科技部補助專題研究計畫成果報告

（□期中進度報告/■期末報告）

台灣失智症疾病成本估計
Cost of illness of dementia in Taiwan

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計畫主持人：古鯉榕　　助理教授(醫學系公共衛生科暨研究所)
共同主持人：王榮德　　教授(醫學系公共衛生科暨研究所)
　　　　　　白明奇　　教授(醫學系神經科)

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中　華　民　國　104 年 10 月 22 日

目錄

摘要

前言：失智症相關文獻中的疾病成本的研究多來自歐美國家，本研究針對南台灣的失智症的居家病人，估計每人每年的失智症照顧成本，並評估失智症病人多重的疾病特性（例如日常生活功能、神經精神行為症狀、認知功能嚴重度等）對於各類照顧成本的影響。

方法：本研究收案期間自 2013 年 11 月至 2015 年 5 月，收案對象為南部地區某醫學中心失智症特別門診的病人及其照顧者，共計 279 雙人組。病人的疾病特性測量包含認知功能(CDR, MMSE)、神經精神行為症狀(NPI)以及日常生活功能(ADL)。照顧者接受結構式問卷調查，題項包含人口學特性、照顧關係、正式服務使用及照顧的花費。本研究參考 2010 年世界失智症報告(World Alzheimer Report)估計失智症的全球經濟衝擊的方法學，將失智症的總成本分為醫療照顧、社會照顧與家庭照顧三類，家庭照顧成本採人力資本法計算，並使用廣義線性模型估計正式服務使用對於各類照顧成本的邊際影響。

結果：本研究的失智症患者樣本的嚴重度分布以輕度(44%)和中度(38%)較多，重度患者僅佔 18%，使用任一項正式支持服務的比例為 44%，家庭照顧者超過六成為女性，成年子女照顧者(62%)多於配偶照顧者(38%)。每位失智症病人每年平均的總成本為台幣$292,328，其中以家庭照顧所佔的百分比最高(40%)、社會照顧居次(32%)，醫療照顧成本最低(28%)；無母數的統計檢定顯示醫療照顧成本不依失智症嚴重度有組間差異，但社會照顧、家庭照顧和總成本皆隨著嚴重度而顯著增加。廣義線性模型(GLM)發現使用正式服務者的家庭照顧成本雖然較低，但其社會照顧及總成本則顯著較高。此外，病人的日常生活功能(ADL)與各類照顧成本皆呈負相關，即功能越佳者的照顧成本越低，但病人的失智症嚴重度或神經精神行為症狀，與照顧成本並無統計顯著的關係。

結論：由於失智症照顧的總成本隨著疾病嚴重度上升，若能藉由高品質的照顧來減緩失智症惡化的速率，特別是著重日常生活功能(ADL)的維持，將可減少失智症照顧的總成本。然而家庭照顧佔總成本的比例最高，也反映了南台灣的失智症照顧者，需要政府提供更多的長照服務資源以減輕其經濟負擔。

中文關鍵詞：失智症、疾病成本、家庭照顧者、照顧成本

Abstract

Objective: Given the shortage of cost-of-illness studies in dementia outside of the Western population, the current study estimated the annual cost of dementia in Taiwan and assessed whether different categories of care costs vary by severity using multiple disease-severity measures.

Methods: We recruited 279 dementia patient–caregiver dyads at the dementia clinic in a national university hospital in southern Taiwan from November 2013 to April 2015. Three disease measures including cognitive, functional, and behavioral disturbances were obtained from patients based on medical history. A societal perspective was used to estimate the total costs of dementia according to three cost sub-categories used by the 2010 World Alzheimer Report. The association between dementia severity and cost of care was examined through bivariate and multivariate analyses.

Results: Our sample consisted of 44% mild, 38% moderate, and 18% severe dementia patients based on the CDR or MMSE scores. The caregivers interviewed were mostly middle-aged (mean age 61 ± 13.2 years), with a majority being women (63%). The average annual total costs of dementia per person were $292,328. The total costs for a moderate dementia patient were 1.4 times the costs for mild dementia and doubled from mild to severe dementia. Multivariate analysis indicated that functional declines had a greater impact on all cost outcomes as compared to behavioral disturbance, which showed no impact on any costs. Informal care costs accounted for the greatest share in total cost of care for both mild (42%) and severe (43%) dementia patients.

Conclusions: Since the total costs of dementia increased with severity, providing care to delay disease progression, with a focus on maintaining patient physical function, may reduce the overall cost of dementia. The greater contribution of informal care to total costs as opposed to social care also suggests a need for more publicly-funded long-term care services to assist family caregivers of dementia patients.

Keywords: cost of illness, dementia, informal care, disease severity, economics

Use of cognitive enhancers and associated medical care costs among patients with dementia: a nationwide study in Taiwan

Abstract

Background: Pharmaceutical therapy for patients with dementia including cholinesterase inhibitors (ChEI) and memantine is covered by Taiwan's National Health Insurance (NHI) but with strict reimbursement criteria. This study compared utilization of selected cognitive enhancers among elderly patients with dementia and estimated associated differences in medical care costs.

Methods: This study used medical claims and pharmacy claims from the NHI Research Database of Taiwan from 2009 to 2011, which included all patients 65 years or older diagnosed with dementia in their outpatient or inpatient claims. Both individual-level and market-level analysis were performed to calculate the average medical costs per person and the share of drug expenditures. Generalized linear models with propensity score adjustment estimated differences in medical care costs by use of selected cognitive enhancers.

Results: Users of ChEI had the highest medication and outpatient costs but the lowest inpatient costs among all users of cognitive enhancers. However, annual adjusted total medical care costs per ChEI user were not significantly different from those who used cerebral vasodilators (CBV). In 2011, 60.3% of the elderly with dementia in Taiwan used cognitive enhancers, but among them 80.2% used CBV while 17.3% used ChEI. Among patients with dementia who used at least one cognitive enhancer, the aggregated expenditure as a share of their total drug expenditures was 15.4% in 2011.

Conclusion: Given that CBV had a much higher utilization rate than ChEI or memantine among elderly people with dementia, the strict reimbursement policy for ChEI and memantine may need to be revisited to increase access to those drugs by patients with dementia in Taiwan.

