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Original article

Effect of multidisciplinary team care on the risk of recurrence in breast cancer patients: A national matched cohort study

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ABSTRACT

Background: Cancer has been the leading cause of death in the past decade in Taiwan, with breast cancer being the most common type of cancer in females. Very few studies looked at the risk of recurrence in patients who received multidisciplinary team (MDT) care. We analyzed the influence of MDT on the risk of recurrence and death in breast cancer patients.

Method: In this retrospective study, we included newly diagnosed patients from 2004 to 2010. The study included 9,266 breast cancer patients who were enrolled in MDT care and 9,266 patients who were not. The study used log-rank test to analyze patients' characteristics, hospital characteristics, cancer staging, and treatment methods to compare the recurrence rates in MDT care and non-MDT care participants. We used Cox proportional hazards model to examine the effect of MDT and associated factors on the risk of recurrence and mortality of breast cancer patients.

Results: Relative risk of recurrence was lower for patients who received MDT care than for patients who did not (HR, 0.84; 95%CI: 0.70–0.99) after matching. The mortality risk for breast cancer patients with relapse was 8.48 times (95%CI: 7.53–9.54) than that for patients without relapse.

Conclusions: The relative risk of recurrence and death was significantly lower for breast cancer patients who received MDT care than for those who did not. We suggest that MDT care be implanted in the National Health Policy settings of breast cancer patients.

Introduction

Breast cancer is one of the most common cancers worldwide, accounting for 25.1% of all cancers [1]. The data from "Surveillance, Epidemiology, and End Results" of the United States show that there were approximately 246,660 newly diagnosed cases of breast cancer in 2016, and the total number of breast cancer patients reached 3,560,570 [2]. Cancer was the top leading cause of death in the past decade, accounting for 28% of all deaths in Taiwan, where breast cancer is fourth leading cause of cancer-related mortality and the most common cancer among women. The cancer mortality of women in Taiwan reached 157.9 per 100,000 people, and 2,000 women died of breast cancer in 2017. There are many treatment modalities including surgery, radiotherapy, chemotherapy, target therapy, and hormone therapy for breast cancer patients [2].

The diagnosis and treatment of cancer is complex. In 1995, a Multidisciplinary Team (MDT) care policy was implemented to improve the care quality of cancer patients in the United Kingdom [3]. MDTs consist of many professionals such as medical, nursing,

Abbreviations: ICD, International Classification of Disease; MDT, Multidisciplinary Team; NHI, National Health Insurance; NHIRD, National Health Insurance Research Database; TCR, Taiwan Cancer Registry; TCRD, Taiwan Cancer Registry Database; CCI, Charlson Comorbidity Index; CI, confidence interval; KM, Kaplan-Meier; HR, hazard ratio.

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and allied professionals and diagnostic experts to determine the optimal treatment pathway for individual patients [4,5]. Previous studies show that MDT care is helpful in making clinical decision [6–8]. MDT care can intercept 98.8% of all medication errors and improve the quality of care [9,10]. After multidisciplinary care was introduced in the United Kingdom, breast cancer mortality in the intervention area was 18% lower than that in the non-intervention area [11]. In another study, the MDT had the following characteristics: comprising specialist breast cancer surgeons, pathologists, oncologists, radiologists, and specialist nurses; working with evidence-based guidelines, written by the specialist breast surgeon whose patients had the highest survival rates; weekly formal meetings to discuss results for individual patients; and audited clinical activity and results recorded at regular intervals [11]. The introduction of MDT care is associated with lower medical cost, improved medical care quality, and higher survival rate [4,12,13]. In Australia, multidisciplinary care is widely recommended for managing breast cancer [14,15]. MDT care has the potential to reduce mortality, improve quality of life, and reduce healthcare costs for early breast cancer patients [14,15]. MDT care was introduced in Taiwan since 2003 for improving the quality of care and survival rates of breast cancer patients. The MDTs include specialist breast cancer surgeons, pathologists, oncologists, and radiologists. They hold regular MDT formal meetings to design individual treatment programs for breast cancer patients.

Obesity is a risk factor for both breast cancer and recurrence [16]. A previous study conducted in Germany showed the recurrence and mortality rates of breast cancer patients who did not exercise were higher than the rates of those who did (HR, 1.71) [17]. Another study in Germany showed the recurrence rates for breast cancer patients in stages I and II were 15% and 16.8%, respectively [18]. A previous study also showed the recurrence rate was 10.4% within five years of diagnosis [19]. This study used national large-scale data to investigate whether MDT care in breast cancer affects the recurrence rate; concurrently, we also aimed to examine the impact of other relevant factors on recurrence. This will provide a reference base for future treatment of breast cancer patients, mainly by increasing the survival rate and decreasing the recurrence rate.

