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EPIDEMIOLOGY

Impact of newly diagnosed breast cancer on quality of life among Chinese women

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Abstract
Background Being diagnosed with breast cancer is a very stressful event that has a profound impact on multiple aspects of a patient's daily life. Little is known about the quality of life (QOL) of Chinese women with newly diagnosed breast cancer.
Methods The authors evaluated QOL in 2,236 Chinese women with newly diagnosed breast cancer who were recruited into the Shanghai Breast Cancer Survival Study between April 1, 2002 and March 31, 2004. Patients' QOL was assessed after cancer diagnosis (median time 6.4 months; range 3.6–11.1 months) by using the General Quality of Life Inventory. Multiple linear regression models were used to analyze the associations of QOL outcomes with medical and socio-demographic factors.
Results Patients showed significantly worse overall QOL and perceived health status than healthy women, reflected mainly by lower QOL scores in physical and psychological well-being domains. Completion of radiotherapy, ever use of tamoxifen, being underweight, having an increased number of chronic diseases, and low household income were significantly associated with lower overall QOL scores after adjusting for other factors. Age at diagnosis was inversely associated with physical well-being, positively associated with material well-being, and had minimal influence on overall QOL. Stage of disease, chemotherapy, and education were only associated with certain domains, but had no influence on overall QOL. Estrogen receptor/progesterone receptor status and type of surgery or immunotherapy did not appear to be associated with QOL.
Conclusions The findings of the present study provide important information on QOL and their correlates among Chinese women with newly diagnosed breast cancer and are helpful in developing treatment strategies accordingly.

Keywords breast cancer · quality of life · Chinese women

Introduction

Breast cancer is by far the most frequently occurring cancer in women throughout the world [1]. Although traditionally the incidence rate of breast cancer in China has been lower than that in Western countries, it has markedly increased during the last few decades. For instance, younger women in Shanghai, the largest industrialized city in China, experienced a greater than 85% increase in breast cancer incidence from 1972 to 1994 [2]. It has been estimated that the age-standardized incidence rate of breast cancer among Chinese women has increased from 19.9 per 100,000 in 2002 to 24.8 per 100,000 in 2005 [3]. Given

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that China is a highly populous country, the absolute number of new cases of breast cancer among Chinese women, in fact, represents one of the largest populations of breast cancer patients in the world. Furthermore, with the improved survival rate of breast cancer patients due to advancements in cancer treatment, quality of life (QOL) among Chinese patients represents a significant issue faced by health care providers and society at large.

During the past decade, research on QOL issues among breast cancer patients has been extensively conducted among North American and Western European populations [4, 5]. QOL is a multidimensional construct that consists of at least physical, psychological, and social dimensions and that represents a patient's perception of the effects of a disease and its related treatments on his or her daily functioning [6, 7]. Because the assessment of QOL can uniquely reflect insights into patients' perceived needs, it has now been established as an important endpoint in cancer medicine [8–10]. Treatment for breast cancer involves a multimodality of approaches, including surgery, chemotherapy, radiotherapy, and/or endocrine therapy. Each of these therapies and/or their various side effects may have the potential to affect patients' QOL. Furthermore, QOL is subjective in nature, and patients may interpret their feeling of well-being using expectation, perception, and religious or community beliefs, each of which may vary from population to population [9, 11]. Thus, not only medical factors but also socio-cultural background may influence a patient's QOL and its measure [12, 13]. Findings from studies on QOL conducted in Western societies may not be directly generalizable cross-culturally or cross-nationally. To date, very little is known about the QOL of breast cancer patients in China [14].

We have previously reported on the long-term impact of medical and socio-demographic factors on the QOL of 1,065 Chinese breast cancer survivors (median survival time 4.3 years) [14]. However, breast cancer patients may have specific needs at different stages over the course of the disease [7]. In the present study, we evaluate QOL in a cohort of 2,236 breast cancer patients approximately 6 months after cancer diagnosis, and systematically examine the effects of socio-demographic and medical factors on their QOL using data collected in the Shanghai Breast Cancer Survival Study (SBCSS). This information will be valuable in identifying the areas of life in which these patients may need specific support and subsequently lead to the development of treatment and prevention strategies.