Introduction

As the number of elderly people suffering from Alzheimer's disease (AD) and related dementia disorders rose from 55,000 in 2005 to almost 130,000 in 2012, Taiwan faces a challenge in the growth of health expenditures to cover the costs of care (Taiwan Alzheimer's Disease Association, 2013). The first estimate of the direct medical costs of dementia in Taiwan published in 2000 was between New Taiwan dollars (NTD) 41,535–52,032 (approx. US$1,200–1,504) per patient per year (the average exchange rate at that time was 34.6 NTD = 1 USD) (Chou *et al.*, 2000). A decade later, there is a need for a more current estimate of the impact of dementia on healthcare costs. As a country with a National Health Insurance (NHI) system, pharmaceutical therapy for dementia has been covered by the NHI in Taiwan since the year 2000 but with strict criteria (Bureau of National Health

Insurance, 2013).

First, patients must be diagnosed with AD by either a neurologist or psychiatrist according to either NINCDS-ADRDA (National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association), DSM (Diagnostic and statistical manual of mental disorders) or ICD (the International Classification of Diseases) criteria to be considered for drug reimbursement. In addition, patients who apply for drug reimbursement for the first time must have their physician complete case studies of clinical symptoms, blood tests, cognitive tests, and neurological images such as brain CT or MRI are also required. For a detailed description of the application and review process for cholinesterase inhibitors (ChEI) reimbursement, see Sun *et al.* (2008). For patients with mild to moderate AD, there are currently three kinds of ChEI for which patients can apply for reimbursement in Taiwan according to the Bureau of National Health Insurance (BNHI): donepezil, rivastigmine, and galantamine hydrobromide. For patients with moderate to moderately severe AD, the BNHI reimbursement rule allows one type of N-methyl-D-aspartate (memantine) antagonist receptor, memantine. For patients with severe AD, they may apply for the use of either donepezil or memantine. However, combined use of memantine with any of the ChEIs is currently not covered. Furthermore, patients on ChEIs or memantine must be re-evaluated every year and the drugs were no longer reimbursed if the MMSE score of the patient worsened by 3 points or more or if their Clinical Dementia Rating (CDR) scale worsened by 1 grade when compared to the initial score at application. Only with a recent change in government policy (as of August, 2013) has the comparator been changed to MMSE or CDR scores recorded in the previous year (Bureau of National Health Insurance, 2013). As a result, patients treated with ChEI or memantine have been at a high risk of discontinuation, and the average treatment duration has only been 14 months (Sun *et al.*, 2008).

In contrast to the strict reimbursement rules mentioned previously, cerebral vasodilators (CBVs) which could improve brain perfusion are covered by the NHI with no additional requirement; thus, these CBVs such as piracetam, nicergoline, and ginkgo are commonly prescribed to patients with dementia. In this paper, we first consider CBVs as one type of cognitive enhancer along with ChEI and memantine (Vellas *et al.*, 2007). However, previous studies have questioned the efficacy of these drugs for treating dementia since no well-performed clinical trial has been able to demonstrate their benefit (Montastruc *et al.*, 2013). Therefore, in addition to a combined analysis of the three groups of cognitive enhancer, we also performed a separate analysis to assess the prevalence of CBV use in Taiwan and its economic impact on medical care costs.

Since hospitalization and post-acute care account for the majority of excess direct costs among patients with mild or moderate AD, a review of several utilization studies from Medicare and managed care organizations in the US indicated that ChEI therapy was able to reduce healthcare costs by improving the cognitive function and daily functioning of the patients under consideration (Fillit and Hill, 2004). One study which was also included in that review examined donepezil use among 204 AD patients in the US and found that the medical costs for patients taking donepezil were significantly lower than those for controls (Hill *et al.*, 2002b). The researchers attributed the cost savings mainly to lower costs of inpatient hospitalization and skilled-nursing facilities services. Another case-control study among patients with mild to moderate dementia enrolled in a large Medicare managed care plan reported similar findings: patients receiving donepezil had lower total healthcare costs compared to matched patients with dementia not on donepezil (Lu *et al.*, 2005). In light of these findings, the

current study seeks to examine whether ChEI or memantine therapy for patients with dementia in Taiwan is also associated with reduced medical care costs.

Using nationwide population-based data for all elderly in Taiwan who were diagnosed with dementia in the NHI claims between 2009 and 2011, our goals were to examine the recent trend in treated prevalence and incidence rates of dementia in Taiwan, to compare the economic impact of using cognitive enhancers among patients with dementia, and to examine whether the potential benefit of using ChEI or memantine for treating dementia was also associated with cost savings for the healthcare system.

Methods
Data and sample
This retrospective economic analysis used 2009– 2011 data from the National Health Insurance Research Database (NHIRD) of Taiwan. Estimates of treated prevalence and incidence rates, number of comorbidities, medical care costs, and medication use were derived from the medical claims and pharmacy claims of the NHIRD. Since the coverage rate for Taiwan's universal health insurance program was greater than 99.5% during the study period, this dataset contained almost all of the patients with dementia in Taiwan who used any health services covered by the NHI. To ensure that our sample included confirmed cases of dementia, we included those aged 65 years or older who had been diagnosed with dementia twice within one year in either an outpatient or inpatient setting.

Measurements
A diagnosis of dementia was defined according to the ICD-9-CM codes since it was the best information available in the claims files: senile or pre- senile organic psychotic condition (290), dementia Alzheimer's disease (331.0) (Chien *et al.*, 2008). We also classified patients into four dementia subtypes based on their ICD-9-CM codes: vascular dementia (VaD) (290.4), AD (290 or 331.0), mixed dementia (those who had both a VaD and an AD diagnosis in one year), and the rest were classified as other types of dementia. Patients with AD were defined by either 290 or 331.0 since previous studies on the costs of dementia which used claims data have also recommended a more inclusive case definition for AD (Lin *et al.*, 2010; Yang *et al.*, 2012).

The cognitive enhancers examined in this study included three groups: ChEI, memantine, and CBVs. We searched the BNHI medication list to identify the drug codes involving different dosages of the following drugs: donepezil, rivastigmine, galantamine hydrobromide, memantine, dihydro- ergotoxine, piracetam, nicergoline, ginkgo biloba, and pentoxifylline. By searching these drug codes, we identified patients with dementia using different types of cognitive enhancers and compared medical care costs associated with using the drugs. Since about half of the ChEI users also took CBVs (before their application for ChEI was approved), we counted those who used both ChEI and CBVs in the same year as ChEI users. A similar definition was applied to memantine users which included combined use of memantine and CBVs. To prevent double counting our sample, we excluded CBV users who were previously on ChEI or memantine but kept those that used only CBVs during three- year study period.

