features and with tumors composed of at least 90% mucin[7]. The population of patients with PMBC is mostly postmenopausal women, showing good clinical pathological characteristics, including lower incidence of lymph node metastasis, higher expression of estrogen and progesterone receptor (PR), and better cancer differentiation[8-9]. Therefore, PMBC was defined as a slow-growing tumor, for which the prognosis is somewhat better than that for MC and infiltrating ductal carcinoma (IDC)[10-12].

In past studies, many clinical features such as tumor size, TMN stage, cellularity, lymph node metastasis and an axillary staging by sentinel lymph node biopsy, have been studied and all been shown to be associated with PMBC tumor survival and prognosis[10,13], molecular phenotype, age, and receipt of chemotherapy and radiotherapy were also confirmed as the independent predictors of PMBC[14].

Not only that, people were starting to focus on the impact of social factors on the survival, development and prognosis of cancer patients. The quality of social support predicts better health related quality of life generally[15]. Among them, marital status has attracted wide attention as an important form of social common relations in modern society. Study has indicated that the not married patients were at greater risk of presentation with metastatic disease and cancer-specific mortality[16]. Marital status is considered to be an important factor affecting the survival and prognosis of cancer patients, which has been discussed in many literature, including small intestinal adenocarcinoma, colorectal cancer, lung cancer and other cancers[17-20]. For breast cancer patients, a number of studies also have shown that married breast cancer patients have better prognosis and survival outcomes than unmarried patients, and it is clear that marital status has become an independent factor affecting the survival prognosis of breast cancer patients[17, 21]. However, the influence of Marital status on the survival trend of PMBC patients has not been fully investigated.

To continue this in-depth study, we conducted this analytical study to explore the correlation between marital status and overall survival (OS) and cancer-specific survival (CSS) in PMBC patients, and whether the correlation varies with other factors such as age and cancer stage.

All of our data came from the Surveillance, Epidemiology, and End Results (SEER) program, which is closest to that representative as it provides population-based data from 18 Cancer Registries from population-based catchment areas related to cancer diagnoses, treatment and survival for approximately 30% of the U.S. population[23].

Materials And Methods

Patients

The data for this study were all from the SEER database (<http://seer.cancer.gov>). The unidentified data held by the SEER database were authorized to obtain, and we used SEER*Stat 8.3.6 software to extract eligible patients included in the database. A total of 21662 patients aged 18 or older who were diagnosed with pure mucinous breast carcinoma between 1998 and 2015 were included in the study. We conducted a series of screening exclusions for the patients initially included, and the inclusion criteria were referred as follows: 1) only one primary malignancy in their lifetime; 2) limited to the following histological types, according to the International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3): mucinous adenocarcinoma (SEER histology codes 8480); 3) known marital status; 4) known stage (Breast Cancer Adjusted AJCC Cancer Staging Manual 6th Edition); 5) known surgery situation; 6) known survival months after diagnosis. Finally, we got a total of 14972 people who met the inclusion criteria.

Co-variables

The main purpose of this study is to investigate the effect of marital status on survival outcomes of PMBC patients by comparing the incidence of OS and CSS in different marital states. OS is defined as the duration from tumor diagnosis to the most recent follow-up or date of death. CSS is defined as the duration from the diagnosis of the tumor to the latest follow-up or death from diagnosed PMBC.

Marital status is the main observation variable in this study, so we mainly divided the population into two groups for observation, namely the married group and the not married group. Married group was defined as married people including common law, and the single(never married), unmarried or domestic Partner, Divorced, Separated, Widowed were all considered disadvantaged in marital status and were therefore defined as not married groups.

Statistical analysis

The Chi-square test was used to compare the clinical characteristics of patients with different categories of marital status, and descriptive statistics were used to investigate the baseline characteristics of the patient population. The categorical variables are expressed as numbers with percentage ages. Kaplan-Meier method was used to calculate CSS and OS and generate the corresponding survival curve. The difference rate between groups was analyzed and calculated by Log-Rank test. For variables with statistically significant differences, Multivariate Cox Proportional Analysis was established to assess the effect of marital status on OS and CSS by calculating hazard ratios (HR) and their corresponding 95% confidence intervals (CI). A two-sided $P < 0.05$ was considered to be statistically significant. The analyses of statistics were conducted using SPSS (SPSS Inc., Chicago, USA, version 23).