Material and methods

Study participants

This was a retrospective matched cohort study. We included 50,982 newly diagnosed breast cancer patients from 2004 to 2010. The newly diagnosed breast cancer patients were defined as ICD-O-3 with C50.0–C50.6 and C50.8–C50.9 without any prior diagnosis of cancer. Male breast cancer patients were excluded (328). Other exclusion criteria were as follows: breast cancer in situ (3,975),

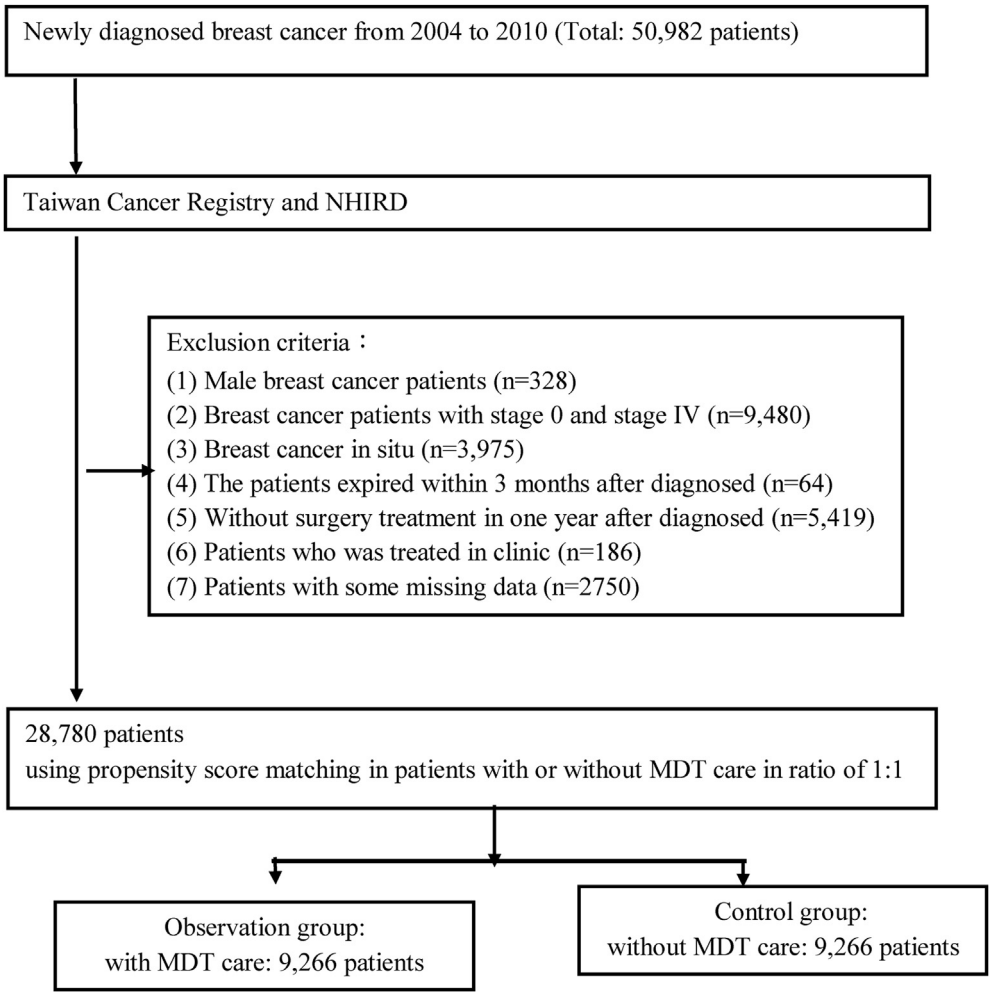

Fig. 1. Flow chart of study participants.

stage 0 and stage IV (9,480), no surgical treatment in one year from diagnosis (5,419), death within three months of diagnosis (64), treatment in clinics (186), and patients with some missing data (2,750). Finally, 28,780 patients were included. We used propensity score matching to match the group of breast cancer patients who received MDT care to those who did not at a ratio of 1:1.

Data sources

The data for this study were obtained from the Taiwan Cancer Registry, which was also used to recruit the study participants. We also linked the data to the National Health Insurance Research Database (NHIRD) and the Cause of Death File from 2004 to 2014 that was provided by the Ministry of Health and Welfare in Taiwan. The accuracy of the Taiwan Cancer Registry (TCR) and NHIRD is excellent. The TCR, a population-based cancer registry, was founded in 1979. The registry is organized and funded by the Ministry of Health and Welfare. The TCR Database (TCRD) records data of all types of cancers diagnosed and treated in Taiwan. The completeness (97%) and data quality of the TCRD is excellent [20]. Fig. 1 shows the flowchart of study participants.

Definition and description of variables

The general characteristics of breast cancer patients were examined. Age was defined as the age at which the patient had a confirmatory diagnosis based on pathological findings. The financial status of the patient was based on monthly salary. The degree of

Table 1
Bivariate analysis of breast cancer patients' characteristics with or without MDT care after matching.