The following cost categories were created for analysis: medication costs, inpatient costs, outpatient costs, and total medical care costs. Total costs in the NHIRD were defined as the sum of inpatient and outpatient costs while medication costs were considered as a component of outpatient costs. Although we compared costs by cognitive enhancer groups, medication costs in this paper refer to the sum of cognitive enhancer drug cost and other medication costs

by patients with dementia regardless of indications. All cost categories included service utilization for any cause because this study was aimed at a calculation of the gross medical care costs of dementia in Taiwan. We chose the gross cost approach to calculate all the costs for patients with dementia but not costs specifically due to dementia following the methods used in the World Alzheimer Report (Wilmo and Prince, 2010). Analyses of costs were conducted on an annual basis, and only direct costs for services covered under the NHI were included. The patient costs were limited to co-payments and did not include costs related to social care or other out-of- pocket medication purchases. All expenditures were Consumer Price Index corresponding and to USD using the average exchange rate in 2011 which was 29 NTD = 1 USD (Directorate General of Budget Accounting and Statistics (DGBAS), 2013).

Statistical analysis

We calculated annual treated prevalence from 2009 to 2011 by dividing the number of annual prevalent cases of dementia by the total number of persons aged 65 years or older in Taiwan in the given year. Persons who filed any medical claim with dementia as their diagnosis for the first time were defined as incident cases, and incidence rates for the year 2009 were not available since in this study we did not have historic data prior to that year. Therefore, the annual treated incidence rate was calculated from 2010 to 2011 using the same denominator as that for annual prevalence.

Next, we took two approaches to analyze the use of three groups of cognitive enhancer in Taiwan. We first conducted an individual-level analysis to examine the characteristics of users and the mean annual costs per person for the three groups of cognitive enhancer, followed by a market-level analysis in which we looked at the overall utilization and compared their share of spending among cognitive enhancer users. For descriptive statistics in the individual- level analysis, an analysis of variance (ANOVA) was used to compare differences in mean costs per service type across the three drug groups; when the differences were found to be significant, *post- hoc* paired comparisons were conducted using the Bonferroni method to identify pairwise differences.

In addition to comparing the unadjusted means in healthcare costs across cognitive enhancer groups, multivariate analysis was used to estimate medication, outpatient, inpatient, and total care costs for patients with dementia after adjusting for patient characteristics including comorbidities. Because healthcare costs were extremely skewed, cost measures were estimated using generalized linear models with a log link and a normal distribution to estimate predicted expenditures (Mihaylova *et al.*, 2011). Our regression model also included stratification on propensity scores to adjust for observed differences between ChEI/memantine users and non-users in order to reduce selection bias (Hirano and Imbens, 2001; Austin *et al.*, 2007). The propensity scores were obtained by calculating predictions after estimating a logistic regression of whether the patients with dementia received any CBVs as the outcome. All in our sample were stratified into four equally sized groups using the quartiles of the estimated propensity score. The stratification indicators were included in the model in addition to a list of covariates including age, gender, and the 16 chronic conditions used to construct the Charlson Comorbidity Index (CCI) based on Deyo's coding algorithm (Deyo *et al.*, 1992). All regressions were conducted with version 12 of the STATA software package (Stata Corp, College Station, TX). Cost differences, defined as the predicted costs for cognitive enhancer users minus the predicted costs for non-users, were calculated and tested for statistical significance using the Z test. Since our data contained repeated observations of annual healthcare costs for an individual across three years, clustered standard errors that allowed for intra-group correlation were used to construct 95% confidence

interval.

Results

Table 1 shows the annual treated prevalence of de- mentia from 2009 to 2011 and the annual incident rates of dementia from 2010 to 2011 among elderly Taiwanese people. The number of elderly people who were diagnosed with dementia in 2009 was 112,368. Dividing the number of prevalent cases by a total of 2,426,251 elderly people aged 65 above in Taiwan yielded a treated prevalence rate of 4.6% in 2009. While the treated prevalence increased from 4.6% to 5.4% in 2011, the annual treated incidence stayed around 1.9%. In the subtype analysis for 2011, AD accounted for 79.4% of the prevalent dementia cases, followed by 9.6% for VaD, 5.9% for mixed dementia, and 5.1% for other types of dementia. AD also accounted for the majority of incidence cases of dementia (78.3%), and we observed a similar distribution of dementia subtypes followed by VaD and mixed dementia (Table 1).

Comparison of three groups of cognitive enhancers

The characteristics of users of three groups of cognitive enhancer are summarized in the upper part of Table 2, and the mean medical care costs per service category are shown in the lower part. We also presented characteristics of patients with dementia who had not used any cognitive enhancer on the far left column, although the *p*-value and *post-hoc* comparisons on the far right were based on three group comparisons. The non-users seemed older, more likely to suffer from VaD than cognitive enhancer users did and reported the highest total medical care costs. Among patients with dementia who also used cognitive enhancers between 2009 and 2011, CBV use was most common ($n = 182,427$), followed by ChEI ($n = 36,334$), while memantine was the least used drug ($n = 4,938$). The mean ages of cognitive enhancer users were between 79.6 and 80.8 years, and female accounted for more than half of the users. Results from the χ^2 -test showed differences in the dementia subtype by cognitive enhancer group. While 93.8% of ChEI users and 92.7% of memantine users reported having AD, a lower percentage of CBV users exhibited AD (74.7%) but relatively more exhibited VaD (12.2%) or mixed dementia (7.1%). On the other hand, CBV users reported higher comorbidity measured in CCI than the other two groups. The bottom part of Table 2 presents mean costs comparisons, and based on results from the Bonferroni method, ChEI was the most costly drug among the three groups of cognitive enhancer. ChEI users also had the highest outpatient costs but the lowest inpatient costs among all cognitive enhancer users. In contrast, CBV users had the highest total medical care costs due to having much higher inpatient costs than the other two groups.

