Integrating traditional Chinese medicine healthcare into dementia care plan by reducing the need for special nursing care and medical expenses

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Abstract

Reducing the need for advanced nursing care and medical expenses is an essential concern of dementia care. We investigated the impact of traditional Chinese medicine (TCM) on advanced nursing care and medical costs.

We used Longitudinal Health Insurance Database to implement a cohort study of patients with dementia between 1997 and 2012 in Taiwan. Data from the onset of dementia to 1st advanced nursing care for the endotracheal tube, urinal indwelling catheterization, and nasogastric tube were assessed using Cox regression proportional hazards model, and independent t test was used to determine the difference of hospitalization costs and days. We also used ANOVA test to compare the hospital cost, hospital stay, and numbers according to different duration of TCM.

We assessed 9438 new diagnosed patients with dementia without advanced nursing care were categorized into 2 groups: 4094 (43.4%) TCM users, and 5344 (56.6%) non-TCM users. In the TCM groups, 894 (21.8%) patients were declared as advanced nursing care, while 1683 (31.5%) patients were in non-TCM group. Cox proportional hazard regression indicated that using TCM may decrease the need for advanced nursing care (adjusted hazard ratio (aHR) = 0.61, 95% confidence interval [95% CI]: 0.56–0.66) compared to non-TCM. The TCM users have lower hospitalization costs and hospitalization time compared to non-TCM users.

Integrating TCM healthcare into dementia care was found to be associated with a lower need for advanced nursing care, hospitalization costs, and admission time with more benefits from longer durations of TCM use.

Abbreviations: 95% CI = 95% confidence interval, aHR = adjusted hazard ratio, CHM = Chinese herbal medicines, ICD-9-CM = International Classification of Diseases, 9th revision, Clinical Modification, NHI = National Health Insurance, NHIRD = National Health Insurance Research Database, TCM = traditional Chinese medicine.

Keywords: dementia, medical expenses, nursing care, traditional Chinese medicine

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1. Introduction

Dementia is a chronic degenerative and age-related disease which accounted for 10% of the prevalence in people aged over 65 years and older in the United States in 2017.[1] The clinical features of the disease include cognition impairment, functional disorder, and behavior or psychological symptoms.[2] Although the severity and progression of advanced dementia vary from person to person, it usually lowers the quality of life and causes the need for advanced nursing care such as nasogastric tube feeding, urinal indwelling catheterization, and even endotracheal intubation,[3–6] and there is no curable treatment for dementia to date.

The increasing dementia population is not only a health problem but a social and economic issue around the world. According to a global research, the total number of patients with dementia will increase from 44.4 million in 2013 to 75.6 million in 2030.[7] As public awareness of the disease and early diagnosis has increased, the huge medical expenditure related to a nursing home or community-based setting has gradually increased annually, making dementia possibly the most expensive disease beyond other aging diseases (cardiovascular, cancers, and diabetes mellitus) in some countries.[8] In Taiwan, people who were diagnosed with dementia had significantly more outpatient visits and outpatient costs, and the total cost was 2-fold greater than that in people without dementia.[9] All the results indicated that developing a cost-
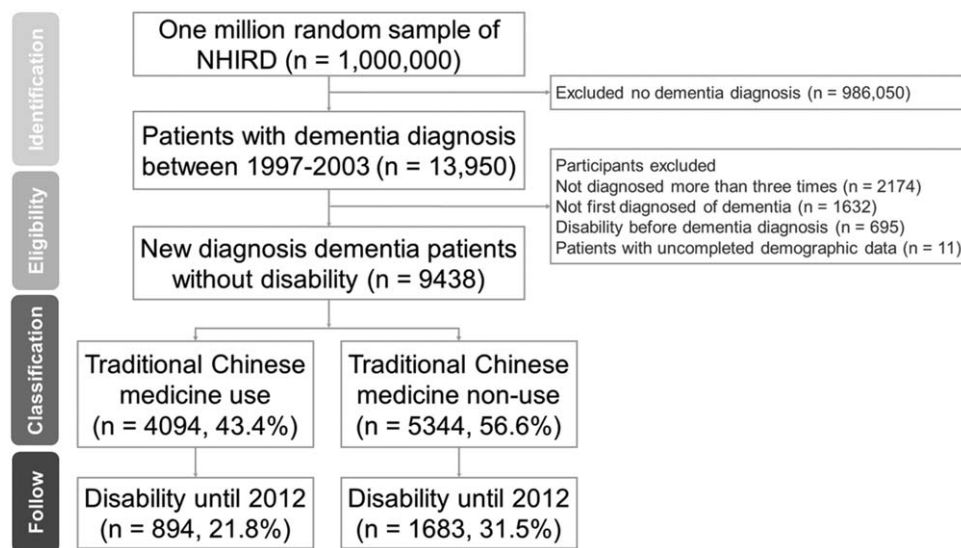
Figure 1. Recruitment flowchart of patients with dementia from NHIRD. We enrolled 9438 patients with dementia, and divided participants into 2 groups: TCM treatment group (4094 patients, 43.4%) and non-TCM treatment group (5344 patients, 56.6%). In the TCM group, 894 (21.8%) patients were declared as advanced nursing care, while 1683 (31.5%) in non-TCM group. NHIRD = National Health Insurance Research Database, TCM = traditional Chinese medicine.