Variables	after matching						P-value[a]
	Total		with MDT care		without MDT care		
	N	%	N	%	N	%	
Total number	18,532	100.00	9,266	50.00	9,266	50.00	
Age							0.792
<35	876	4.73	456	4.92	420	4.53	
35-44	4,253	22.95	2,120	22.88	2,133	23.02	
45-54	7,095	38.29	3,536	38.16	3,559	38.41	
55-64	4,010	21.64	2,011	21.70	1,999	21.57	
≧65	2,298	12.40	1,143	12.34	1,155	12.46	
CCI score							0.148
0	13,297	71.75	6,610	71.34	6,687	72.17	
1	3,482	18.79	1,741	18.79	1,741	18.79	
≧2	1,753	9.46	915	9.87	838	9.04	
Monthly salary (NTD)							0.224
≦17,280	4,423	23.87	2,165	23.36	2,258	24.37	
17,281–22,080	5,565	30.03	2,796	30.17	2,769	29.88	
22,081–36,300	3,966	21.40	2,029	21.90	1,937	20.90	
≧36,301	4,578	24.70	2,276	24.56	2,302	24.84	
Urbanization level							0.352
Level 1	7,245	39.09	3,572	38.55	3,673	39.64	
Level 2 + Level 3	8,245	44.49	4,142	44.70	4,103	44.28	
Level 4 + Level 5	2,240	12.09	1,135	12.25	1,105	11.93	
Level 6 + Level 7	802	4.33	417	4.50	385	4.15	
Cancer stage							0.188
Stage I	6,172	33.30	3,092	33.37	3,080	33.24	
Stage II	8,299	44.78	4,098	44.23	4,201	45.34	
Stage III	4,061	21.91	2,076	22.40	1,985	21.42	
Hospital ownership							0.114
Public	5,454	29.43	2,678	28.90	2,776	29.96	
Private	13,078	70.57	6,588	71.10	6,490	70.04	
Physician services volume							0.309
Low	3,819	20.61	1,902	20.53	1,917	20.69	
Medium	9,846	53.13	4,885	52.72	4,961	53.54	
High	4,867	26.26	2,479	26.75	2,388	25.77	

Variables	after matching						P-value[a]
	Total		with MDT care		without MDT care		
	N	%	N	%	N	%	
Treatment							0.211
Surgery	692	3.73	338	3.65	354	3.83	
Surgery + Radiotherapy	541	2.92	287	3.10	254	2.74	
Surgery + Chemotherapy	1,200	6.48	595	6.42	605	6.53	
Surgery + Hormone therapy	2,265	12.22	1,109	11.97	1,156	12.48	
Surgery + Radiotherapy + Chemotherapy	2,339	12.62	1,191	12.85	1,148	12.39	
Surgery + Radiotherapy + Hormone therapy	2,570	13.87	1,295	13.98	1,295	13.76	
Surgery + Chemotherapy + Hormone therapy	2,387	12.88	1,184	12.78	1,203	12.98	
Surgery + Chemotherapy + Drug	89	0.48	52	0.56	37	0.40	
Surgery + Chemotherapy + Hormone therapy + Drug	104	0.56	59	0.64	45	0.49	
Surgery + Radiotherapy + Chemotherapy + Drug	327	1.76	179	1.93	148	1.60	
Surgery + Radiotherapy + Chemotherapy + Hormone therapy	5,665	30.57	2,790	30.11	2,875	31.03	
Surgery + Radiotherapy + Chemotherapy + Hormone therapy + Drug	353	1.90	187	2.02	166	1.79	

[a] Log-rank test.

urbanization at the patient's place of residence was used to represent environmental factors. The level of urbanization was based on seven levels of classification from highly urbanized developed cities (level 1) to remote areas (level 7). The health status of the patients included data on whether the patient had other catastrophic illnesses besides cancer, their Charlson Comorbidity Index (CCI), and the stage of breast cancer. The definition of catastrophic illness was based on the 30 types of catastrophic illnesses or injuries as defined by the National Health Insurance Administration, including stroke, chronic kidney failure, systemic lupus erythematosus, type I diabetes, and severe mental illness. The degree of comorbidity was classified into three levels based on the CCI. Tumor staging was based on the guidelines of the American Joint Committee on Cancer (sixth edition for tumors diagnosed from 2004 to 2009; seventh edition for tumors diagnosed in 2010), which includes stages I, II, and III. Hospital attributes includes hospital ownership (public or private institutions). The physician's service volume was divided into low, medium, and high on the basis of quartiles: service volumes of <25%, 25–75%, and >75% were low, medium, and high, respectively. Patients were

Table 2
Bivariate analysis of variables in breast cancer patients with or without recurrence and relative risk of recurrence.