Table 3 presents the shares of both utilization and spending on three groups of cognitive enhancer nationwide between 2009 and 2011. Overall, more than 60% of patients with dementia were taking cognitive enhancers, but the costs of cognitive enhancers on average accounted for 15% of the total pharmaceutical expenditures incurred by cognitive enhancer users. Among 71,869 patients with dementia who took at least one type of cognitive enhancer in 2011, CBV users claimed the highest proportion (80.2%) while ChEI accounted for the highest share (72.7%) of pharmaceutical spending. NHI spending on cognitive enhancers in Taiwan was calculated to be US$6.6 million annually, and the dollars spent on ChEI amounted to US$3.7 million. Looking at the trend of growth during this period, the share of ChEI users among patients with dementia stayed around 10%, but the share of ChEI spending in total cognitive enhancer spending increased slightly from 64.5% to 72.7%. The share of

CBV spending in total cognitive enhancer spending, on the other hand, decreased from 31.9% to 23.2% during the same period, possibly due to its lower price as compared to ChEI.

Comparison between unadjusted and adjusted medical care costs by types of cognitive enhancers Since the clinical effectiveness of ChEI and memantine was quite different from that of CBVs, we combined users of ChEI and memantine against CBV users in this comparative cost analysis. The left columns in Table 4 showed that ChEI/memantine users had higher medication and outpatient costs but lower inpatient and total healthcare costs than CBV users. However, the right columns in Table 4 showed that after adjusting for comorbidities, predicted care costs were still higher among ChEI/memantine users in regard to medication costs and outpatient costs. The cost difference remained in that ChEI/memantine users reported lower inpatient costs than CBV users after adjustment. However, there was no statistically significant difference in adjusted total healthcare costs by user status (p = 0.670)

Discussion

An earlier survey that also used NHI claims found that the prevalence of treated dementia in Taiwan increased from 0.7% in 1996 to 1.92% in 2003 (Chien et al., 2008). A decade later, our study showed that the treated prevalence rate of dementia has increased three times more to 5.4% in 2013. However, the latest figure released in 2012 from a nationwide community survey of dementia in Taiwan was 4.79% , a figure lower than our prevalence estimate (Taiwan Alzheimer's Disease Association, 2013). While the current study used only ICD-9-CM codes to identify patients with dementia, the community survey used Clinical Dementia Rating scale to define its disease population. Therefore, plausible explanations for the rate difference could be due to sampling design 1997; Lopez et al., 2011). Among prevalent cases of dementia in 2011, we found AD to be the most common subtype (79.4%), followed by VaD (9.6%), and this gap in proportion was similar to an earlier community-based study of dementia in rural Taiwan (Liu et al., 1998). However, this unequal distribution in regard to the dementia subtype could also reflect current clinical practice using the ICD-9-CM diagnoses, in which less common subtypes, such as dementia with Lewy bodies or frontotemporal dementia, were rarely used in coding during this period. Another issue related to dementia subtype was why patients other than AD patients also used ChEI or memantine, when there was no indication for the prescription according to the NHI criteria. While AD and mixed dementia together accounted for over 96% of ChEI use, VaD accounted for 0.8% and other subtype for 3.0%. As Parkinson's disease dementia has been approved for ChEI reimbursement in Taiwan since May 2010, we found that 18.4% of ChEI users with other unspecified dementia had Parkinson's disease. Furthermore, the small number of VaD diagnoses (n = 164) may have occurred after prescription of ChEI or memantine given that our unit of observation was by year. Since we found that in 2011 about 52.4% of elderly patients with dementia in Taiwan used any cognitive enhancer and among those users, only 9.2% of them took ChEI, multiplying the two numbers yielded a low proportion (4.8%) of ChEI users among all elderly patients with dementia identified from the NHI claims. A similar calculation was done for the other two groups of cognitive enhancer and indicated that only 1.3% of our study population used memantine, but 46.3% of them took CBVs. The percentage of patients with dementia receiving ChEI or memantine observed in our study was much lower than that from studies based in Europe. In a study that examined medication in community- residing patients with AD in France, 89% of the sample received ChEI therapy, and 24% had been prescribed

CBVs, although the latter drugs were considered potentially inappropriate medications due to their limited efficacy for patients with dementia (Montastruc et al., 2013). Another study using national data from the Swedish Dementia Registry (SveDem) found that more than 80% of AD patients were treated with ChEI (Johnell et al., 2013). Although there is currently no curative treatment available for dementia, results from many cost-effective studies have supported the use of ChEI and memantine to be beneficial for cognition and global functioning in patients with AD (Bond et al., 2012; Hyde et al., 2013). While the magnitude of improvement may be small, the limited use of these drugs among patients in Taiwan is still a concern since more patients with dementia could have benefited from this therapy.

On the other hand, the high proportion of CBV use observed in our study deserves attention, especially since the social healthcare systems in other countries like France have discontinued reimbursement for CBVs (Montastruc et al.,2013). In fact, a consensus panel established in France selected CBVs, including ergot derivatives, ginkgo-biloba, and nicergoline, in the list of potentially inappropriate medications for the elderly population in France (Laroche et al., 2007). It is likely that CBVs have been prescribed as a replacement for ChEI therapy in Taiwan given that ChEI had strict reimbursement rules; yet the main concern is that evidence from clinical trials does not support their therapeutic equivalency (Mimica revealed that the treatment of both ChEI and memantine among patients with dementia was limited both in regard to expenditures and in regard to the share of patients who had access to the drugs. Although these drugs cost much more than CBVs, our findings of comparable total healthcare costs between the two groups seem to challenge the preconception that ChEI/memantine treatment for dementia is costly to Taiwan's healthcare system. This is a reminder that the overall spending in CBVs should not be overlooked. While the strict NHI reimbursement rules were initially in place to control healthcare budgets, these rules may also have unintendedly increased the use of CBVs.

The use of a retrospective claims-based database for this study allowed for a large sample of patients who used cognitive enhancer across Taiwan. However, several limitations need to be discussed. First, it was not possible to verify the basis for which an AD diagnosis in this administrative Matanovic´ and Vlahovic-Palcevski, 2012). In our database was made because of a lack of clinical study, patients with dementia who used CBVs reported more comorbidities and higher medical care costs than other cognitive enhancer users, but it was not clear whether the higher spending was a cause or consequence of CBV use. A follow-up study of new drug users is needed in the future to evaluate the cost-effectiveness of CBVs in comparison with the use of ChEI in treating dementia.