effectiveness medical model and establishing a well healthcare policy for patients with dementia are urgently needed.[7–10]

Besides the pharmacologic treatment of western medicine including anticholinesterase agents or antipsychotic medications, there are plenty of complementary or alternative treatments for such patients. Among these, traditional Chinese medicine (TCM) therapy (including Chinese herbal medicine and acupuncture) was used for preventing symptoms from becoming worse or for improving cognitive function and activities of daily living in patients with dementia in many researches.[11–14] Previous studies also revealed that integrated TCM therapy can reduce the catheter indwelling risk in dementia with difficult voiding[15] and also reduce the risk of pneumonia among such patients.[16,17] In Taiwan, the well-established healthcare system covers almost 99.6% of the whole nation, and TCM treatment has been reimbursed in National Health Insurance (NHI) system from 1996 until now. Because of the accessibility and less expense, the utilization rate of TCM therapy was 43.3% among patients with dementia.[18] In this research, our aim is to use the National Health Insurance Research Database (NHIRD) to investigate the impact of TCM on advanced nursing care and medical costs in patients with dementia.

2. Methods

2.1. Data sources

We used NHIRD for the present research. National Health Insurance Administration collects insurance and medical information on people across the country in Taiwan and releases them for medical research after encryption and delinkage.[19] Several researchers have used the healthcare database to conduct a large-scale and long-term study of TCM efficacy.[15,20] Longitudinal Health Insurance Database 2005 is a subset of NHIRD's 17-year tracking data covering millions of people; medical information such as disease diagnosis, medicine, surgery, medical expenses are included.[21] The insurance information e tracked from 1996 to 2012 includes information on the diagnosis of the disease according to the International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM). The Research Ethics

Committee at Taipei City Hospital reviewed and approved this study with the number TCHIRB-10410114-E.

2.2. Study sample

As seen in Figure 1, we selected and tracked a dementia cohort from the NHI database. From 1997 to 2003, 13950 patients were diagnosed with dementia. We used ICD-9-CM to access the patients with Alzheimer's disease (ICD-9-M:331), Lewy body dementia (ICD-9-CM:331.82), frontotemporal dementia (ICD-9-CM:331.19), vascular dementia (ICD-9-CM:290.4), senile dementia (ICD-9-CM:290), dementia from obstructive hydrocephalus (ICD-9-CM:331.4), dementia from cerebral degeneration (ICD-9-CM:331.7), amnestic disorder (ICD-9-CM:294.0), dementia classified in elsewhere (ICD-9-CM:294.1), and dementia, unspecified (ICD-9-CM:294.2). Those without dementia diagnosis such as Huntington disease (ICD-9-CM:334) and traumatic encephalopathies (ICD-9-CM:348.3) were not included in our study sample. To ensure that patients had an equal severity at the beginning of the study, we included only the 1st diagnosed patients with dementia during the study period. We only include patients with dementia diagnosed by neurologists or psychiatrists, and received treatment for anti-dementia drugs. Additionally, we excluded patients who were not diagnosed more than 3 times (n = 2174), those not 1st diagnosed with dementia (n = 1632), those receiving advanced nursing care before dementia diagnosis (n = 695), and those with incomplete demographic data (n = 11). The similar exclusion criteria have been widely used in dementia research to improve the accuracy of the study population.[17,22]

2.3. Exposure and follow-up

Traditional Chinese medicine treatment is the primary intervention factor in this study. We searched all the medical records of patients with dementia and classified them according to whether the patients received TCM treatment or not. The TCM treatment includes Chinese herbal medicine and acupuncture; all therapies require the diagnosis and prescription by a licensed TCM doctor. We defined the TCM users as those who have received TCM treatment between dementia diagnosis and the 1st advanced

nursing care (or to the date of study end on December 31, 2012); others were classified as non-TCM users. We recorded the names, doses, frequency, and duration of TCM treatments. To measure the duration of TCM treatment, we calculated cumulative TCM treatment received by each patient throughout the follow-up period. Many cohort studies have used this classification to evaluate the long-term effects of TCM.[23,24]

Since the NHI database contains all medical information, we can track all medical data of patients with dementia between 1997 and 2012. We defined the starting date of the tracing as the 1st diagnosis date of dementia, and the end date as the date of the 1st advanced nursing care or the end of December in 2012.