Subjects and methods

Study population

Study subjects were women who were diagnosed with a primary breast cancer and were enrolled in the SBCSS, a large epidemiologic study of breast cancer survivors in China. All study subjects were permanent residents of urban Shanghai, were between the ages of 25 and 70, had no prior history of cancer, and were alive at the time of interview. Through the population-based Shanghai Cancer Registry, 2,600 eligible breast cancer patients were identified during the period between April 1, 2002 and March 31, 2004, and in-person interviews were completed for 2,236 (86%) of them, approximately 6 months after diagnosis. The major reasons for non-participation included refusal (237 cases, 9.1%), inability to locate (104 cases, 4%), and health or communication problems (23 cases, 0.9%). In addition, 100 healthy women were randomly selected from the control group (20 women for each age group: <40, 40–49, 50–59, ≥60) to participate in a population-based, case–control study that was concurrently conducted in the same area as the QOL survey. The study was approved by the institutional review boards of all institutions involved in the study.

Data collection

Data were collected via an in-person interview and through medical chart abstraction using structured questionnaires. Information gathered from breast cancer patients fell into two groups. The first group included socio-demographic and lifestyle-related factors such as age at diagnosis, marital status, annual household income, educational level, age at first live birth, age at menarche, age at menopause, menopausal status, and weight and height (from which body mass index, BMI, was calculated). The second group included disease- and treatment-related factors such as stage of breast cancer at the time of primary diagnosis, co-mobility, estrogen receptor (ER) and progesterone receptor (PR) status, surgery, chemotherapy, radiotherapy, tamoxifen use, and immunotherapy. The QOL of both breast cancer patients and healthy subjects was assessed by using the General Quality of Life Inventory-74 (GQOLI-74), which has been demonstrated to have a satisfactory level of reliability, validity, and sensitivity in the Chinese population [14–16]. This questionnaire comprises a total of 74 items that can be grouped into 20 facets including a perceived global health status/QOL assessment and covers four domains. (1) The physical well-being domain sleep and energy, pain and physical discomfort, eating functioning, sexual functioning, sensory function, and capability of daily living. (2) The psychological well-being domain, includes psychological distress, negative feelings, positive feelings, cognitive functioning, body/self-image. (3) The social well-being domain includes social support, interpersonal relationships, work and study capacity, recreational and leisure activities, marriage and family. (4) The material well-being domain includes housing situation, community services, living environment, financial situation. Participants' responses were converted to a score according to a scale from 0 to 100 for each domain and facet, with higher scores reflecting better QOL. We did not included analysis of sexual functioning because over 93% patients reported no sexual activity during the week prior to interview.

Statistical analyses

Statistical analyses were performed by using Statistical Analysis Software (version 10, SAS Institute, Cary, NC, USA). Multiple linear regression models were used to estimate the mean differences and 95% confidence intervals of QOL scores across categories of medical and socio-demographic variables. This allowed us to evaluate the independent effect of each of these variables on QOL outcomes with adjustment for confounding from other variables in the model. Tests for trend were performed by entering the categorical variables as continuous parameters in the models. The significance level for all analyses was set at α=0.05, and all tests were two-sided.

Results

Table 1 summarizes the socio-demographic and medical characteristics of the 2,236 breast cancer patients. The mean age at diagnosis for the patients was 53.5 years and half of them (49.4%) were post-menopausal. The majority of these women were married or living with a partner (87.3%) and had an annual household income greater than 10,000 yuan (65.2%). Half of them (50.9%) had attained a high school or higher education. On average, age at menarche was 14.4 years, age at first live birth was 26.6 years, and age at menopause about 49.9 years for this patient population. Approximately 35% of women were overweight or obese (BMI>25 or ≥30), and 40% had at least one type of chronic disease, including diabetes, hypertension, coronary heart disease, stroke, chronic obstructive pulmonary disease, chronic hepatitis, chronic gastritis, or asthma. Cancer stage information was available for 92% of patients, and the majority of cases were stage 0–I (33%) and stage II (50.6%). The median time between the initial diagnosis of breast cancer and the survey was 6.4 months (range=3.6–11.1 months; data not shown in Table 1). During this period of time, almost all participants (99.4%) had undergone surgery for breast cancer, 72.4% had received and 18.8% were on adjuvant chemotherapy, 25.4% had received and 5.1% were receiving radiotherapy, 45.3% were current and 12% were former users of tamoxifen, and 3.7% were current and 9.8% had completed immunotherapy.