Results

Patient baseline characteristics

Based on the inclusion criteria, we identified a total of 14972 patients with PMBC diagnosed between 1998 and 2015 in the SEER database. Specific inclusion and exclusion processes were detailed in Figure 1. All the patients were further divided into the married ($n=7462$ 49.84%) and the not married ($n=7510$ 50.16%), and the baseline characteristics of the marital status of the two groups were shown in table 1. In terms of gender, the gender gap was too large to have any statistical significance. In other respects, For patients older than 75 years old, there were significantly more unmarried patients than married patients ($\text{aged} \geq 75$ 21.5% vs. 44.1%). Both the married group and the not married group showed low tumor differentiation and cancer grade, while the married group's cancer stage were even lower (stage I: 69.6% vs. 62.6%), (stage II: 28.6% vs. 33.9%), (stage III: 0.5% vs. 0.9%), (stage IV: 1.3% vs. 2.6%). More married patients received breast conserving surgery (67.4% vs. 62.9%), chemotherapy (15.3% vs. 11.0%) and radiation therapy (54.3% vs. 43.1%). The married group was also less likely to have recurrent lymph node metastases compared to unmarried (82.8% vs. 74.6%). All of which were statistically significant ($P < 0.001$), as noted in Table 1.

Effects of marital status and other factors on OS and CSS of PMBC

The overall patients were divided into the married group and the not married group, and the Kaplan-Meier curve was used to evaluate the OS and CSS of PMBC. The results showed that the OS and CSS were significantly greater in married patients than not married patients (79.27 vs 62.49% for OS and 96.07 vs 93.34% for CSS). Meanwhile, by checking the Log-Rank tests, OS and BCSS were significantly higher in the married subgroup than in the not married group (Figure 2). Further Multivariate Cox Proportional Hazards Model showed that marital status, age, cancer stage, operation, and radiation therapy were independent prognostic factors associated with OS and CSS (Table 2 and 3). It turns out that for PMBC patients, both OS and BCSS in the not married group performed worse than those in the married group, while OS (HR=2.150, 95% CI: 2.020-2.288, $P<0.001$) and CSS (HR=1.942, 95% CI: 1.681-2.244, $P<0.001$).

For other factors, after uni-variate analysis by Cox Regression (Table 2 and 3), we found that: In the age group, with the increase of age, it is obvious that OS and CSS show worse results, with the age older than 75 years old, OS(HR=17.391, 95% CI: 9.038-33.464 $P<0.001$) and CSS (HR=2.639, 95% CI: 1.249-5.576, $P=0.011$). The same results were observed with regard to cancer stage, with both OS and CSS in PMBC patients showing poorer outcomes as the cancer grade increased: Take stage I as a reference, stage II OS (HR=1.415, 95% CI: 1.327-1.508 $P<0.001$) and CSS(HR=2.590, 95% CI: 2.202-3.046 $P<0.001$); stage III OS(HR=2.377, 95% CI: 1.802-3.137 $P<0.001$) and CSS(HR=11.991, 95% CI: 8.181-17.576 $P<0.001$); stage IV OS(HR=8.003, 95% CI: 6.965-9.196 $P<0.001$) and CSS(HR=52.909, 95% CI: 43.693-64.068 $P<0.001$). In terms of treatment, patients who choose breast-conserving surgery had better survival benefits than the others. Compared to patients who chose breast conserving surgery, mastectomy group OS(HR=1.339, 95% CI: 1.802-3.137 $P<0.001$) and CSS(HR =11.991, 95% CI: 8.181-17.576 $P<0.001$). Patients who choose radiotherapy can obviously get better OS and CSS, while without radiation therapy group OS(HR=2.193, 95% CI: 2.060-2.334 $P<0.001$) and CSS(HR =2.308, 95% CI: 1.989-2.677 $P<0.001$). After Multivariate Cox Regression Analysis, we could also get the conclusion above (Table 2 and 3).