2.4. Study outcomes

The outcome of this study was the 1st advanced nursing care, the cost, and the time of hospitalization. We defined the outcome of the survey as receiving advanced nursing care for patients with endotracheal tube care, urinal indwelling catheterization, and insertion of nasogastric tube care.

We collected information on hospitalization costs from the file "inpatient expenditures by admissions" which contains all hospital fees including examination fees, ward fees, food and beverage charges, radiation medical expenses, treatment and disposal costs, operation costs, rehabilitation services, blood plasma costs, hemodialysis costs, anesthesia fees, medical equipment fees, medicines and drugs service fees, psychiatric treatment fees, and injection technique fees. Hospitalization time was calculated from the 1st day of admission until the end of hospitalization, including acute ward and chronic ward.

2.5. Potential confounders

We systematically identified potential confounders for need of advanced nursing care, including comorbidities, such as diabetes mellitus, cerebral vascular accident, coronary heart disease, cancer, and chronic kidney disease; we also calculated the Charlson comorbidity index of patients, which is a suitable indicator that is widely used prospectively to predict the medical expenses and the need of advanced nursing care.[25,26] We included only those comorbid conditions that were diagnosed and treated before the 1st time of advanced nursing care. We divided patients by the Charlson comorbidity index into 4 groups: less than 2, 2 to 3, 4 to 5, and more than 5.

We also involved important demographic variables such as age at dementia diagnosis, sex, urbanization of residence area, and insured amount; these variables might affect the progress of dementia and the need of advanced nursing care.[15,18] We separated patients according to age at dementia diagnosis: less than 60 y, 60 to 69 y, 70 to 79 y, and more than 79 y. The degree of urbanization considered the population density, education level, medical resources, the proportion of the elderly population, which could represent the development degree of the area in which the patients live. In this study, the degree of urbanization was divided into low, moderate, high, and very high. The insured amount of NHI can roughly represent people's income. In this study, the insured number of patients was divided into dependent people, and those with income as 1 to 644, 645 to 1289, and more than 1289 USD.

2.6. Statistical analysis

We compared demographic and medical variables for TCM users and non-TCM users and examined the significance using Chi-square test. We used the Cox regression proportional hazard

analysis to examine the differences between the TCM treatment and the need for advanced nursing care in patients with dementia. We represented the adjusted hazard ratio (aHR) and the accompanying 95% confidence intervals (CIs) and adjusted the possible covariates mentioned earlier. We employed independent t test to investigate the difference in hospitalization costs and days between TCM user or not. Furthermore, we used ANOVA test to compare the hospital cost, hospital days, and numbers according to different duration of TCM. We used 2-tail tests and set the significance level of P-values as less than .05, and the statistically high significance at $P < .001$. The SAS statistical software was used (version 9.4; SAS Institute Inc, Cary, NC) to arrange and analyze the information.

3. Results

We assessed 13,950 patients with dementia, and 9438 new diagnosis in patients with dementia without the advanced nursing care were categorized into 2 groups: 4094 (43.4%) were TCM users, and 5344 (56.6%) were non-TCM users. After a total of 15 years of tracking, 894 (21.8%) patients were declared as the advanced nursing care in the TCM groups, while 1683 (31.5%) patients were in non-TCM group, as shown in Figure 1. The average duration of follow-up was 4.72 years in non-TCM group compared to 7.56 years in TCM groups.

Demographic characteristics and medical variables of the study participants are shown in Table 1. The mean age of patients in the non-TCM group (77.6 ± 10.24) was higher than that of patients

Table 1

Demographic characteristics of patients with dementia according to traditional Chinese medicine (TCM) use.

Variables	TCM group 4094 (100%)	Non-TCM group 5344 (100%)	P-value of Chi-square test
Age at diagnosis			<.001
<60	489 (11.9%)	354 (6.6%)	
60–70	691 (16.9%)	626 (11.7%)	
70–80	1300 (31.8%)	1590 (29.8%)	
≥80	1614 (39.4%)	2774 (51.9%)	
Gender			<.001
Male	2227 (54.4%)	2655 (49.7%)	
Female	1867 (45.6%)	2689 (50.3%)	
Urbanization			<.001
Very high	964 (23.5%)	1010 (18.9%)	
High	2569 (62.8%)	3476 (65.0%)	
Moderate	370 (9.0%)	541 (10.1%)	
Low	191 (4.7%)	317 (5.9%)	
Insured amount (USD)			<.001
Dependent	1373 (33.5%)	1923 (36.0%)	
1–644	1346 (32.9%)	2365 (44.3%)	
645–1289	1153 (28.2%)	939 (17.6%)	
>=1290	222 (5.4%)	117 (2.2%)	
Comorbidity			
Diabetes mellitus	1845 (45.1%)	2058 (38.5%)	<.001
Cerebral vascular accident	2527 (61.7%)	3306 (61.9%)	.02
Coronary heart disease	2075 (50.7%)	1951 (36.5%)	<.001
Cancer	1678 (41.0%)	1230 (23.0%)	<.001
Chronic kidney disease	715 (17.5%)	733 (13.7%)	<.001
Charlson comorbidity index			
<2	428 (10.5%)	1272 (23.8%)	<.001
2–3	750 (18.3%)	1218 (22.8%)	
4–5	830 (20.3%)	1072 (20.1%)	
6<=	2086 (51.0%)	1782 (33.3%)	