Table 2 shows the averaged crude scores of overall QOL, adjusted mean differences for overall QOL scores, and domain-specific and facet-specific scores for breast cancer patients and healthy subjects. Compared to healthy subjects, breast cancer patients showed significantly lower overall QOL scores and worse perception of global health status/QOL, which was due mainly to lower QOL scores in physical and psychological well-being domains. Breast cancer patients were more likely than healthy subjects to report poorer sleep and lack of energy, more pain and physical discomfort, impaired eating functioning, and capability of daily living. They were more likely to experience psychological distress, both negative and positive feelings, such as depression and anxiety, and diminished cognitive functioning. No significant difference was observed in social and material well-being domains between these two groups. However, patients were more likely to report impaired work and study capacity and problems with marriage and family issues, although they also identified receiving more social support.

We further examined the effects of socio-demographic and medical factors on the patients' QOL. As shown in Tables 3 and 4, overall QOL was significantly associated with household income, number of additional chronic diseases, BMI, radiotherapy, and tamoxifen use. Household incomes were positively associated with all QOL domains, while existence of other chronic diseases was inversely associated with QOL in almost all domains. Underweight (BMI<18.5) was associated with poorer QOL in almost all well-being domains, with the exception of psychological and material domains, whereas patients with a BMI of 25–29.9 reported a better perceived health status and QOL in the physical and psychological domains. Patients who had received radiotherapy reported poorer perception of their QOL and had lower scores in overall QOL, as well as the physical and social domains. Patients who were receiving tamoxifen reported better physical well-being, as well as better perception of QOL, whereas those who had stopped tamoxifen

Table 1 Socio-demographic and medical characteristics of breast cancer patients, Shanghai Breast Cancer Survival Study

Characteristics	Number (*n*=2,236)	Percentage (%)	Characteristics	Number (*n*=2,236)	Percentage (%)
Age at diagnosis (years)			Type of surgery		
<40	126	5.6	Radical mastectomy	2,149	96.1
40–49	893	39.9	Conservation	50	2.2
50–59	599	26.8	Surgery, type unknown	24	1.1
≥60	618	27.7	No surgery	13	0.6
Marital status			Chemotherapy		
Married/living with partner	1,951	87.3	Yes	2,052	
Unmarried/single/widowed/divorced	285	12.7	Current	420	18.8
			Complete	1,618	72.4
Education			Unknown	14	0.6
<High school	1,098	49.1	No	184	8.2
=High school	803	35.9			
>High school	335	15.0	Radiotherapy		
			Yes	681	
Household income (yuan/year)			Current	114	5.1
<10,000	778	34.8	Complete	567	25.4
10,000–19,999	1,259	56.3	No	1,555	69.5
≥20,000	199	8.9			
			Tamoxifen use		
Menopausal status			Yes	1,281	
Pre-menopause	1,131	50.6	Current	1,013	45.3
Post-menopause	1,105	49.4	Complete	268	12.0
			No	955	42.7
BMI					
<18.5	77	3.4	ER status		
18.5≤BMI<25	1,373	61.4	Positive	1,335	59.7
25≤BMI<30	648	29.0	Negative	681	30.5
≥30	138	6.2	Unknown	220	9.8
Number of live births			PR status		
0	125	5.6	Positive	1,258	56.3
1	1,413	63.2	Negative	725	32.4
2	394	17.6	Unknown	253	11.3
≥3	304	13.6			
			Immunotherapy		
Age at first live birth (mean ± SD)	2,137	26.6±4.9	Yes	301	
			Current	82	3.7
Age at menarche (mean ± SD)	2,236	14.4±1.6	Complete	219	9.8
			No	1,935	86.5
Age at menopause (mean ± SD)	1,131	49.9±5.1			
			Stage		
Number of chronic diseases			0–I	739	33.0
0	1,345	60.1	IIa	710	31.8
1	596	26.7	IIb	421	18.8
2	215	9.6	III or IV	169	7.6
≥3	80	3.6	Unknown	197	8.8

treatment had a lower overall QOL score due mainly to poorer psychological and material well-being. Age at diagnosis was inversely associated with the patients' QOL scores in the physical domain (trend $p<0.0001$) and was positively associated with the material domain (trend $p<0.0001$); thus, the null association observed between age and overall QOL may be due to the opposite associations of these two domains with age. Stage of disease, chemotherapy, and education level were associated with certain QOL domain(s), although they did not influence overall QOL. Specifically, an advanced stage of disease was significantly associated with worse social well-being. Patients who were currently on chemotherapy had a lower QOL score in the physical domain, while patients who had completed chemotherapy had a QOL score similar to those who did not receive chemotherapy. Although patients' perceptions of QOL may be influenced by marital status or menopausal status, their overall QOL, as well as the major QOL domains, were not influenced. No significant associations were found between overall QOL or the major QOL domains and ER/PR status,