Variables	Total		No recurrence		Recurrence		P-value[a]	Adjusted			
	N	%	N	%	N	%		HR	95% CI		P-value[b]
Total number	18,532	100	18,021	97.24	511	2.76					
MDT care							0.101				
Yes	9,266	50	9,029	97.44	237	2.56					
No	9,266	50	8,992	97.04	274	2.96		0.84	0.7	0.99	0.047
Age							0.002				
<35	876	4.73	853	97.37	23	2.63					
35–44	4,253	22.95	4,158	97.77	95	2.23		0.89	0.57	1.41	0.628
45–54	7,095	38.29	6,913	97.43	182	2.57		0.94	0.61	1.46	0.793
55–64	4,010	21.64	3,887	96.93	123	3.07		0.96	0.61	1.51	0.854
≧65	2,298	12.4	2,210	96.17	88	3.83		1	0.62	1.62	0.998
Mean age (SD)	51.17	11.01	51.11	10.97	53.03	11.95	<0.001				
CCI score							0.384				
0	13,297	71.75	12,939	97.31	358	2.69					
1	3,482	18.79	3,386	97.24	96	2.76		1.05	0.83	1.33	0.669
≧2	1,753	9.46	1,696	96.75	57	3.25		1.15	0.86	1.55	0.351
Monthly salary (NTD)							<0.001				
≦17,280	4,423	23.87	4,279	96.74	144	3.26					
17,281–22,080	5,565	30.03	5,387	96.8	178	3.2		1.04	0.83	1.3	0.733
22,081–36,300	3,966	21.4	3,874	97.68	92	2.32		0.78	0.6	1.02	0.065
≧36,301	4,578	24.7	4,481	97.88	97	2.12		0.77	0.59	0.99	0.048
Urbanization level							0.37				
Level 1	7,245	39.09	7,062	97.47	183	2.53					
Level 2 + Level 3	8,245	44.49	8,007	97.11	238	2.89		0.98	0.81	1.2	0.854
Level 4 + Level 5	2,240	12.09	2,177	97.19	63	2.81		0.86	0.64	1.16	0.332
Level 6 + Level 7	802	4.33	775	96.63	27	3.37		0.95	0.62	1.43	0.791
Cancer stage							<0.001				
Stage I	6,172	33.3	6,124	99.22	48	0.78					
Stage II	8,299	44.78	8,126	97.92	173	2.08		2.56	1.84	3.56	<0.001
Stage III	4,061	21.91	3,771	92.86	290	7.14		8.69	6.27	12.06	<0.001
Hospital ownership							0.005				
Public	5,454	29.43	5,332	97.76	122	2.24					
Private	13,078	70.57	12,689	97.03	389	2.97		1.16	0.94	1.42	0.177
Physician services volume							<0.001				
Low	3,819	20.61	3,616	94.68	203	5.32					
Medium	9,846	53.13	9,663	98.14	183	1.86		0.33	0.27	0.4	<0.001
High	4,867	26.26	4,742	97.43	125	2.57		0.39	0.31	0.49	<0.001
Treatment							<0.001				
Surgery	692	3.73	672	97.11	20	2.89					
Surgery + Radiotherapy	541	2.92	508	93.9	33	6.1		2.24	1.28	3.93	0.005
Surgery + Chemotherapy	1,200	6.48	1,155	96.25	45	3.75		1.44	0.85	2.45	0.176
Surgery + Hormone therapy	2,265	12.22	2,238	98.81	27	1.19		0.55	0.31	0.99	0.045
Surgery + Radiotherapy + Chemotherapy	2,339	12.62	2,227	95.21	112	4.79		1.22	0.75	1.99	0.426
Surgery + Radiotherapy + Hormone therapy	2,570	13.87	2,541	98.87	29	1.13		0.57	0.32	1.02	0.059
Surgery + Chemotherapy + Hormone therapy	2,387	12.88	2,346	98.28	41	1.72		0.83	0.48	1.42	0.49
Surgery + Chemotherapy + Drug	89	0.48	72	80.9	17	19.1		6.29	3.24	12.22	<0.001
Surgery + Chemotherapy + Hormone therapy + Drug	104	0.56	97	93.27	7	6.73		2.49	1.04	5.96	0.041
Surgery + Radiotherapy + Chemotherapy + Drug	327	1.76	282	86.24	45	13.76		3.03	1.74	5.25	<0.001
Surgery + Radiotherapy + Chemotherapy + Hormone therapy	5,665	30.57	5,547	97.92	118	2.08		0.63	0.39	1.04	0.07
Surgery + Radiotherapy + Chemotherapy + Hormone therapy + Drug	353	1.9	336	95.18	17	4.82		1.26	0.65	2.48	0.495

[a] Log-rank test.
[b] Cox proportional hazards regression.

considered to be enrolled in MDT care if they received MDT treatment after pathological diagnosis of breast cancer and declared the MDT treatment fees in the NHI database (47079B). The definitions of relevant treatments were based on the relevant treatment codes was declared in the NHI database, which were checked against the treatment registration information in the Taiwan Cancer Information Database. Recurrence was defined as the first recurrence after disease-free or remission period as recorded in the TCR. We observed all participants for two years since the first diagnosis of breast cancer to check for recurrence. The death rate was based on the data from the Cause of Death File until 2014.

Main outcome measurements

The main outcomes examined in this study were the recurrence and survival rates of breast cancer patients. The death and recurrence rates were based on patient data from the NHI database and these were compared with the Taiwan Cause of Death archives for confirmation.