TCM = traditional Chinese medicine.
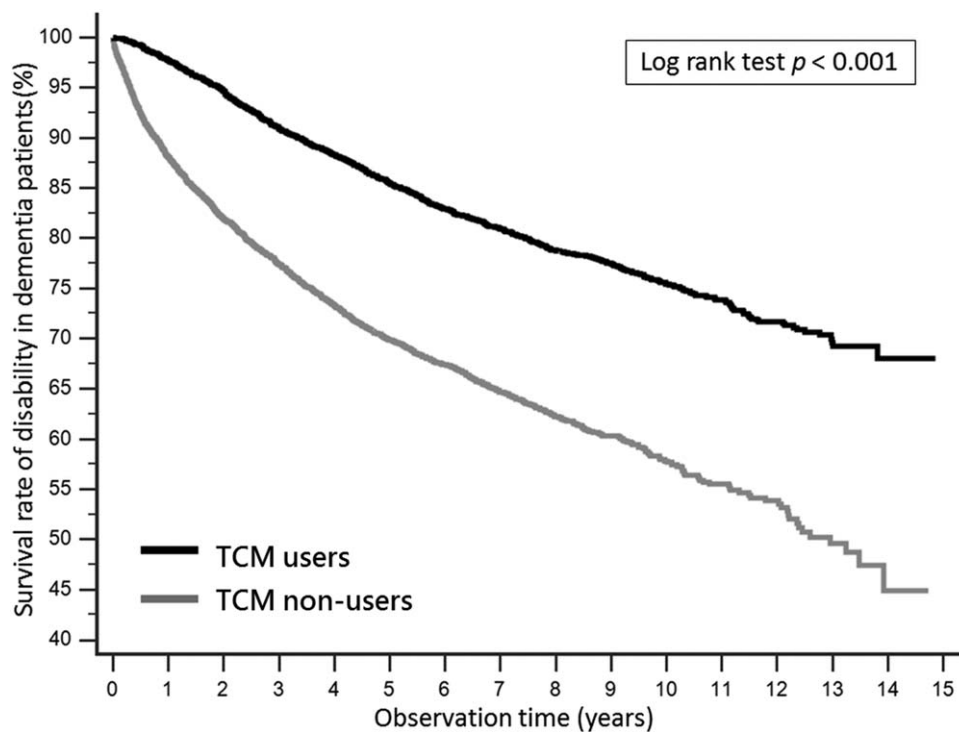
Figure 2. Survival curve of advanced nursing care in patients with dementia. Kaplan–Meier survival curves and log-rank analyses revealed significant differences in the rates of advanced nursing care between TCM and non-TCM users (log-rank test, $P < .001$). TCM = traditional Chinese medicine.

in the TCM group (74.6 ± 11.42). Chi-square test showed that there were significant differences in age, sex, urbanization in residential areas, insurance coverage, and Charlson comorbidity index between the TCM user group and non-user group. The TCM users had a higher proportion of senior citizens, men, higher incomes, and high Charlson comorbidity index relative to non-TCM users. The TCM users also had a higher proportion of patients with diabetes mellitus, coronary heart disease, cancer, and chronic kidney disease. Kaplan–Meier survival curves and log-rank analyses revealed significant differences in the need of advanced nursing care among TCM and non-TCM users (log-rank test, $P < .001$), as shown in Figure 2.

We further compared the cumulative dose of different Chinese medicine and found that with the increase in treatment, the need for advanced nursing care decreased, as shown in Table 2. Cox proportional-hazards regression indicated that using TCM may decrease the risk of advanced nursing care (adjusted hazard ratio (aHR) = 0.61, 95% CI: 0.56–0.66) compared to non-TCM users. We found that seniority and male sex were positively related to advanced nursing care needs. Past medical history including diabetes mellitus, cerebral vascular accident, coronary heart disease, cancer, and chronic kidney disease increased the requirement for advanced nursing care. There was a positive correlation between the Charlson comorbidity index and risk of receiving special care needs (i.e., the higher the patient's Charlson comorbidity index, the higher the risk of receiving special care needs). The aHR of patients whose Charlson comorbidity index were 2 to 3, 4 to 5, and more than 5 were 1.77 (1.53–2.05), 2.60 (2.21–3.06), and 4.32 (3.56–5.25), respectively. We further compared whether TCM for different levels of advanced nursing care had an impact, as shown in Table 3. The duration of care needed for an

endotracheal tube, indwelling urinary catheter, and nasogastric tube were longer in the TCM group than in the non-TCM group, and the adjusted hazard ratio were 0.72 (0.58–0.86), 0.62 (0.51–0.73), and 0.58 (0.49–0.66) respectively. We defined the average occurrence time was the duration from the 1st dementia diagnosis to the 1st application of advanced nursing treatment. The TCM users had lower hospitalization costs compared to non-TCM users. The mean difference was 867.3 USD, and the P-value was .015, as shown in Figure 3. The TCM users had lower hospitalization time compared to non-TCM users. The mean difference was 5.19 days, and the P-value was .035, as shown in Figure 4.