Table 2 Averaged crude scores and adjusted mean difference of scores for overall QOL, each domain and facet for breast cancer survivors and healthy women, Shanghai Breast Cancer Survival Study

Overall QOL/domains/facets	Averaged crude scores		Adjusted mean difference of scores
	Breast cancer patients (*n*=2,236) Mean ± SD	Healthy subjects (*n*=100) Mean ± SD	
Overall QOL	61.8±8.6	64.9±8.7	**–2.9 (–4.7, –1.2)**
Physical domain	61.9±12.1	68.4±12.9	**–5.9 (–8.4, –3.4)**
Sleep and energy	13.1±2.7	14.0±2.9	**–0.8 (–1.4, –0.3)**
Pain and physical discomfort	14.1±2.9	14.9±3.1	**–0.7 (–1.3, –0.1)**
Eating functioning	14.4±2.4	15.2±1.9	**–0.8 (–1.2, –0.3)**
Capability of daily living	14.0±2.0	15.7±2.3	**–1.5 (–1.9, –1.1)**
Psychological domain	68.0±11.0	71.7±10.7	**–3.5 (–5.7, –1.3)**
Psychological distress	16.2±2.2	16.8±2.3	**–0.7 (–1.1, –0.2)**
Negative feelings	15.4±2.3	15.9±1.8	**–0.5 (–1.0, –0.1)**
Positive feelings	14.7±2.8	15.5±2.8	**–0.7 (–1.3, –0.1)**
Cognitive functioning	14.2±2.3	14.8±2.4	**–0.5 (–1.0, –0.1)**
Body/self-image	14.0±1.9	14.3±1.7	–0.3 (–0.7, 0.1)
Social domain	64.2±9.5	65.7±9.6	–1.7 (–3.6, 0.2)
Social support	14.7±2.9	14.0±3.0	**0.7 (0.1, 1.3)**
Interpersonal relationship	16.3±1.9	16.0±2.1	0.3 (–0.1, 0.6)
Work and study capacity	12.6±2.0	13.8±1.6	**–1.2 (–1.6, –0.8)**
Recreational and leisure activities	13.0±1.9	12.8±1.8	0.2 (–0.2, 0.6)
Marriage and family	14.7±2.3	15.9±2.4	**–1.3 (–1.8, –0.8)**
Material domain	52.5±13.6	53.2±12.5	–0.7 (–3.4, 2.0)
Housing situation	14.0±3.4	14.0±3.5	0.0 (–0.7, 0.7)
Community services	11.5±2.8	12.2±2.7	**–0.6 (–1.2, –0.1)**
Living environment	12.2±3.5	11.7±3.3	0.5 (–0.2, 1.2)
Financial situation	11.9±3.1	12.2±2.9	–0.3 (–0.9, 0.3)
Perception of global health status/QOL	12.9±2.2	13.4±2.2	**–0.4 (–0.9, 0)**

Obtained from multiple linear regression models with adjustment for age, education, income, and marital status
Bold face indicates statistical significance

type of surgery, or immunotherapy. We also found null associations for QOL and the major reproductive risk factors for breast cancer (age at first live birth, age at menarche, and age at menopause; data not shown in Tables 3 and 4).

Discussion

This study is the first to evaluate the impact of newly diagnosed breast cancer on QOL and to comprehensively examine the role of medical and socio-demographic factors in the QOL of Chinese breast cancer survivors shortly after cancer diagnosis in a large-scale, population-based setting. Our data indicate that newly diagnosed breast cancer has a negative impact on patients' physical, psychological, and social well-being, in turn, leading to a poorer overall QOL. Furthermore, we identified that radiotherapy, tamoxifen use, BMI, additional chronic diseases, and household income were significantly associated with overall QOL and multiple QOL domains; whereas other factors, including advanced stage of disease, age at diagnosis, educational level, and chemotherapy may influence certain aspects of QOL, but not overall QOL. Methodological strengths of the study include a large sample size, population-based study design, high participation rate, using a group of healthy subjects as a reference, and ability to simultaneously examine both the medical and socio-demographic factors of QOL.