Statistical analysis

The current research is a retrospective and longitudinal controlled cohort study. We employed descriptive statistics to analyze the general characteristics, financial status, environmental factors, health status of patients, hospital attributes, and status of enrolment in MDT of breast cancer patients who had a confirmatory diagnosis as per pathological findings from 2004 to 2010. We used Propensity score to match the group of breast cancer patients who received MDT care to those who did not at a ratio of 1:1. Chi-square test was used to analyze the patients' age, monthly salary, degree of urbanization of the patient's place of residence, catastrophic illnesses besides cancer, and CCI after matching. Then, bivariate analysis was performed using the log-rank test to determine whether there were significant differences between recurrence status by the end of 2012 and general characteristics, financial status, environmental factors, health status of patients, hospital attributes, and enrolment in MDT. We then used univariate Cox proportional hazards regression to analyze relevant prognostic factors that affect the recurrence rates of breast cancer patients. The adjusted Cox proportional hazards model was used to investigate the relative risk of survival of breast cancer patients with or without MDT enrolment, after controlling for related variables. Independent variables included patient characteristics, financial status, environmental factors, health status, hospital attributes, and enrolment in MDT. The dependent variable was recurrence. Lastly, after controlling for relevant variables, the adjusted Cox proportional hazards model was used to generate the survival curves for breast cancer patients in various stages with or without MDT care.

All statistical analyses were performed using SAS software, version 9.4 (SAS Institute, Inc., Cary, NC, USA). A p value of <0.05 was regarded statistically significant, and all tests were two-sided. This study has been approved by the research ethics committee of China Medical University Hospital in Taiwan (IRB Number: CRREC-106-008).

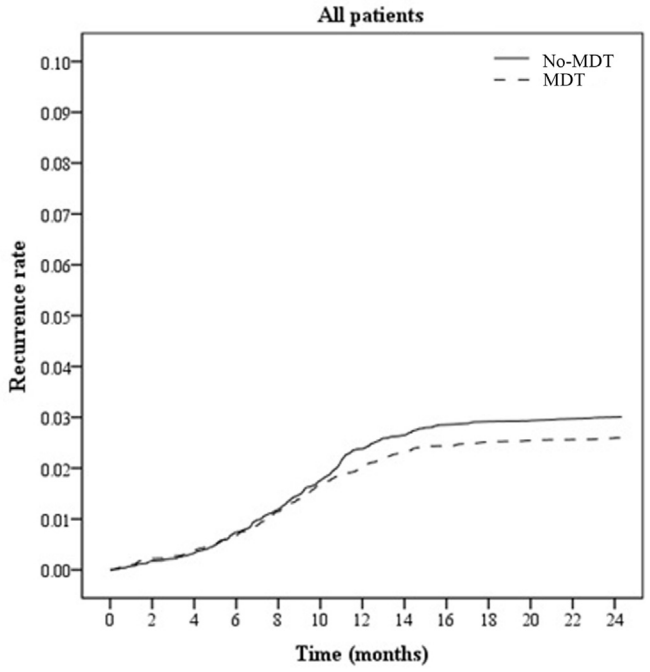

Fig. 2. Kaplan-Meier curve of recurrence rate of breast cancer patients with or without multidisciplinary team care. The solid line showed the recurrence rate of breast cancer patients who received MDT care. The dotted line showed the recurrence rate of breast cancer patients who did not receive MDT care.

Results

Demographic characteristics of the study population

After matching by propensity score, a total of 18,532 breast cancer patients were included in the study (Table 1). There was no significant difference ($p > 0.05$) in age, monthly salary, CCI score, environmental factors, health status of patients, hospital attributes and other characteristics between MDT care participants and non-MDT care participants.

The effect of MDT care and relevant variables on recurrence risk of breast cancer patients

We used log-rank test to analyze the variables of breast cancer patients with or without recurrence. Table 2 shows that the recurrence rate of the MDT group was significantly lower than that of the non-MDT group (HR, 0.84; 95%CI: 0.70–0.99; $p < 0.05$). The Cox proportional hazards model was utilized to analyze the relative risk in recurrence between MDT group and non-MDT groups after adjusting for demographic characteristics, CCI score, monthly salary, urbanization level of residence area, cancer stage, hospital ownership, treatment modality, and physician service volume. Fig. 2 shows the KM curve of recurrence rate of breast patients with or without MDT care. Fig. 3 shows the KM curve of recurrence rate in different stages of breast cancer.

The effect of MDT care and relevant variables on mortality risk of breast cancer patients

We carried out log rank test to analyze the survival rate of breast cancer patients with or without MDT care and with or without recurrence (Table 3). The mortality rate of the MDT care group (12.48%) was lower than that of the non-MDT care group (13.05%). The mortality rate of the breast cancer patients with recurrence (74.95%) was significantly higher than that of patients without recurrence (16.19%) ($p < 0.05$). The Cox proportional hazards model was utilized to analyze the relative risk of death between the MDT care and non-MDT group and also between the recurrence and non-recurrence group after adjusting for demographic characteristics, CCI score, monthly salary, urbanization level, cancer stage, hospital ownership, treatment modality, and physician's service

volume. The relative risk of mortality was significantly lower for the MDT care than for the non-MDT group (HR: 0.89, 95%CI: 0.82–0.96). The relative risk of mortality was significantly higher for the recurrence group than for the non-recurrence group (HR, 8.48; 95%CI: 7.53–9.54).