Hospitalization costs and time significantly reduced in patients with dementia who received TCM treatment and ANOVA test showed statistical significance ($P < .001$), as shown in Tables 4 and 5. The average hospital costs were 8419.9, 7342.6, 7423.1, and 7886.9 USD for patients who did not use TCM, and those who used it for less than 100 days, 100 to 199 days, and more than 199 days, respectively. The average hospital days in TCM users was relatively lower than that in non-TCM users. We divided the Chinese medicine treatment received by patients into acupuncture and Chinese herbal medicine. We classified TCM users into 3 groups: Chinese herbal medicine alone, acupuncture treatment alone, and both therapies. The Cox-model regression showed that patient who received acupuncture alone (aHR = 0.43, 95%CI = 0.30–0.63) or both acupuncture and Chinese herbal medicine treatment (aHR = 0.49, 95%CI = 0.44–0.56) have a lower adjusted hazard ratio than patients who use Chinese herbal medicine alone (aHR = 0.72, 95%CI = 0.66–0.78). But the 3 groups of patients were significantly less likely to receive advanced nursing care than non-TCM users, as shown in Table 6.
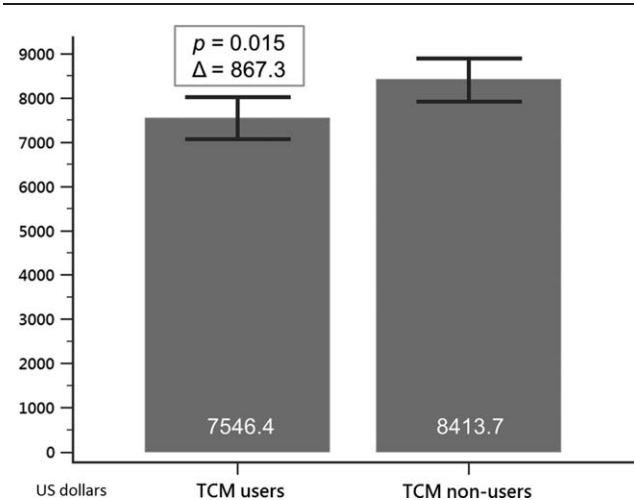
Table 2

Adjust hazard ratio with 95% confidence interval (CI) of advanced nursing care in dementia cohort.

Variables	Adjust hazard ratio (aHR)	95% CI	P-value
Traditional Chinese medicine (TCM) use			
Non users	[Reference]	[Reference]	[Reference]
User	0.61	0.56–0.66	<.0001*
< 100 Days	0.65	0.58–0.73	<.0001*
100–199 Days	0.60	0.52–0.68	<.0001*
≥200 Days	0.43	0.37–0.50	<.0001*
Age at diagnosis			
<60	[Reference]	[Reference]	[Reference]
60–69	0.96	0.82–1.12	<.0001*
70–79	2.04	1.77–2.36	<.0001*
≥80	1.61	1.38–1.87	<.0001*
Gender			
Male	[Reference]	[Reference]	[Reference]
Female	0.82	0.75–0.90	.8237
Urbanization			
Low	[Reference]	[Reference]	[Reference]
Moderate	0.97	0.88–1.07	.4939
High	0.96	0.83–1.10	.5296
Very high	0.84	0.69–1.02	.0841
Insured amount (USD)			
Dependent	[Reference]	[Reference]	[Reference]
1–644	1.06	0.96–1.16	.2670
645–1289	0.83	0.75–0.93	.0011*
>= 1290	0.99	0.81–1.21	.9187
Comorbidity			
Diabetes mellitus	1.42	1.26–1.59	<.0001*
Cerebral vascular accident	1.60	1.10–2.32	<.0001*
Coronary heart disease	1.40	1.26–1.54	<.0001*
Cancer	2.24	1.14–2.35	<.0001*
Chronic kidney disease	2.07	1.25–2.18	<.0001*
Charlson comorbidity index			
<2	[Reference]	[Reference]	[Reference]
2–3	1.77	1.53–2.05	<.0001*
4–5	2.60	2.21–3.06	<.0001*
6<=	4.32	3.56–5.25	<.0001*

aHR=Adjust Hazard Ratio, CI=confidence interval, TCM=traditional Chinese medicine.