Stage of breast cancer is an important predictor of survival. Although it is commonly assumed that patients with advanced breast cancer may suffer from a variety of symptoms, little information is available on the relationship between stage of breast cancer and QOL. A recent study reported that there are no meaningful differences in QOL among newly diagnosed breast cancer patients with stage 0–II [17]. In our study, patients with more advanced disease only showed poorer QOL scores in the social well-being domain. These findings suggest that cancer diagnosis in general, rather than severity of the disease, is the critical factor that impacting QOL among newly diagnosed breast cancer patients. This notion is further supported by the fact that the recurrence of breast cancer also shows a significantly negative influence on overall QOL and on various QOL domains among breast cancer survivors [14, 18–23].

Table 3 Average crude scores of overall QOL, and adjusted mean difference of scores for overall QOL and each domain by socio-demographic factors, Shanghai Breast Cancer Survival Study

Variables	Average overall QOL crude scores (mean ± SD)	Adjusted mean difference of scores for overall QOL and domains					
		Overall QOL	Physical	Psychological	Social	Material	Perceived QOL
Age at diagnosis (ref.: <40 years)	62.3±9.5						
40–49	61.9±8.6	0.6 (–0.9, 2.1)	–2.1 (–4.3, 0.1)	0.3 (–1.7, 2.4)	**2.2 (0.5, 4.0)**	2.1 (–0.2, 4.4)	–0.2 (–0.6, 0.2)
50–59	62.1±8.2	0.1 (–1.7, 1.9)	**–3.4 (–6.0, –0.8)**	–0.2 (–2.6, 2.1)	1.7 (–0.3, 3.7)	2.1 (–0.5, 4.8)	–0.1 (–0.6, 0.3)
≥60	61.2±8.8	0.2 (–1.8, 2.2)	**–5.5 (–8.4, –2.6)**	0.1 (–2.5, 2.8)	0.8 (–1.5, 3.0)	**5.3 (2.4, 8.3)**	0 (–0.5, 0.5)
Trend (*p* value)		0.75	**<0.0001**	0.85	0.40	**0.0001**	0.74
Marital status (ref.: married)	62.0±8.7						
Unmarried/single/widowed/divorced	60.8±7.8	–0.3 (–1.4, 0.7)	0.5 (–1.0, 2.0)	–0.9 (–2.3, 0.5)	–0.8 (–2.0, 0.3)	–0.4 (–1.1, 2.0)	–0.3 (–0.5, 0)
Household income (ref.: <10,000 yuan/year)	58.7±8.3						
10,000–19,999	62.7±8.1	**4.3 (3.5, 5.1)**	**2.1 (0.9, 3.2)**	**3.0 (2.0, 4.1)**	**3.1 (2.2, 4.0)**	**9.8 (8.7, 11.0)**	**0.6 (0.4, 0.8)**
≥20,000	68.2±8.2	**9.0 (7.6, 10.4)**	**4.3 (2.3, 6.3)**	**7.1 (5.2, 8.9)**	**5.3 (3.8, 6.9)**	**20.8 (18.8, 22.9)**	**1.3 (1.0, 1.7)**
Trend (*p* value)		**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
Education (ref.: <high school)	60.8±8.4						
=High school	62.0±8.6	0 (–0.8, 0.8)	**–1.1 (–2.3, 0)**	0.3 (–0.8, 1.3)	**1.4 (0.5, 2.3)**	–1.0 (–2.1, 0.2)	0.0 (–0.2, 0.2)
>High school	64.8±8.8	0.9 (–0.2, 2.0)	–0.7 (–2.2, 0.9)	0.6 (–0.9, 2.0)	**2.6 (1.3, 3.8)**	1.2 (–0.4, 2.8)	–0.1 (–0.4, 0.2)
Trend (*p* value)		0.08	0.31	0.27	**<0.0001**	0.28	0.80
Menopausal status (ref.: pre-menopause)	61.6±8.6						
Post-menopause	62.0±8.6	–0.6 (–0.5, 1.7)	0.2 (–1.5, 1.8)	–0.7 (0.8, 2.2)	–0.7 (–0.5, 2.0)	0.7 (–1.0, 2.3)	**0.3 (0, 0.5)**
BMI (ref.: 18.5≤BMI<25)	61.8±8.6						
<18.5	58.9±9.4	**–2.7 (–4.6, –0.8)**	**–4.1 (–6.9, –1.4)**	–1.7 (–4.2, 0.9)	**–2.1 (–4.3, 0)**	–2.6 (–5.4, 0.2)	**–0.9 (–1.4, –0.4)**
25≤BMI<30	62.3±8.5	**1.1 (0.4, 1.9)**	**2.1 (1.0, 3.2)**	**1.6 (0.6, 2.7)**	0.7 (–0.1, 1.6)	–0.3 (–1.4, 0.9)	**0.4 (0.2, 0.6)**
≥30	60.8±8.2	0.2 (–1.2, 1.6)	1.3 (–0.8, 3.3)	0.4 (–1.5, 2.3)	–0.3 (–1.9, 1.3)	–0.6 (–2.7, 1.5)	0.1 (–0.3, 0.5)