Analysis of marital status at different stages in age subgroup

In order to further explore the influence of marital status on the survival outcome of PMBC patients at different ages, we stratified all the included patients according to their ages and conducted Kaplan-Meier survival curve and Log-Rank test. Figure 3 shows Kaplan–Meier curve of OS rates in different ages: For PMBC patients aged over 45 years, the OS and CSS survival curves of the married group were both better than those of the not married group, all of which were $P\geq 0.001$, which were statistically significant. For patients aged 45-54, the OS of the marrieds and the not marrieds were 93.27% vs 89.78%; In age 55-64 years old, the difference in survival outcome was most obvious in two marital states that the OS of the marrieds and the not marrieds were 89.07% vs 81.78%; In aged 65-74 years group, the OS of the marrieds and the not marrieds were 78.16% vs 70.28%; And in aged older than 75 years group, the OS of the marrieds and the not marrieds were 52.09% vs 41.01%. All the above results have been Log-Rank test: $P\leq 0.001$.

Analysis of marital status at different stages in SEER stage subgroup

We then assessed the effect of marital status on survival at each stage of the PMBC (Table 4). The results showed that marital status was an independent prognostic factor affecting survival and prognosis for PMBC patients with cancer stage I, II and IV ($P \leq 0.005$). Since the sample size of stage III was too small ($N=109$), there was no statistical difference after examination. In each SEER stage, the OS rate of the married group and the not married group was 80.80% vs 65.81% (stage I), 78.18% vs 59.81% (stage II), 58.54% vs 50.00% (stage III), 29.17% vs 20.94% (stage IV); The CSS rate of the married group and the not married group was 97.75% vs 96.47% (stage I), 94.93% vs 92.39% (stage II), 73.17% vs 73.53% (stage III), 40.63% vs 36.13% (stage IV). In the CSS uni-variate risk models, we also saw that for patients in stage I, II, and IV cancers, the unmarried group had a higher risk of dying from PMBC than the married group. Using the married group as a reference, the not married group had a significantly higher risk of cancer-specific mortality: Stage I: (HR = 1.804, 95% CI: 1.423-2.286; $P < 0.001$), Stage II: (HR = 1.758, 95% CI: 1.389-2.226; $P < 0.001$), Stage IV: (HR = 1.583, 95% CI: 1.153-2.280; $P = 0.005$).

Discussions

PMBC has become a “niche” tumor due to its low incidence, and there are few modern clinical studies on it. Similarly, it also has the characteristics of small tumor size, benign disease variation, low grade, low recurrence rate and high survival rate[8-9, 24]. There will be more treasures to be found in his research. On the other side, there have been extensive studies on the effect of marital status on the quality of life of cancer patients, especially breast cancer patients[16, 21, 25-26]. However, in clinical trials and epidemiology, there have been no studies on the effect of marital status on survival outcomes in patients with PMBC.

The purpose of this research is to investigate whether marital status has a significant impact on the survival outcome of PMBC. Through a series of data analysis, it has been found that there are significant differences in OS and CSS between the marrieds and the not marrieds, the married patients can achieve a better survival outcome than the not marrieds. The results indicated that marital status was an independent prognostic factor for the survival of PMBC patients. In addition, for patients older than 45 years of age, or with stage I, II, and IV tumors, the not married people have a significantly higher risk of dying from cancer than the marrieds.

Some studies have suggested that the hysteresis of disease diagnosis is one reason for the poor survival outcomes of the not married patients[17]. Looking deeper, it turns out that for older breast cancer patients, several researchers have proposed that spouses promote positive health behavior (i.e. regular screening and timely medical treatment), which would promote earlier diagnosis[17, 28-29]. Late diagnosis directly affects the survival rate of cancer patients[27]. The PMBC patients in our study were older, with a median age of 68 years old. While the median age of diagnosis for the married and the not married groups was 64 vs 72 years old. Obviously, there were significant differences in the age of diagnosis. The married patients showed a tendency toward earlier and more timely diagnosis than the the not marrieds.

At the same time, there are also studies that suggested that marital status played a role in the treatment stage of cancer patients, resulting in differences in their survival and prognosis[16]. For patients with inferior marital status, they often need to worry about whether they can bear the economic and social pressure brought by cancer treatment, thus increasing uncertain risk factors in the selection of clinical treatment programs. Previous studies have shown that the not married patients were more likely than married patients to have a longer interval between surgery and radiation and to show lower adherence to treatment, which leading to poorer outcomes[30]. Anan et al. [22] suggested that patients with PMBC, except for those invading the local skin, are suitable candidates for breast-conserving therapy. Yang et al. [24] also considered that adjuvant radiotherapy and endocrine therapy after breast-conservation were recommended for PMBC. From the results of our study, we can find that married patients are more likely to choose breast conserving surgery than the not marrieds in terms of surgical options. And in terms of whether or not to accept radiotherapy, the proportion of married patients and the not marrieds choosing radiotherapy is 54.3% vs 43.1%. The marital status did influence the choice of surgery and chemotherapy for PMBC patients. Meanwhile, proportional hazards model also proved that patients who didn't choose breast conserving surgery or radiotherapy did have a higher risk of dying from cancer.