Discussion

After matching by propensity score, we found that the recurrence rate of the MDT care group was significantly lower than that of the non-MDT care group (HR, 0.84; 95%CI: 0.70–0.99, $p < 0.05$). The relative risk of mortality was significantly lower for the MDT care group than for the non-MDT care group (HR, 0.89; 95%CI: 0.82–0.96). The relative risk of mortality for the recurrence group was significantly higher than that for non-recurrence group (HR, 8.48; 95%CI: 7.53–9.54).

MDT care can significantly decrease the mortality risk of breast cancer patients [9–11]. Although intrinsically multidisciplinary care should be associated with better survival, there remains a paucity of supporting evidence [21]. However, a few studies discussed the underlying mechanisms of MDT care, namely team focus, enhanced structure and process, and improved team performance, resulting in better outcomes in terms of survival rates and patient satisfaction [22]. The most important parts of MDT care are the team members, evidence-based guidelines, regular formal meetings, and personalized treatment programs [11]. In Taiwan, the MDT program faced problems, such as excessive caseload, low attendance at MDT meetings, poor teamwork, lack of leadership, role ambiguity, and no attention to holistic needs [23]. Previous studies show that the MDTs in most countries consist of medical oncologists (95%), surgical oncologists (95%), radiation oncologists (90%), pathologists (84%), radiologists (73%), and specialist nurses (49%). The frequency of MDT meetings in most countries (82%) is once per week [24]. In our study, data on low attendance at MDT meetings, poor teamwork, lack of leadership, and role ambiguity were not available.

Another study showed that specialist nurses were important for evaluating the holistic needs of breast cancer patients and improving their life quality [23]. A previous systemic review showed that MDT care led to precise diagnosis of cancer stage

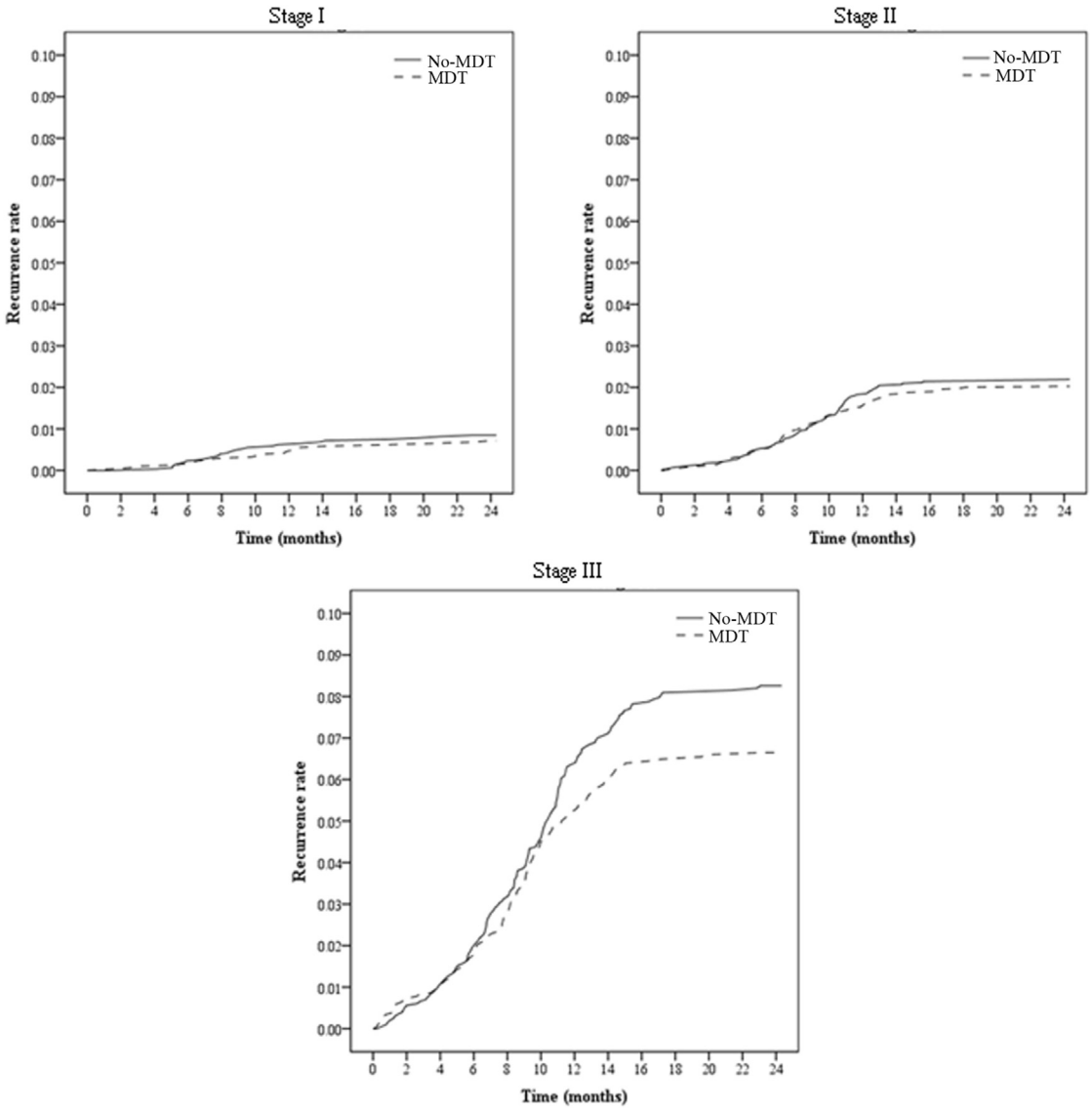

Fig. 3. Kaplan-Meier curve of recurrence rate in different stages of breast cancer with or without multidisciplinary team care. The solid line showed the recurrence rate of breast cancer patients who received MDT care in stages I, II, and III. The dotted line showed the recurrence rate of breast cancer patients who did not receive MDT care in stages I, II, and III.