Obtained from multiple linear regression models with mutual adjustment of the other factors listed in the table

Bold face indicates statistical significance

Table 4 Average crude scores of overall QOL, and adjusted mean difference of scores for overall QOL and each domain by medical factors, Shanghai Breast Cancer Survival Study

Variables	Average overall QOL crude scores (mean ± SD)	Adjusted mean difference of scores for overall QOL and domains					
		Overall score	Physical	Psychological	Social	Material	Perceived QOL
Stage (TNM; ref.: 0–I)	62.4±8.1						
IIa	62.2±8.6	0.1 (–0.8, 0.9)	–0.5 (–1.7, 0.8)	0.6 (–05, 1.7)	–0.5 (–1.5, 0.4)	0.6 (–0.6, 1.9)	0 (–0.2, 0.2)
IIb	60.7±8.9	–0.9 (–1.9, 0.1)	–0.5 (–2.0, 0.9)	–0.3 (–1.7, 1.0)	**–2.0 (–3.2, –0.9)**	–0.6 (–2.1, 0.9)	–0.2 (–0.4, 0.1)
III or IV	60.1±9.2	–0.7 (–2.1, 0.7)	0.4 (–1.7, 2.4)	0 (–1.8, 1.9)	**–1.9 (–3.5, –0.3)**	–1.0 (–3.1, 1.1)	–0.1 (–0.5, 0.2)
Trend (*p* value)		0.97	0.98	0.35	0.76	0.47	0.85
Type of surgery (ref.: mastectomy)	61.8±8.6						
Breast conservation	62.6±9.8	0.5 (–1.8, 2.7)	1.1 (–2.2, 4.5)	–0.3 (–3.3, 2.8)	0.4 (–2.2, 3.0)	0.4 (–3.0, 3.8)	0 (–0.6, 0.6)
Surgery with unknown types	63.2±7.4	0 (–3.3, 3.2)	–0.6 (–5.4, 4.2)	–1.4 (–5.8, 2.9)	1.0 (–2.6, 4.7)	0.9 (–4.0, 5.7)	0 (–0.8, 0.9)
Chemotherapy (ref.: no)	61.0±8.5						
Yes—current	59.8±8.9	–0.9 (–2.4, 0.5)	**–2.4 (–4.5, –0.2)**	–0.7 (–2.7, 1.2)	–1.1 (–2.7, 0.6)	0.4 (–1.7, 2.6)	–0.2 (–0.5, 0.2)
Yes—complete	62.5±8.4	0.9 (–0.4, 2.2)	1.2 (–0.7, 3.1)	0.1 (–1.6, 1.8)	0.8 (–0.8, 2.2)	1.6 (–0.3, 3.6)	0.2 (–0.2, 0.5)
Radiotherapy (ref.: no)	62.2±8.7						