More generally, it is believed that the lack of social support and more psychological pressure are the main reasons for the poor survival outcomes of patients with inferior marital status[16, 32]. The impact of psychological distress is more severe in those with cancer than those living with other chronic health conditions[31], and studies also suggest that unmarried adults reported more difficulty adjusting to some aspects of their illness than did married adults. Unmarried patients reported more dysphoric thoughts and feelings (e.g., sadness, reduced self-esteem, body image problems) directly related to their illness than did married patients[32]. In our study, there were also differences in the effect of marital status on survival outcomes of PMBC patients at different ages (Figure 3). For PMBC patients older than 45 years old, the OS survival curve between the two marital states is significantly different. We suspect that for women older than 45, who are more likely to be in perimenopause or postmenopause, are more likely to produce negative emotions. Study has shown that new onset of depression was also more likely to occur when a woman was peri-or postmenopausal[33]. This also suggests that paying attention to the psychological state of unmarried people with cancer, providing adequate social support and psychological counseling may be an effective treatment direction to deal with the increased risk of death caused by unmarried cancer patients in the future.

However, there are some limitations and problems in our study. First of all, it is possible that some patients cohabited with a partner in the absence of marriage, although the percentage of Americans engaged in such a living arrangement was likely small. In this study, we define them as an the not married population, but in fact, these people have better marital status than unmarried people. Secondly, limited by the SEER database information, we can only obtain the marital status of the included patients at the time of diagnosis. For those whose marital status changed in subsequent stages, it is an unknown factor. Third, prognostic factors associated with marital status that affect patient survival (for example, education, socioeconomic status, and lifestyle) are not included in the SEER database, which bring limitations to our research. Last, our study hypothesize that social and psychological factors may affect

survival outcomes of unmarried patients, though this can not be validated due to lack of relevant data, but still gives us some hints.

Conclusions

In summary, by analyzing the information of 14,972 PMBC patients in this study, we found that the risk of death in unmarried patients was significantly higher than that in married patients. The married pure mucinous breast carcinoma patients can obtain better OS and CSS than unmarried patients. Marital status is an independent factor affecting the survival of PMBC patients. We speculate that marital status influences the difference in survival and prognosis of patients by influencing the diagnosis stage, treatment stage and psychological state of patients. The significance of this study is that the not married people in PMBC patients will be a focus target in our clinical treatment, and we should consider investing in targeted social support services and interventions to help reduce significant survival differences between married and unmarried cancer patients paying attention to the psychological state of cancer patients in different marital states will be our future research direction.

Declarations

Ethics approval and consent to participate

The study was approved by the ethics committee of Guang Dong Provincial Hospital of Chinese Medicine.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed during the current study are available in the [Surveillance, Epidemiology, and End Results (SEER)] repository. (<http://seer.cancer.gov>)

Competing interests

The authors declare that they have no conflicts of interest.

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Authors' contributions

Conception and design: Fan Tang, Xiaoqing Wei, Yuzhu Zhang, Liping Dian; Administrative support: Rui Xu; Liping Ren; Quzhi Zhou; Qianjun Chen; Yuzhu Zhang; Data analysis and interpretation: Fan Tang, Xiaoqing Wei, Yuzhu Zhang, Liping Dian; Manuscript writing: Fan Tang; Final approval of manuscript: all of the authors.

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Authors' information

Fan Tang; Xiaoqing Wei; Liping Dian; Rui Xu; Liping Ren; Quzhi Zhou; Qianjun Chen; Yuzhu Zhang.