Figure 3. Independent *t* test for accumulated hospitalization costs in patients with dementia. The TCM users have lower hospitalization costs compared to non-TCM users. The mean difference was 867.3 USD, and the *P*-value was .014. TCM = traditional Chinese medicine.

4. Discussion

Patients with dementia usually experience cognitive or memory impairment at an early stage, as the disease progresses or other comorbidities occur, they gradually lose their physical function or become incapable of performing activities of daily living. According to the Global Deterioration Scale (Reisberg Scale), dementia is classified into 7 degrees by its symptom severity, based on memory, verbal ability, ability to ambulate, and performing activities of daily livings. While dementia progresses to the terminal stage, patients usually lose their ability of walking, eating and eventually become incontinent, which is called advanced dementia.[27] Previous research has indicated that the major problem of advanced dementia is swallowing disorder (dysphagia), which causes high aspiration pneumonia risk and subsequent high mortality rate.[4] A study reported that eating problems account for 38.6% and pneumonia accounts for 46.7% for 6-months mortality rates of advanced dementia in a nursing home.[4] Another research also found that such patients with severe pneumonia have elevated requirement of tracheal intubation (48.3%) and intensive care (52.5%) in hospital.[17] It is unfortunate that patients with advanced dementia may encounter dysphagia and may need to receive nasogastric tube insertion, and once they experience severe pneumonia, nearly half of them require intubation. Besides, dementia causing atrophy of the hippocampus, temporal lobes, parietal lobes, and pons, affects the bladder function resulting in urinary incontinence or urinary retention.[15] Patients who have voiding problems may need catheter indwelling and have increased risk of urinary tract infection. Both pneumonia and urinary tract infection lead patients to a poor health condition and cause high hospitalization rate and mortality rate. In our study, we used the indwelling of the nasogastric tube, urinary catheter, and the procedure of tracheostomy as the criteria of advanced nursing care in patients with dementia. Patients who underwent one of those procedures

Table 3

Adjust hazard ratio (aHR) with 95% confidence interval (CI) of the different advanced nursing care.

Variables	TCM group 4094 (100%)		Non-TCM group 5344 (100%)		aHR (95% CI)	
	Number (%)	Average occurrence time, (year)*	Number (%)	Average occurrence time, (year)*	aHR	95% CI
Endotracheal Tube care	99 (2.4%)	7.4	248 (4.6%)	6.2	0.72	0.58–0.86
Urinal indwelling Catheterization Care	1260 (30.8%)	6.3	2038 (38.1%)	5.6	0.62	0.51–0.73
Nasogastric tube Care	953 (23.3%)	5.8	1906 (35.7%)	4.9	0.58	0.49–0.66

* We defined the average occurrence time was the duration from the 1st dementia diagnosis to the 1st application of advanced nursing treatment.

aHR = Adjust Hazard Ratio, CI = confidence interval, TCM = traditional Chinese medicine.
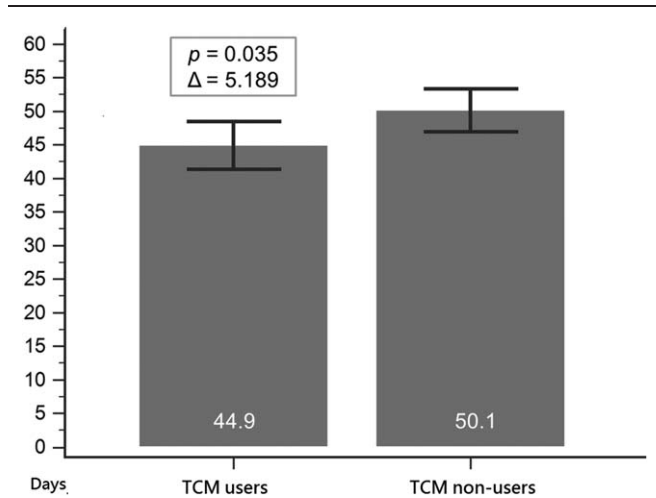
Figure 4. Independent *t* test for accumulated number of days in hospital for patients with dementia. The TCM users have lower hospitalization days compared to non-TCM users. The mean difference was 5.19 days, and the *P*-value was .035. TCM = traditional Chinese medicine.

had not only capability deprivation but also a poor health condition for the rest of their lives.[3]