Our findings that the use of ChEIs was associated with lower inpatient and total medical care costs are consistent with results from several studies conducted in US Medicare managed care populations (Hill *et al.*, 2002b; Fillit and Hill, 2004; Lu *et al.*, 2005). A recent study showed that each additional month of ChEI treatment was associated with a reduction of 1% in total all- cause healthcare costs (Mucha *et al.*, 2008). In the case of donepezil and memantine, a great deal of evidence has suggested that the cost of these drugs can be offset by the clinical and economic benefits provided by slowing the progression of dementia (Cappell *et al.*, 2010). ChEI achieves cost savings by reducing the incidence of negative events that trigger hospitalizations (such as falls and other accidents) and thus prevent inpatient stays (Fillit and Hill, 2004). The potential cost savings for the society is presumably greater if we consider costs related to institutionalization, given that many studies have found that ChEI could possibly delay entry into nursing homes (Hill *et al.*, 2002a; Marin *et al.*, 2003; Wimo *et al.*, 2003).

Under the current NHI policy in Taiwan, ChEI is only allowed in the treatment of good responders who can maintain cognitive function before disease progression. However, this population-based study back-ups (e.g. cognition tests or brain imaging). However, the possibility of incorrect diagnosis was also greatly diminished for users of ChEI or memantine given that current reimbursement rules required such stringent clinical details. Moreover, due to the nature of the claim data, we did not have information on other key variables, including functional status or behavioral symptoms. While numerous studies on the cost-of-illness of dementia have shown that indirect costs are a much heavier burden for caregivers than direct costs (Wilmo and Prince, 2010; Mauskopf and Mucha, 2011), our dataset only provided information regarding direct costs of medical care. Finally, since this was not a randomized study, we cannot rule out sample biases that might account for the differences across medication utilization. Although we used propensity score adjustment methods to correct for observed differences, we could not evaluate the potential influence of some important but unobserved factors, such as disease severity or more detailed classification of dementia.

Conclusions

This study used national data to compare utilization of major types of cognitive enhancers among patients with dementia in Taiwan and found some significant differences in both user profile and by types of healthcare costs. ChEI users had the highest medication and outpatient costs but the lowest inpatient costs among all users. While CBV users had lower medication costs, their total medical care costs were not significantly different from ChEI users. Given that only 11.9% of the elderly patients with dementia in Taiwan used ChEI or memantine compared to the 48.3% that were on CBVs, our finding suggests that the strict reimbursement policy of the NHI may have prevented greater utilization of anti-dementia medications.

Acknowledgments

Table 1. Treated prevalent and incident rates of dementia and its subtypes, 2009–2011

| | ANNUAL TREATED PREVALENCE | | | | | ANNUAL TREATED INCIDENCE | | | | |
| | | SUBTYPES | | | | | SUBTYPES | | | |
YEAR	Overall	AD	VaD	MIXED	OTHER	Overall	AD	VaD	MIXED	OTHER
2009	4.6%	79.5%	9.5%	6.1%	4.9%	N/A	N/A	N/A	N/A	N/A
2010	5.0%	79.4%	9.5%	6.1%	4.9%	1.9%	78.7%	9.3%	6.1%	5.9%
2011	5.4%	79.4%	9.6%	5.9%	5.1%	1.9%	78.3%	9.4%	6.0%	6.3%

Data Source: 2009–2011 NHIRD including patients aged 65+ with≧2 diagnoses of dementia in a year; the denominator of prevalence rate and incidence rates was the total number of population aged 65+ in Taiwan in a given year from the Census Bureau.

*Subtypes were based on ICD-9-CM codes: AD = Alzheimer's disease (290 or 331.0); VaD = vascular dementia (290.4); Mixed = Mixed AD/VaD.

Table 2. The mean costs and utilization patterns of three selected cognitive enhancers (CE)

Variable	Non-users	(SD)	ChEI	(SD)	MEM	(SD)	CBVs	(SD)	p-value	post-hoc
					Users					
N (person-year)	128,638		36,334		4,938		182,427		< 0.01	
User characteristics										
Gender (female %)	57.3%		60.8%		64.5%		54.5%		< 0.01	
Age	81.6	(7.5)	79.6	(6.5)	80.8	(6.6)	80.4	(7.0)	< 0.01	
Dementia subtype									< 0.01	
AD	81.6%		93.8%		92.7%		74.7%			
VaD	8.5%		0.7%		0.8%		12.2%			
Mixed	4.6%		3.0%		4.1%		7.1%			
Other	5.3%		2.5%		2.3%		6.0%			
Comorbidity measured in CCI	3.0	(1.9)	2.6	(1.7)	2.5	(1.7)	3.2	(1.9)	< 0.01	
Mean annual health care costs*										
Cognitive enhancer costs**			732	(436)	307	(209)	55	(56)	< 0.01	CH>MEM, CBV; MEM> CBV
Other medication costs	1,136	(1,784)	845	(1,243)	1,035	(1,510)	992	(1,427)	< 0.01	CBV >CH; MEM>CH
Outpatient costs***	1,827	(2,687)	2,565	(2,154)	2,129	(2,052)	1,965	(2,645)	< 0.01	CH>MEM, CBV; MEM> CBV
Inpatient costs	2,774	(6,346)	1,004	(3,467)	1,357	(4,145)	2,012	(5,016)	< 0.01	CBV>CH, MEM; MEM>CH
Total costs	4,600	(7,077)	3,363	(4,225)	3,337	(4,806)	3,962	(5,941)	< 0.01	CBV>CH, MEM

P-value reported from ANOVA was performed for continuous variables, and an χ2-test was used for categorical variables; pairwise comparisons between drugs using the Bonferroni methods are reported in the post-hoc column: CH=ChEI (cholinesterase inhibitors); MEM=memantine; CBV=cerebral vasodilators. Dementia subtypes were based on ICD-9-CM codes: AD=Alzheimer's disease (290 or 331.0), VaD=vascular dementia (290.4), Mixed=Mixed AD/VaD.

*All costs reported in USD$ among prevalent cases of dementia; ** cognitive enhancer costs refer to ChEI, MEM, or CBVs used; ***outpatient costs also include medication costs.