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Tables

Table 1. Baseline demographic characteristics of patients stratified by marital status (%)

Characteristic	Married (n=7462)	Not Married (n=7510)	P
Age/year			0.000
≤35	86(1.2)	101(1.3)	
35-44	673(9.0)	399(5.3)	
45-54	1308(17.5)	763(10.2)	
55-64	1665(22.3)	1136(15.1)	
65-74	2125(28.5)	1797(23.9)	
≥75	1605(21.5)	3314(44.1)	
Sex			0.010
female	7421(99.5)	7489(99.7)	
male	41(0.5)	21(0.3)	
Grade			0.020
Well differentiated	3861(51.7)	3750(49.9)	
Moderately differentiated	2153(28.9)	2182(29.1)	
Poorly differentiated	285(3.8)	275(3.7)	
Undifferentiated; anaplastic	25(0.3)	16(0.2)	
Unknown	1138(15.3)	1287(17.1)	
AJCC 6th Stage			0.000
I	5194(69.6)	4703(62.6)	
II	2131(28.6)	2548(33.9)	
III	41(0.5)	68(0.9)	
IV	96(1.3)	191(2.6)	
AJCC 6th T			0.000
T0	1(0.0)	1(0.0)	
T1	5458(73.1)	4906(65.3)	
T2	1746(23.4)	2087(27.8)	
T3	147(2.0)	292(25)	
T4	11(0.1)	25(0.3)	
TX	3(0.0)	8(0.1)	
Any T, Mets	96(1.3)	191(2.5)	
AJCC 6th N			0.000
N0	6832(91.6)	6834(91.0)	
N1	542(7.3)	518(6.9)	
N2	9(0.1)	14(0.2)	
N3	49(0.7)	91(1.2)	
NX	30(0.4)	53(0.7)	
AJCC M			0.000
M0	7366(98.7)	7319(97.5)	
M1	98(1.3)	191(2.5)	
Operation			0.000
BCS	5032(67.4)	4727(62.9)	
Mastectomy	2247(30.1)	2423(32.3)	
NO	183(2.4)	360(4.8)	
Radiation therapy			0.000
Yes	4052(54.3)	3236(43.1)	
No	3410(45.7)	4274(56.9)	
Chemotherapy			0.000
Yes	1142(15.3)	823(11.0)	
No	6320(84.7)	6697(89.0)	
Regional node examined			0.000
0	715(9.6)	1360(18.1)	
1-3	3486(46.7)	3114(41.5)	
4-9	1681(22.5)	1463(19.5)	
≥10	1514(20.3)	1502(20.0)	
Unknown	66(0.9)	71(0.9)	
Regional node positive			0.000
0	6178(82.8)	5604(74.6)	
1-3	498(6.7)	462(6.2)	
4-9	15(0.2)	12(0.2)	
≥10	31(0.4)	42(0.6)	
Unknown	740(9.9)	1390(18.5)	
ER			0.000
Negative	6776(90.0)	6697(86.2)	

Positive	157(2.1)	153(2.0)	
Unknown	526(7.0)	857(8.7)	
Borderline	3(0.0)	3(0.0)	
PR			0.050
Negative	5995(80.3)	5921(78.8)	
Positive	795(10.7)	793(10.6)	
Unknown	638(8.5)	772(10.3)	
Borderline	34(0.5)	24(0.3)	
Vital status			0.000
Alive	5915(79.3)	4693(62.5)	
Dead	1547(20.7)	2817(37.5)	

1) Abbreviations: PMBC, Pure mucinous breast carcinoma; AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; ER, estrogen receptor; PR, progesterone receptor.

2) All *P* values comparing characteristics of married and unmarried patients

3) Percentages may not add up to 100 because of rounding.

Table 2. Univariate analysis and multivariate analyses of overall survival of patients with PBMC