before surgery [25]. There was not enough evidence of MDT care improving the survival rate of breast cancer patients [25]. There were some differences in the effect of MDT care on breast cancer patients between these studies. The main cause could be the different settings of MDT including teamwork, performance, and leadership. Previous studies highlighted the need for quality indicators for measuring the effect of MDT [26]. It is important to reevaluate the structure and models of MDT care to ensure that they are efficient [23,27]. However, there is no nationwide study on the effect of MDT policy on the recurrence of breast cancer. Therefore, we recommend that in future policies, MDT should be included to reduce the recurrence rates of breast cancer.

We found that the recurrence risk of breast cancer patients with a monthly salary of ≥36,301 was significantly lower than that of

Table 3
Bivariate analysis of variables in breast cancer patients with survival or death and relative risk of survival.

Variables	Total		Survival		Death		P-value[a]	Adjusted model			
	N	%	N	%	N	%		HR	95% CI		P-value[b]
Total number	18,532	100	16,167	87.24	2,365	12.76					
MDT care							0.087				
No (ref.)	9,266	50	8,057	86.95	1,209	13.05					
Yes	9,266	50	8,110	87.52	1,156	12.48		0.89	0.82	0.96	0.004
Recurrence							<0.001				
No (ref.)	18,021	97.24	16,039	83.81	1,982	16.19					
Yes	511	2.76	128	25.05	383	74.95		8.48	7.53	9.54	<0.001
Age							<0.001				
<35(ref.)	876	4.73	771	88.01	105	11.99					
35–44	4,253	22.95	3,858	90.71	395	9.29		0.75	0.61	0.93	0.01
45–54	7,095	38.29	6,358	89.61	737	10.39		0.82	0.66	1	0.053
55–64	4,010	21.64	3,467	86.46	543	13.54		0.99	0.8	1.22	0.923
≧65	2,298	12.4	1,713	74.54	585	25.46		1.65	1.33	2.06	<0.001
Mean age (MSD)	51.17	11.01	50.56	10.48	55.34	13.35	<0.001				
CCI score							<0.001				
0 (ref.)	13,297	71.75	11,749	88.36	1,548	11.64					
1	3,482	18.79	3,025	86.88	457	13.12		1.02	0.91	1.13	0.762
≧2	1,753	9.46	1,393	79.46	360	20.54		1.36	1.21	1.54	<0.001
Monthly salary							<0.001				
≦17,280 (ref.)	4,423	23.87	3,784	85.55	639	14.45					
17,281–22,080	5,565	30.03	4,743	85.23	822	14.77		1.05	0.94	1.17	0.386
22,081–36,300	3,966	21.4	3,510	88.5	456	11.5		1.01	0.9	1.15	0.832
≧36,301	4,578	24.7	4,130	90.21	448	9.79		0.89	0.79	0.96	0.041

Variables	Total		Survival		Death		P-value[a]	Adjusted model			
	N	%	N	%	N	%		HR	95% CI		P-value[b]
Urbanization level						<0.001					
Level 1 (ref.)	7,245	39.09	6,414	88.53	831	11.47					
Level 2 +Level 3	8,245	44.49	7,178	87.06	1,067	12.94		0.98	0.89	1.08	0.685
Level 4 +Level 5	2,240	12.09	1,901	84.87	339	15.13		0.97	0.85	1.11	0.648
Level 6 +Level 7	802	4.33	674	84.04	128	15.96		0.91	0.75	1.11	0.359
Cancer stage							<0.001				
Stage I (ref.)	6,172	33.3	5,931	96.1	241	3.9					
Stage II	8,299	44.78	7,378	88.9	921	11.1		2.89	2.5	3.34	<0.001
Stage III	4,061	21.91	2,858	70.38	1,203	29.62		9.04	7.78	10.51	<0.001
Hospital ownership						<0.001					
Public (ref.)	5,454	29.43	4,847	88.87	607	11.13					
Private	13,078	70.57	11,320	86.56	1,758	13.44		1.16	1.05	1.28	0.003
Physician services volume							<0.001				
Low (ref.)	3,819	20.61	2,987	78.21	832	21.79					
Medium	9,846	53.13	8,837	89.75	1,009	10.25		0.4	0.36	0.44	<0.001
High	4,867	26.26	4,343	89.23	524	10.77		0.32	0.28	0.36	<0.001