Table 3. Profile of utilization and expenditures on cognitive enhancers in Taiwan

| | Overall | | | | CE groups | | | | | | | | |
| | | | | | ChEI | | | MEM | | | CBVs | | |
Year	CE users	No.of dementia patients	Share of CE users among dementia patients (%)	$CE/$total drug expenditures among CE users (%)	No.of users	Share among CE users (%)	$ChEI /$CE (%)	No.of users	Share among CE users (%)	$MEM /$CE (%)	No.of users	Share among CE users (%)	$CBV /$CE (%)
2009	67,546	112,368	60.1%	15.8%	10,267	15.2%	64.5%	1,301	1.9%	3.5%	55,978	82.9%	31.9%
2010	74,274	123,494	60.1%	15.0%	11,866	16.0%	70.8%	1,615	2.2%	3.9%	60,793	81.8%	25.3%
2011	81,869	135,810	60.3%	15.4%	14,201	17.3%	72.7%	2,012	2.5%	4.1%	65,656	80.2%	23.2%

CE= cognitive enhancer; ChEI=cholinesterase inhibitors; MEM=memantine; CBV=cerebral vasodilators.

Table 4. Comparison between unadjusted and adjusted medical care costs by types of cognitive enhancers (CE)

| Annual expenditure category | Unadjusted health care costs | | | Annual adjusted health care costs | | | | |
	ChEI/ MEM (N= 41,262)	CBV (N=182,427)	Cost difference	ChEI/ MEM (N= 41,262)	CBV (N=182,427)	Cost difference	95% CI	p-val
Medication costs*	1,549	1,047	502	1,659	1,051	607	(583, 631)	<0.00
Outpatient costs**	2,513	1,965	548	2,534	1,974	560	(502, 618)	<0.00
Inpatient costs	1,046	2,012	-966	1,480	1,903	-423	(-482, -363)	<0.00
Total costs	3,360	3,962	-602	3,900	3,919	-19	(-106, 68)	0.670

ChEI=cholinesterase inhibitors; MEM=memantine; CBV=cerebral vasodilators.

All costs in USD$ and costs differences were derived from generalized linear models with propensity score adjustments and controlling for calendar year, age, gender, and 16 comorbid conditions.

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Economic impact of dementia in Taiwan by disease severity: Exploring the relationship between stage of dementia and cost of care in a community setting

Introduction

Cost-of-illness (COI) studies provide estimates about the economic impact of diseases and offer comprehensive data to assist decision makers for purposes of planning and financing of health systems (Wimo and Prince, 2010). As a degenerative disease with an average duration of 4 to 8 years of survival after diagnosis (Alzheimer's, 2015), it is important to understand how costs evolve over the course of the disease (Quentin et al., 2010). Considering the latest estimate of the global societal costs of dementia to be US$818 billion, or 1.09% of the worldwide Gross Domestic Product (GDP), dementia poses great challenge not only for the patients and their families, but also for health care systems around the world (Wimo et al., 2015). In the last two decades, research on the COI of dementia has expanded, leading to several systematic reviews focusing on costs of dementia and disease severity (Quentin et al., 2010; Mauskopf et al., 2010; Schaller et al., 2015). In all of these reviews, disease stage was an important determinant of costs of dementia, and the costs were found to increase with dementia severity. Despite these common findings, large variations were found between various cost estimates due to setting and cultural characteristics (Schaller et al., 2015). For instance, cultural traditions in East Asia often make adult children reluctant to send their parents with dementia to nursing homes; therefore, the utilization of formal versus informal care can be influenced by culture and ultimately affects COI (Lim et al., 2012). It is thus important for each nation to have country-specific data on cost of care at different stages of dementia for health policy planning (Schwarzkopf et al., 2011).

Currently, most published COI studies of dementia have been conducted in North America or Europe, as only 4 out of a total of 84 studies included in those three systematic reviews were done in East Asian countries. Given the shortage of COI studies of dementia outside the Western population (Chong et al., 2013), this article is aimed at investigating the relationship between dementia severity and cost of care using data from Taiwan in order to increase the diversity of the literature.

A review of past epidemiological studies showed the prevalence of dementia in Taiwan among the elderly to be between 1.7% and 4.3%, with Alzheimer's disease being the most common type of dementia (Fuh and Wang, 2008). The latest nationwide survey in Taiwan found that the age-adjusted prevalence of dementia among those 65 years and above was 4.79% (Sun et al., 2014). Although the number of people with dementia is clearly on the rise, there have only been a few economic studies about dementia in Taiwan. The first estimate of the COI of dementia in Taiwan was published in 2002, and the figure was between NT$310,018 to 710,737 per patient per year (Chou et al., 2000). In 2010, a study provided an updated estimate

of $462,700 for the cost of home care (Kuo et al., 2010). However, as the later study focused on comparison of costs between home-based versus institutional care, it did not report these costs of care according to dementia severity. Therefore, the first two aims of the current study are to calculate the annual cost of care for community-based dementia patients in Taiwan and to estimate the distribution of different cost categories in proportion to the total cost of dementia. In order to make our cost estimates comparable internationally, we adopted the COI methodology outlined in the 2010 World Alzheimer Report (WAR) to examine three sub-categories of total care costs: direct medical, direct social care, and informal care costs (Wimo and Prince, 2010).

In addition to providing an updated COI estimate for our sample in Taiwan, this study is also an attempt to address limitations in previous COI studies by including multiple measures instead of a single measure of disease severity (Jonsson and Wimo, 2009). While cognitive status, functional limitation, and behavioral disturbance are all correlated with cost of care, independent associations with costs have been noted for different measures (Mauskopf et al., 2010). One study including all three measures found that cognitive status had a greater impact on informal costs while functional declines had a greater impact on social care costs more than medical costs (Rapp et al., 2012). The third aim of our study is to conduct analyses with multiple disease-severity measures to assess whether different care cost categories vary by dementia severity.