As our results revealed, patients with dementia in TCM group had a 39% lower need of advanced nursing care outcome compared with those in non-TCM group, which means TCM therapy lowers the need of inserting the nasogastric tube, urinary catheter, or/and the procedure of tracheostomy in dementias. Previous randomized control trials indicated that Chinese herbal formula Ban-Xia-Hou-Pu-Tang reduces the incidence of pneumonia by improving the swallow reflex in patients with dementia,[16] and another large scale cohort study commented that TCM group was associated with a lower incidence of pneumonia risk compared with non-TCM group in dementia (adjusted hazard ratio: 0.62; 95%CI = 0.55–0.70), and the longer the TCM therapy received, the lower is the risk of hospitalization

due to pneumonia.[17] In the aspect of the urinary problem, a previous research has shown that TCM reduced the risk of indwelling catheterization in patients with dementia (aHR: 0.58%, 95%CI = 0.52–0.66), and the benefit prolonged with the use of TCM.[15] The most frequent prescribed herbal formulas to patients with dementia were revealed from our previous research. We founded that top 3 Chinese herbal formulae were Qi-Ju-Di-Huang-Wan (9.7%), Jia-Wei-Xiao-Yao-San (8.1%), and Ban-Xia-Bai-Zhu-Tian-Ma-Tang (6.7%).[18] Another study revealed the most frequent prescribed Chinese herbal formulae for patients with Alzheimer's disease were Bu-Zhong-Yi-Qi-Tang, Ji-Sheng-Shen-Qi-Wan, and Ma-Zi-Ren-Wan.[22] Previous study reported that Ba-Wei-Di-Huang-Wan (a derivatives of Liu-Wei-Di-Huang-Wan) improved the cognitive function in dementias in a clinical trials.[12] Besides, Bu-Zhong-Yi-Qi-Tang and Ba-Wei-Di-Huang-Wan (a derivatives of Liu-Wei-Di-Huang-Wan) have been reported delaying the progression of renal failure.[31] Although different Chinese medicine herbal formulae have different composition, many Chinese herbal medicines have been found effective in treating urinary tract symptoms, promoting blood circulation in genitourinary system, avoiding kidney stone synthesis, and protecting kidney function.[23,28–31]

It seems that our findings are consistent with those of previous results that TCM therapy is beneficial in patients with dementia. Patients with dysphagia or urinary problems and lack of proper rehabilitation or medical care usually have increased need of inserting the nasogastric tube and urinary catheter. Our study demonstrates that TCM lowers the risk associated with insertion of tubes (nasogastric tube, urinary catheter, tracheostomy tube) and hospital duration in patients with dementia, which also represents that TCM therapy could potentially lower the risk of infection, avoiding symptoms from getting worse, and elevating the quality of life in patients with dementia.

In addition, our study indicated the result was better in patients receiving acupuncture treatment. Clinically, the most commonly used acupoints for dementias were located in scalp area including Baihui (GV20), Sishencong (Standard Acupuncture Nomenclature EX-HN 1), Xiu Shenzhen (Standard Acupuncture Nomenclature GB13 and DU24), and Taichong (Liv3), Hegu (LI4) in 4

Table 4

Hospital cost grouped according to different duration of traditional Chinese medicine (TCM).

TCM use	Cumulative hospital cost (USD)	Average hospital cost (USD)	Standard deviation	*P*-value of *t* test	*P*-value of ANOVA test
TCM non-TCM users	44,937,157	8419.93	18216.96	[Reference]	[Reference]
TCM users	30,894,887	7546.38	15472.56	*P* = .015	*P* < .001
< 100 Days	12,093,291	7342.62	13932.03	–	
100–199 Days	8,440,075	7423.11	16368.90	–	
≥200 Days	10,387,127	7886.96	16455.60	–	

TCM = traditional Chinese medicine.

Table 5

The length of hospital stay grouped according to different duration of traditional Chinese medicine (TCM).

TCM use	Cumulative hospital days	Average hospital days	Standard deviation	*P*-value of *t* test	*P*-value of ANOVA test
TCM non-TCM users	267,775	50.17	120.09	[Reference]	[Reference]
TCM users	184,010	44.95	115.86	*P* = .035	*P* < .001
< 100 Days	72,725	44.16	102.08	–	
100–199 Days	48,087	42.29	106.63	–	
≥200 Days	63,350	48.10	137.47	–	

TCM = traditional Chinese medicine.

Table 6

Adjust hazard ratio with 95% confidence interval (CI) of the different treatment for the need of advanced nursing care.

Variables	aHR	95% CI	P-value
Traditional Chinese Medicine use			
Non users	[Reference]	[Reference]	[Reference]
All TCM Users	0.61	0.56–0.66	<.0001*
Chinese herbal medicine alone	0.72	0.66–0.78	<.0001*
Acupuncture treatment alone	0.43	0.30–0.63	<.0001*
Both acupuncture and Chinese herbal medicine treatment	0.49	0.44–0.56	<.0001*

aHR = Adjust Hazard Ratio, CI = confidence interval, TCM = traditional Chinese medicine.

extremities. Although the real neural mechanism of acupuncture in dementia are still unclear, recent studies discovered that acupuncture modulates the default mode network activity of functional-MRI, or enhanced the functional activity in hippocampus and the precentral gyrus.[32–33] Another research found the acupuncture had anti-apoptotic effect in Alzheimer disease, and the possible mechanisms were associated with a series of downstream signaling pathways and the up-regulated expression of neurotrophic factors.[34]