Characteristic	Univariate analysis			Multivariate analysis		
	OS HR	95% CI	P value	OS HR	95% CI	P value
Marital status						
Married	Reference			Reference		
Not Married	2.150	2.020-2.288	0.000	1.363	1.277-1.454	0.000
Age/year						
≤34	Reference			Reference		
35-44	1.347	0.676-2.685	0.398	1.302	0.653-2.597	0.453
45-54	1.568	0.802-3.067	0.189	1.620	0.828-3.171	0.159
55-64	2.894	1.494-5.604	0.002	3.125	1.611-6.061	0.001
65-74	5.562	2.932-10.895	0.000	6.065	3.138-11.724	0.000
≥75	17.391	9.038-33.464	0.000	14.911	7.719-28.804	0.000
Sex						
Women	Reference			Reference		
Men	1.369	0.900-2.081	0.142	1.545	1.013-2.357	0.044
Grade						
Grade I	Reference			Reference		
Grade II	1.019	0.948-1.095	0.610	1.037	0.964-1.116	0.328
Grade III	1.114	0.954-1.300	0.174	1.273	1.087-1.492	0.003
Grade IV	1.028	0.618-1.708	0.916	1.584	0.951-2.637	0.077
Unknown	1.169	1.083-1.262	0.000	0.972	0.897-1.052	0.481
AJCC 6th Stage						
I	Reference			Reference		
II	1.415	1.327-1.508	0.000	1.412	1.317-1.514	0.000
III	2.377	1.802-3.137	0.000	1.273	0.820-1.975	0.283
IV	8.003	6.965-9.196	0.000	4.112	3.443-4.910	0.000
Operation						
BCS	Reference			Reference		
Mastectomy	1.339	1.256-1.426	0.000	1.045	0.962-1.135	0.301
NO/Unknown	5.987	5.324-6.732	0.000	1.588	1.361-1.854	0.000
Radiation therapy						
Yes	Reference			Reference		
No	2.193	2.060-2.334	0.000	1.471	1.362-1.590	0.000
Chemotherapy						
Yes	Reference			Reference		
No	2.023	1.814-2.256	0.000	0.909	0.802-1.030	0.134
ER						
Negative	Reference			Reference		
Positive	1.198	0.995-1.443	0.056	1.366	1.119-1.669	0.002
Unknown	1.432	1.313-1.562	0.000	1.081	0.879-1.329	0.460
Borderline	1.277	0.412-3.961	0.672	0.945	0.303-2.948	0.923
PR						

Negative	Reference			Reference		
Positive	1.101	1.003-1.208	0.042	1.062	0.961-1.173	0.237
Unknown	1.365	1.256-1.483	0.000	0.997	0.820-1.212	0.972
Borderline	0.968	0.624-1.503	0.886	1.216	0.782-1.891	0.420
Regional nodes examined						
0	Reference			Reference		
1-3	0.252	0.232-0.273	0.000	0.604	0.354-1.030	0.064
4-9	0.303	0.277-0.331	0.000	0.680	0.398-1.161	0.158
≥10	0.324	0.299-0.352	0.000	0.666	0.390-1.136	0.136
Unknown	0.647	0.496-0.844	0.000	0.873	0.578-1.320	0.520
Regional node positive						
0	Reference			Reference		
1-3	1.116	0.983-1.268	0.090	0.938	0.816-1.077	0.365
4-9	1.746	0.938-3.248	0.079	1.513	0.793-2.886	0.209
≥10	2.313	1.614-3.315	0.000	2.499	1.414-4.418	0.002
Unknown	3.516	3.289-3.759	0.000	1.095	0.644-1.861	0.738

Abbreviations: PMBC, Pure mucinous breast carcinoma; OS, overall survival; AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; ER, estrogen receptor; PR, progesterone receptor.

Table 3. Univariate analysis and multivariate analyses of cancer-specific survival of patients with PBMC

Characteristic	Univariate analysis			Multivariate analysis		
	CSS HR	95% CI	P value	CSS HR	95% CI	P value
Marital status						
Married	Reference			Reference		
Not Married	1.942	1.681-2.244	0.000	1.377	1.182-1.603	0.000
Age/year						
≤34	Reference			Reference		
35-44	1.240	0.564-2.725	0.592	1.081	0.488-2.391	0.848
45-54	1.073	0.497-2.318	0.857	1.095	0.503-2.386	0.818
55-64	1.029	0.479-2.211	0.941	1.223	0.564-2.654	0.610
65-74	1.254	0.589-2.668	0.558	1.799	0.834-3.883	0.131
≥75	2.639	1.249-5.576	0.011	2.902	1.347-6.253	0.007
Sex						
Women	Reference			Reference		
Men	2.003	0.897-4.472	0.09	1.799	0.798-4.057	0.157
Grade						
Grade I	Reference			Reference		
Grade II	1.500	1.266-1.778	0.000	1.215	1.022-1.445	0.027
Grade III	3.479	2.703-4.477	0.000	1.913	1.462-2.504	0.000
Grade IV	1.530	0.491-4.773	0.463	1.472	0.469-4.618	0.508
Unknown	1.576	1.307-1.901	0.000	0.879	0.719-1.075	0.210
AJCC 6th Stage						
I	Reference			Reference		
II	2.590	2.202-3.046	0.000	2.145	1.795-2.563	0.000
III	11.991	8.181-17.576	0.000	2.741	1.27-5.839	0.009
IV	52.909	43.693-64.068	0.000	18.709	14.010-24.984	0.000
Operation						
BCS	Reference			Reference		
Mastectomy	1.953	1.670-2.284	0.000	1.275	1.042-1.560	0.018
NO/Unknown	20.165	16.660-24.407	0.000	1.966	1.448-2.670	0.000
Radiation therapy						
Yes	Reference			Reference		
No	2.308	1.989-2.677	0.000	1.252	1.039-1.510	0.018
Chemotherapy						
Yes	Reference			Reference		
No	0.531	0.451-0.625	0.000	0.679	0.553-0.834	0.001
ER						
Negative	Reference			Reference		
Positive	2.628	1.930-3.579	0.000	1.213	0.853-1.725	0.282
Unknown	1.497	1.216-1.845	0.000	1.297	0.770-2.183	0.328
Borderline	2.542	0.357-18.073	0.000	0.784	0.100-6.131	0.817
PR						