Yes—current	61.2±7.9	–0.8 (–2.4, 0.7)	–1.4 (–3.6, 0.9)	0.3 (–1.8, 2.4)	–1.0 (–2.8, 0.8)	–0.9 (–3.2, 1.5)	**–0.5 (–0.9, 0)**
Yes—complete	60.9±8.4	**–1.3 (–2.1, –0.4)**	**–2.4 (–3.7, –1.2)**	–0.9 (–2.1, 0.2)	**–1.0 (–1.9, 0)**	–0.6 (–1.9, 0.6)	**–0.4 (–0.7, –0.2)**
Tamoxifen (ref.: no)	61.6±8.8						
Yes—current use	62.5±8.3	0.4 (–0.4, 1.2)	**1.3 (0.1, 2.5)**	0 (–1.1, 1.1)	0.7 (–0.2, 1.6)	–0.5 (–1.7, 0.7)	**0.2 (0, 0.5)**
Yes—ever use	59.9±8.7	**–1.4 (–2.5, –0.3)**	–0.9 (–2.6, 0.7)	**–1.7 (–3.2, –0.2)**	–0.9 (–2.1, 0.4)	**–2.1 (–3.8, –0.5)**	–0.2 (–0.5, 0.1)
Immunotherapy (ref.: no)	61.8±8.5						
Yes—current	60.3±9.7	–0.3 (–2.2, 1.5)	–0.3 (–3.1, 2.4)	–1.1 (–3.7, 1.4)	0.6 (–1.6, 2.7)	–0.8 (–3.6, 2.0)	0.1 (–0.3, 0.6)
Yes—complete	62.4±8.8	–0.2 (–1.3, 1.0)	–0.2 (–1.8, 1.5)	–0.2 (–1.8, 1.3)	–0.3 (–1.6, 0.9)	0 (–1.7, 1.7)	0.1 (–0.2, 0.4)
ER status (ref.: negative)	61.6±8.4						
Positive	62.2±8.4	–0.1 (–1.0, 1.0)	–0.4 (–1.8, 1.1)	0.2 (–1.1, 1.6)	–0.1 (–1.2, 1.1)	0 (–1.5, 1.5)	–0.1 (–0.3, 0.2)
PR status (ref.: negative)	61.6±8.8						
Positive	62.1±8.2	0.2 (–0.8, 1.2)	–0.1 (–1.6,1.3)	0.3 (–1.1, 1.5)	–0.1 (–1.2, 1.0)	0.9 (–0.6, 2.4)	0 (–0.3, 0.2)
Number of chronic diseases (ref.: 0)	62.6±8.5						
1	60.7±9.0	**–1.9 (–2.7, –1.1)**	**–3.2 (–4.4, –2.0)**	**–2.3 (–3.4, –1.2)**	**–1.2 (–2.1, –0.3)**	–1.1 (–2.3, 0.1)	**–0.3 (–0.5, –0.1)**
2	61.1±7.8	**–1.7 (–2.9, –0.5)**	**–4.0 (–5.8, –2.2)**	–1.5 (–3.1, 0.2)	–0.9 (–2.3, 0.5)	–0.6 (–2.4, 1.3)	**–0.3 (–0.6, 0)**
≥3	58.3±8.7	**–4.2 (–6.1, –2.4)**	**–7.4 (–10.1, –4.7)**	**–4.3 (–6.8, –1.8)**	**–2.6 (–4.7, –0.5)**	–2.3 (–5.1, 0.5)	**–1.1 (–1.6, –0.6)**
Trend (*p* value)		**<0.0001**	**<0.0001**	**<0.0001**	**0.0009**	**0.0443**	**<0.0001**