This study indicated that patients with dementia on TCM therapy have reduced hospital stay and decreased hospital medical expenditure. According to a previous research, the medical cost for inpatient care in patients with dementia was estimated to be 670,000 USD in 2000 and 2.4 million USD in 2001 with an increase shown every year.[35] In our study, the total inpatient medical cost of patients with dementia from 1997 to 2012 was about 75.6 million USD in Taiwan. However, TCM therapy group had the lower total inpatient cost (30.9 million) compared with non-TCM group (45.0 million), reaching a 31.3% decrease in total hospitalization cost with statistical significance (Table 4). The cumulative hospitalization stay in TCM group (44.9 days) was also shorter than that in non-TCM group (50.1 days), indicating that integrated TCM therapy can provide a better health condition and reduce the hospital utilization in patients with dementia. Above all, these data still represent that integrated TCM therapy in patients with dementia can provide an efficient use of medical resources and relief from a considerable burden in terms of medical expenditure in the healthcare system.

To our knowledge, this is the 1st study for investigating the advanced nursing care in patients with dementia with TCM therapy. Our results demonstrated that TCM not only lowered the risk of indwelling nasogastric tube, urinary catheter, and tracheostomy tube in patients with dementia clinically, but also reduced the hospital stay and medical expenditure. The TCM is widely used in many countries and acupuncture is known to be efficacious in many diseases by the World Health Organization. The medical cost of TCM including CHM and acupuncture, and both of them are reimbursed by NHI in Taiwan. Under the total amount of NHI program payment, the medication fee of CHM is about 1 USD per day,[36] which is relatively affordable than any other dementia medications (cholinesterase inhibitors, N-methyl-D-aspartate antagonist). Besides, the cost of acupuncture is lower in Taiwan, which accounts for 9 USD at the 1st time,[37] and the 2nd to 6th times are free of cost. With efficacy and effectiveness, TCM seems to be a cost-effectiveness therapy among patients with dementia. We suggest that the NHI program reallocates the medical resources and encourages integrating TCM therapy into

conventional therapy in treating patients with dementia, because the benefit is more than that by using conventional treatment alone.

In Taiwan, the government provides a variety of long-term care and rehabilitation services for patients with dementia, including home care, exercise therapy, and health education. There is no difference of rehabilitation services between TCM users and TCM non-users. The study aim is to compare the long-term effect of TCM on dementia care based on similar neurology, psychiatry, and rehabilitation. In previous studies, we have found that TCM can reduce the risk of hospitalization for patients with dementia due to pneumonia,[17] and the need for catheterization.[15] Besides, some studies have found that Chinese medicine can reduce cognitive impairment[11] and psychiatric symptoms[29] in patients with dementia. Based on the findings of previous studies, we further found that TCM can not only improve short-term symptoms but also have long-term effects.

Our research used nationwide population-based cohort datasets. The NHI datasets perform with reliability and avoid recall bias with the advantages of sufficient sample size and well-recorded healthcare service utilization, thus suggesting a suitable way of investigating the impact of TCM on advanced nursing care needs and medical costs in dementia. However, there are still some limitations in our study. First of all, the NHIRD contains only the medical expenses paid by the health insurance; we might underestimate the cost of hospitalization. However, because health insurance pays for all diseases, patients have a little chance of paying by themselves. Second, the health data could only provide the record of the physician's prescription drugs, but couldn't know the patient's medication compliance. Therefore, our research might underrate the effectiveness of Chinese medicine treatment for patients with dementia. Third, NHIRD database does not contain biochemical and imaging data, so we only included the 1st diagnosis of patients with dementia to ensure the same as the severity of the patient. Lastly, the cost of health care for patients with dementia, regardless of etiology, depends partly on the wishes of their relatives which we did not evaluate. Some would prefer to offer everything to prolong the life of the affected relative thereby increasing the cost of healthcare–while others, who are aware of the grim prognosis of dementia, would instead take the natural route, avoid resuscitation measures and let their relative die with dignity. For those who are reluctant to accept the reality and inevitable outcome of this disease, the institution of TCM maybe provide some solace to family members. However, health care providers in western medicine, realistically, have to overcome major bureaucratic hassles with particular emphasis on health care insurance coverage. For all unproven treatment such as modalities-curative or palliative-bureaucratic roadblock, courtesy of health insurance companies is likely to be encountered. Such limitation means that caution is necessary for interpreting the present results. Nevertheless, the present study still provides some intriguing results for western healthcare providers.

In conclusion, integrating TCM healthcare into dementia care would seem to help to decrease the need of advanced nursing care, hospitalization costs, and hospital stay with more benefits from longer durations of TCM use. We recommend that TCM be considered for inclusion in dementia care.

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