Variables	Total		Survival		Death		P-value[a]	Adjusted model			
	N	%	N	%	N	%		HR	95% CI		P-value[b]
Treatment							<0.001				
Surgery (ref.)	692	3.73	582	84.1	110	15.9					
Surgery + Radiotherapy	541	2.92	454	83.92	87	16.08		1.15	0.87	1.53	0.332
Surgery + Chemotherapy	1,200	6.48	1,004	83.67	196	16.33		1.36	1.08	1.73	0.01
Surgery + Hormone therapy	2,265	12.22	1,985	87.64	280	12.36		0.97	0.78	1.22	0.815
Surgery + Radiotherapy + Chemotherapy	2,339	12.62	1,887	80.68	452	19.32		1.08	0.87	1.34	0.479
Surgery + Radiotherapy + Hormone therapy	2,570	13.87	2,345	91.25	225	8.75		0.92	0.73	1.17	0.497
Surgery + Chemotherapy + Hormone therapy	2,387	12.88	2,171	90.95	216	9.05		0.86	0.68	1.09	0.216
Surgery + Chemotherapy + Drug	89	0.48	64	71.91	25	28.09		1.11	0.71	1.72	0.657
Surgery + Chemotherapy + Hormone therapy + Drug	104	0.56	93	89.42	11	10.58		0.8	0.43	1.49	0.478
Surgery + Radiotherapy + Chemotherapy + Drug	327	1.76	245	74.92	82	25.08		1.1	0.82	1.49	0.516
Surgery + Radiotherapy + Chemotherapy + Hormone therapy	5,665	30.57	5,032	88.83	633	11.17		0.75	0.61	0.93	0.01
Surgery + Radiotherapy + Chemotherapy + Hormone therapy + Drug	353	1.9	305	86.4	48	13.6		0.95	0.67	1.35	0.761

[a] Log-rank test.
[b] Cox proportional hazards regression.

patients with a monthly salary of ≤17,280 (HR, 0.77; 95%CI: 0.59–0.99). Further, the mortality risk of breast cancer patients increased as the monthly salary decreased (HR, 0.89; 95%CI: 0.79–0.96; $p < 0.05$). Previous studies showed that breast cancer patients with low education and neighborhood-level socioeconomic status had 1.4 to 2.7 times worse all-cause survival than patients with high education, neighborhood-level and socioeconomic status [28]. Another study stated that the mortality risk for low socioeconomic level was significantly higher than that for high socioeconomic level (HR, 1.08; 95%CI: 1.05–1.11) [29]. Our results were consistent with these findings.

Previous studies showed that the five-year survival rate decreased with advanced stages of breast cancer (from 97.5% to 18.4%) [30]. Similarly, another previous study showed that the five-year survival rate was 98%–23.4% from stage I to stage IV [31]. We observed the same trend. The five-year survival rate was 61.61%–5.11% from stage I to stage IV of breast cancer.

Conclusions

We collected nationwide data of 18,532 breast cancer patients, which, to the best of our knowledge, is the first nationwide study discussing policy-related issue. After matching by propensity score, the recurrence risk of the MDT care group was significantly lower than that of the non-MDT care group (HR, 0.84; $p < 0.05$). The mortality risk of breast cancer patients receiving MDT care was significantly lower than that of patients not receiving MDT care (HR, 0.89; $p < 0.05$). MDT policy should be offered in breast cancer care in the future.

Limitations

Secondary data from the National Health Insurance Research Database was employed for this study. The information on individual lifestyle and health behaviors, which may also affect the result, was not available. Disease-free survival was also not evaluated in this study.

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Author's contribution

Chang-Hung Tsai: Conceptualization: Methodology: Validation: Writing - review & editing: Huan-Fa Hsieh, Conceptualization: Methodology: Data curation: Project administration: Funding acquisition: Writing - review & editing: Ting-Wei Lai, Validation: Resources: Writing - original draft preparation: Pei-Tseng Kung, Conceptualization: Methodology: Validation: Data curation: Resources: Writing - review & editing: Funding acquisition: Wen-Chen Tsai, Conceptualization: Methodology: Software: Validation: Data curation: Resources: Writing - original draft preparation: Supervision: Writing - review & editing: Ting-Wei Lai, Conceptualization: Methodology: Formal analysis: Data curation: Writing - original draft preparation: Project administration.

Patient consent

As this study used anonymized secondary data retrieved from the Taiwan's National Health Insurance Research Database, the requirement for informed consent was waived by the ethics committee. This study has been approved by the research ethics committee of China Medical University Hospital in Taiwan (IRB Number: CRREC-106-008).

Data sharing

This study used the National Health Insurance Research Database published by the Ministry of Health, Taiwan. Due to legal restrictions imposed by the Taiwan government related to the Personal Information Protection Act, the database cannot be made publicly available. All researchers can apply for using the databases for conducting their studies. Requests for data can be sent as a formal proposal to the Science Center of the Ministry of Health and Welfare (http://www.mohw.gov.tw/EN/Ministry/Index.aspx). Any raw data are not allowed to be brought out from the Science Center. Only the analytic outputs in format of table or figure can be printed out. The restrictions prohibited the authors from making the minimal data set publicly available.

Declaration of competing interest

The authors declare that they have no conflicts of interest in this study.

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