Obtained from multiple linear regression models with mutual adjustment of the other factors listed in the table
Bold face indicates statistical significance

A large body of studies have compared the effect of breast-conserving surgery (BCS) and mastectomy on QOL, because both surgical options have shown equivalent long-term survival rates in early stage breast cancer [24–26]. With the exception of body image, the majority of studies have reported no significant differences between BCS and mastectomy in terms of QOL among newly diagnosed breast cancer patients [17, 27–30]. Generally in line with previous studies, no significant differences were found for Chinese breast cancer patients receiving BCS or mastectomy for the overall QOL, physical, psychological, or social domains in our study. However, differing from studies reporting that patients who underwent BSC perceived a better body image [27, 28], we did not detect a significant association between body/self-image and the type of surgical procedure in our study population. One possible explanation for this difference may involve sociocultural background. It has been reported that breasts carry less significance for an Asian woman's self-concept [31]. In our study, more than 95% of patients chose mastectomy, rather than BCS, supporting this explanation and further suggesting that Chinese women with breast cancer are more concerned about the recurrence of disease than about body image and view mastectomy as protective against recurrence.

Chemotherapy and radiotherapy are the primary adjuvant therapies for breast cancer. Studies have documented a range of acute and late side effects of chemotherapy that have the potential to affect patients' QOL. However, most acute side effects (e.g., nausea and vomiting, mucositis, hair loss, and neutropenia) occur in varying degrees with the different chemotherapy regimens and resolve soon after completion of treatment [32]. In this study, we observed only a marginal association of current use of chemotherapy with poorer QOL in the physical well-being domain, suggesting that while these symptoms may be bothersome, they are transient and may not be substantial enough to affect the major dimensions of health-related QOL in our study population. In contrast to chemotherapy, we found that patients who received radiotherapy perceived poorer QOL and the impaired QOL appeared to be more evident among patients who had completed radiotherapy than among those who were currently receiving it. It has been reported that the frequency and severity of the side effects of radiotherapy (e.g., fatigue, drowsiness, sleep problems, pain, and skin problems) increase over time and reach their maximum at the end of the treatment course [33]. Furthermore, the symptoms may last several months after radiotherapy and worsen QOL among breast cancer patients [34]. This may explain why patients in our study tended to report a decline in their QOL after completion of radiotherapy, rather than during the treatment.

Until recently, tamoxifen was the gold standard in adjuvant hormone therapy for ER-positive breast cancer. Previously, two randomized trials reported that although tamoxifen use was associated with increased menopausal symptoms (e.g., hot flashes, sweats, vaginal dryness), it had no measurable impact on overall QOL [35–37]. A recent study reported that tamoxifen use improved overall QOL after primary treatment, although endocrine symptoms increased during the first 3 months and stabilized thereafter [38]. Similarly, in our study, patients who were receiving tamoxifen reported better physical well-being scores, as well as a better overall perception of QOL. Interestingly however, a lower overall QOL score was seen in patients who had stopped tamoxifen treatment. Further analysis showed that the lower overall QOL score was mainly due to a lower score in the psychological and material domains, and no significant association was found between tamoxifen use and impaired QOL in the physical and social well-being domains or in the perception of overall QOL in this group of patients. Possible explanations for this result may be that those patients did not adhere to tamoxifen treatment because they could not bear the financial burden and/or they could have been affected by certain psychological consequences. For example, studies have reported that depression and depressive symptoms adversely affect compliance with anti-cancer therapy [39–41].

Although overweight and obesity have been linked to poorer overall and disease-free survival in most but not all studies of breast cancer prognosis [42, 43], little is known about the relationship between body weight and QOL among breast cancer patients. We found in this study that underweight women with newly diagnosed breast cancer had poorer overall QOL, perception of QOL, and QOL scores in the physical and social well-being domains. However, in contrast to several studies reporting that overweight and/or obesity were associated with lower QOL in physical functioning or mental functioning in the general population [44, 45], we did not find evidence showing such associations for obesity. Rather, we observed a better QOL in the physical and psychological well-being domains and in perception of QOL in overweight breast cancer patients. The different results regarding the role of overweight in QOL between studies are probably at least partially derived from differing socio-cultural backgrounds and data analyses, although the differences in the populations studied and methodologies used, such as sampling strategies, sample size, and instruments, do exist. Huang et al. found that overweight and obese people in Taiwan have a better mental QOL despite scoring lower in the physical domain of QOL and attributed this to a positive feeling about being overweight in traditional Asian cultures [44]. Another possible explanation involves data analyses. It is well known that obesity is closely linked to a variety of chronic diseases such as diabetes mellitus, hypertension, coronary heart disease, gall-bladder disease, sleep apnea, and respiratory problems, and many chronic diseases may be associated with lower QOL. Our study showed that QOL was inversely associated with the number of chronic diseases, and in our analyses we controlled many potential confounding factors, including the number of chronic diseases. Thus, our analyses with adjustment for many confounders, including chronic diseases, may reflect the effect of body weight itself on QOL in this study population.

Studies have demonstrated the long-term impact of socio-demographic factors on the QOL of breast cancer survivors in culturally different populations [14, 46, 47]. This study further showed that age, income, and education influence the QOL of newly diagnosed breast cancer patients with a similar pattern observed in long-term Chinese breast cancer survivors [14]. These findings suggest that the effects of socio-demographic factors on breast cancer patients are relatively consistent with time and circumstances and highlight the importance that such factors should always be taken into consideration in study design, statistical analyses, comparison of results among different trials, and in treatment strategy development.

In summary, our study indicates that Chinese women with newly diagnosed breast cancer experienced poorer QOL in the physical, psychological, and social domains. Many medical and socio-demographic factors may influence their overall QOL and/or different QOL well-being domains during the period shortly following cancer diagnosis. Such information is valuable in providing insights into the patients' perceived needs and in developing treatment and preventive strategies.

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