Methods
Study design
We recruited 286 dementia patient–caregiver dyads in a dementia clinic at a national university hospital in southern Taiwan from November of 2013 to April of 2015. We included patients aged ≥65 years with dementia diagnosed by a senior behavioral neurologist (MCP) according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria (American Psychiatric Association, 1994). Dementia subtypes included mostly AD (n=191) as well as dementia with Lewy bodies (DLB) (n=9), vascular dementia (n=5) and other unspecified types. Inclusion criteria required that dementia patients had been living in the community and had an informal caregiver. The caregiver of the dementia patient was required to be a family member, ≥18 years of age, who was fluent in either Mandarin or Taiwanese. We excluded paid caregivers or those who had been a caregiver for less than 12 months. Subjects were excluded from this cost analysis if they had younger-onset dementia (n=31), if living in an institution (n=8), or if they did not consent to linkage to medical claims data (n=10). After removing 4 withdrawals and 2 incomplete responses, our final sample included 231 community-dwelling patient–caregiver dyads. Ethics approval was obtained from the National Cheng Kung University Hospital Institutional Review Board for the Protection of Human Subjects. Telephone interviews with caregivers were conducted after obtaining consent for the study from both the caregivers and the patients (when possible).

Patients' measures

Demographic data, including age, gender, and years of education, were collected from both patients and their caregivers. Three clinical measures of disease severity were obtained from the patients based on their history or relevant examinations. Cognitive status was determined with either the Clinical Dementia Rating Scale (CDR) (Hughes et al., 1982) or the Chinese version of the Mini-Mental State Examination (MMSE) (Chuo et al., 2007), depending on which of these was on the patient's medical record. A CDR global score of 1, 2, and 3 indicates mid, moderate, or severe dementia respectively. If no CDR scores but only MMSE scores were available, we categorized subjects with an MMSE score above 15 as mild dementia, an MMSE score from 10 to 14 as moderate dementia, and those with an MMSE score below 10 as severe dementia according to Taiwan's National Health Insurance (NHI) reimbursement rule for dementia drugs (Bureau of National Health Insurance, 2013). Functional status was measured with the Katz ADL scale to assess whether the patient was dependent on the following five ADLs: bathing, dressing, toileting, transferring, continence, and feeding (Benaim et al., 2005; Thomas et al., 2006). The total ADL score may range from 0 to 100, with higher scores indicating less need for support. The Neuropsychiatric Inventory (NPI) was used to estimate both the severity and frequency of a wide range of behavioral reactions including agitation, depression, and disinhibition (Cummings et al., 1994). The total NPI score may range from 0 to 120, where higher scores indicate greater impairment.

Cost estimates

We collected data on socioeconomic status and household composition from caregivers using a structured questionnaire. This study takes a societal perspective to calculate four cost outcomes, including total costs and three cost sub-categories. First, medical costs included costs of inpatient and outpatient visits, medication use covered by Taiwan's NHI, and medical expenditures paid out-of-pocket. Medical costs were obtained from linkage to medical claims records for the 12 months prior to the survey. Secondly, social care costs included costs associated with the use of adult daycare, respite care, home care, paid domestic help, and transportation costs. Third, informal costs were valued by the level of contribution to patient care by the caregiver. We assessed informal care time based on assistance with (1) basic ADL, (2) instrumental ADL (IADL), and (3) supervision for the person with dementia in the week prior to the interview. Informal care contribution was collected using the Resource Utilization in Dementia (RUD) instrument, where its measurement validity in community-living persons with dementia has been established (Wimo et al., 2013).

Two methods are frequently used for calculating the cost of informal care, namely, the "opportunity cost" and the "replacement cost" approaches (Wimo and Prince, 2010). In this study, the opportunity cost approach was selected for our base-case estimates as recommended by the WAR 2010 (Wimo and Prince, 2010), valuing informal care by the average hourly wage rates in Taiwan stratified by gender and education level. We separated caregivers according to Taiwan's official retirement age of 65 and only estimated opportunity costs of informal care for those

caregivers aged below 65. However, in a sensitivity analysis, we estimated informal care costs using the replacement costs approach in which the mandated wage rates of NT$200/hour (US$6.7/hour) for home care aides were assumed for all caregiving hours (Ministry of Health and Welfare, 2014). We did not include supervision hours in valuing informal care but rather reported them separately following the WAR 2010 method.

Total costs per annum per person with dementia were calculated by adding medical, social, and informal care costs as valued by the opportunity cost approach. In addition to the base-case estimate, informal care costs valued by the replacement cost approach resulted in an upper bound estimate of total costs. Because our cost data spanned from 2013 to 2014, we inflated all costs to the 2014 values using the Consumer Price Index and reported all costs in 2014 New Taiwan dollars (NTD). The average exchange rates in 2014 were 1 USD = 30.37 NTD and 1NTD =14.97 US dollars using purchasing power parity (PPP) conversion rates (International Monetary Fund, 2015), respectively.

Statistical analysis

We compared different categories of care costs according to dementia severity using nonparametric Kruskal-Wallis tests since the cost variables were highly skewed. For the multivariate cost analyses, we employed a generalized linear model (GLM) assuming a log link and a Poisson family of error distribution after running a modified Park's test (Manning and Mullahy, 2001). In addition to disease severity measures, the GLM analysis also accounted for other patient and caregiver characteristics, including the use of any formal services and the caregivers' education and economic status. Given the nonlinear nature of our statistical model, the log coefficients do not provide a straightforward interpretation of the substantive influence of predictors (Lafortune et al., 2009). Consequently, marginal estimates were used to illustrate the predicted differences in care costs by disease severity, holding all other variables unchanged. A marginal estimation was carried out using the margins command in Stata version 12 (StataCorp, 2011).

Results
<Insert Table 1>

Table 1 shows the demographic and disease characteristics of the patients and their caregivers. The average age of the patients was 80 years, and they had been diagnosed with dementia, on average, 4.6 years prior to inclusion in the study. Our sample consisted of 102 mild, 88 moderate, and 41 severe dementia patients based on the CDR or MMSE scores. The caregivers interviewed were mostly middle-aged (mean age 61 ± 13.2 years), with a majority being women (63%). The majority of the caregivers were highly educated (70% had finished senior high school or college) compared to their care recipients, who had received less education. Combining adult children and children-in-law caregivers together, they accounted for 60% as opposed to 38% of spousal caregivers. In a typical week, these caregivers

spent 6.4 hours in assisting dementia patients with basic ADLs and 15 hours with IADLs.