Negative	Reference			Reference		
Positive	1.935	1.612-2.322	0.000	1.554	1.269-1.903	0.000
Unknown	1.509	1.234-1.845	0.000	0.850	0.517-1.399	0.523
Borderline	1.836	0.821-4.106	0.139	2.296	0.994-5.299	0.052
Regional nodes examined						
0	Reference			Reference		
1-3	0.151	0.124-0.184	0.000	0.218	0.087-0.548	0.001
4-9	0.241	0.196-0.296	0.000	0.287	0.114-0.723	0.008
≥10	0.304	0.253-0.364	0.000	0.268	0.107-0.675	0.005
Unknown	1.175	0.768-1.798	0.458	0.654	0.389-1.100	0.110
Regional node positive						
0	Reference			Reference		
1-3	2.794	2.216-3.521	0.000	1.103	0.851-1.430	0.383
4-9	7.740	3.455-17.342	0.000	1.366	0.571-3.271	0.484
≥10	12.259	8.048-18.675	0.000	3.627	1.552-8.474	0.003
Unknown	5.647	4.847-6.580	0.000	0.567	0.228-1.411	0.223

Abbreviations: PMBC, Pure mucinous breast carcinoma; CSS, cancer-specific survival; AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; ER, estrogen receptor; PR, progesterone receptor.

Table 4. Univariate analysis of overall survival and cancer-specific survival of PMBC patients with marital status in different cancer stage

Characteristic	Univariate analysis (OS)				Univariate analysis (CSS)			
	OS%	OS HR	95% CI	P value	CSS%	CSS HR	95% CI	P value
Stage I								
Married	80.80%	Reference			97.75%	Reference		
Not Married	65.81%	2.072	1.914-2.242	0.000	96.47%	1.804	1.423-2.286	0.000
Stage II								
Married	78.18%	Reference			94.93%	Reference		
Not Married	59.81%	2.197	1.968-2.452	0.000	92.39%	1.758	1.389-2.226	0.000
Stage III								
Married	58.54%	Reference			73.17%	Reference		
Not Married	50.00%	1.292	0.720-2.315	0.390	73.53%	1.019	0.481-2.161	0.960
Stage IV								
Married	29.17%	Reference			40.63%	Reference		
Not Married	20.94%	1.656	1.239-2.213	0.001	36.13%	1.583	1.153-2.280	0.005

Abbreviations: PMBC, Pure mucinous breast carcinoma; OS, overall survival; CSS, cancer specific survival.

Figures

Figure 1

Figure 1

Flowchart for included patients from the SEER database.

Figure 2

Figure 2

Kaplan-Meier Survival curves: The overall survival (A) and Cancer-specific survival (B) of patients with pure mucinous breast carcinoma to marital status. A): $\chi^2=510.213$ P=0.000; B): $\chi^2=55.664$ P=0.000.

Figure 3

Figure 3

Analysis of marital status at different stages in age subgroup: Kaplan-Meier Survival curves: The overall survival of patients with pure mucinous breast carcinoma to marital status: A): age: <35 years group, $\chi^2=0.812$ P=0.367; B): age: 35-44 years group, $\chi^2=3.386$ P=0.066; C): age: 45-54 years group, $\chi^2=10.402$ P=0.001; D): age: 55-64 years group, $\chi^2=41.422$ P=0.000; E: 65-74 years group $\chi^2=41.319$ P=0.000; F: age >75 years old, $\chi^2=65.234$ P=0.000.