<Insert Table 2>

Table 2 presents results of the bivariate analyses of annual total costs per person and detailed cost categories by severity of dementia. As severity increased, significant increases were found in the costs of social care, informal care, and total costs, but not in medical costs, for which a Chi-square test indicated no difference. Looking into medical costs by cost components, it was found that the mild dementia patients actually had greater drug expenditures than either the moderate or severe dementia patients. (We will come back to this seemingly unintuitive result in the Discussion section). Informal care cost estimates from both the opportunity costs and the replacement costs approach are listed in Table 2, with the first serving as the base-case estimate and the latter as an upper bound. The difference in the two estimation approaches also led to variations between total cost base-case estimates and total cost upper-bounds. According to the base-case estimate, the total costs for moderate dementia patients were 1.4 times the costs for mild dementia and doubled from mild to severe dementia. Despite the difference in absolute numbers, both sets of total cost estimates increased significantly by disease severity.

<Insert Figure 1>

The proportion of medical, social care, and informal care cost in total cost per person with dementia is displayed in Figure 1. The bar chart highlights the fact that as dementia advances, social care costs increased strongly from mild to severe dementia while the relative importance of medical care as the cost driver decreased from 39.2% to 17.3%. Except for moderate dementia patients, informal care costs accounted for the greatest share in total cost of care for both mild and severe dementia patients. The last row in Figure 1 shows that in our full sample, regardless of severity, medical care contributed to only 28.2% of total care costs, while social care costs and informal care costs each accounted for 32% and 38.9% of the total costs, respectively.

<Insert Table 3>

Results of the GLM analysis (Table 3) indicated that in the multivariate analysis, functional declines measured by ADL had a greater impact on the cost of care than behavioral disturbance as measured by NPI across all four cost categories. Cognitive decline was not associated with higher costs except that informal care costs increased for severe dementia patients in comparison with mild dementia patients. Formal service use was associated with higher social care costs and total costs but lower informal care costs. Patients whose caregivers had completed senior high school and above or those with better economic status had greater total costs.

<Insert Table 4>

The marginal estimates of predicted cost differences by dementia severity are presented in Table 4. After adjusting for patient and caregiver characteristics, the model predicted that neither medical costs nor social care costs were significantly different for dementia patients at different stages. However, the informal care cost predictions were NT$122,363 for moderate and NT$178,141 for severe dementia, both being significantly higher than the NT$86,637 estimate for mild dementia.

Discussion

In this study, the annual COI of dementia in Taiwan was calculated, and the association between dementia severity and cost of care was examined through bivariate and multivariate analyses. In the bivariate analysis presented earlier, we found that total costs increased with dementia severity and that total costs doubled from mild to severe dementia, which was similar to a systematic review of COI studies of dementia, which reported that total costs more than doubled from mild to severe dementia (Quentin et al., 2010). However, our finding that mild dementia patients actually had greater drug expenditures than moderate or severe dementia patients was different from the results of earlier studies (Jönsson et al., 2006; Schwarzkopf et al., 2011). The main reason for this is that Taiwan's NHI reimbursement rule for dementia drugs stipulates that patients on cholinesterase inhibitors or memantine must be re-evaluated every year, and the drugs are no longer reimbursed following disease progression or abrupt deterioration (Bureau of National Health Insurance, 2013). Another plausible reason why medical costs did not vary by dementia severity was due to the nature of this disease— continuous support in daily living rather than curative treatment will naturally become more important as dementia progresses (Schwarzkopf et al., 2011).

Although the annual costs of dementia were initially reported in NTD, the following PPP conversions for the base-case total cost estimates were US$14,609 (SD=± 13,353) for mild, US$20,643 (SD=± 14,051) for moderate, and US$29,398 (SD=±16,721) for severe dementia. A comparison of these numbers to the COI estimates reported in a systematic review of 8 studies examining dementia severity indicated that our mild dementia estimate was similar, but both our moderate and severe dementia estimates were much lower than those of previous studies (US$42,930 for moderate and US$51,659 for severe dementia). Given that all of the cost estimates were reported in community-based settings, we next looked into each cost category to try to explain the observed differences in costs.

Our results show that informal care taking the largest share of the total care costs is in line with the literature, in which informal costs were found to be the main cost driver (Schaller et al., 2015). However, in our study, the percentage of informal care to the total care costs was between 41.9% and 43.4%, while previous reviews have reported that across different stages, informal care usually contributes to more than half of the total costs of dementia among community samples (Quentin et al., 2010; Mauskopf et al., 2010; Schaller et al., 2015). Similar to previous studies, we found as dementia severity increases, so do social care costs, as does the proportion of social care to total costs (Schwarzkopf et al., 2011; Schaller et al., 2015). However, the overall share of social care costs (32%) was far less than the 43.1% reported among high income countries (Wimo et al., 2015), where publicly-funded long-term care services are more available than in Taiwan. The greater contribution of informal care to total costs as opposed to social care also reflected traditional Asian family values, where family members of patients usually view caregiving as an obligation (Lim et al.,

2012; Chan, 2010).

By including measures of cognitive, functional, and behavioral disturbance in our multivariate model, we compared the strength of association between costs and different measures of disease severity. Similar to previous studies indicating that ADLs are highly correlated with both medical costs (Hill J, 2006; Taylor DH, 2001) and informal care costs (Neubauer et al., 2008; Small GW, 2002), our results demonstrated ADLs to be associated with all cost categories, from medical costs to social care costs, as well as informal care costs. It is worth noting that the association between functional limitation and costs was significant regardless of other severity measures that were included. What we found regarding the null effect of behavioral disturbance on costs was similar to the conclusion of an earlier review on this topic (Mauskopf et al., 2010). On the other hand, it was somewhat surprising that the marginal effect of severe dementia was only significant in informal costs but not in other cost categories after adjusting for other disease indicators. In fact, the strength of the independent association between cognitive decline and cost of care remains questionable since some study has reported a positive association (Jönsson et al., 2006) while another study has reported a null effect (Zhu et al., 2008)

Although the main objective of the current study was to examine the relationship between dementia severity and cost of care, in our regression analyses, we found that formal service use by dementia patients turned out to be an important predictor of care costs. One Singaporean study that calculated informal care costs related to caring for mild-moderate dementia patients in a community setting concluded that the use of paid domestic help resulted in cost savings (Chong et al., 2013). Similar to that study, we also found that formal service use was negatively associated with informal care costs. However, since our study also included other cost categories, we found that formal service use was correlated with higher social care costs and higher total costs, which implies that a substitution effect between formal services and informal care will still lead to higher societal costs overall.

There are several limitations in the current study we would like to acknowledge. First of all, our study sample came from a single dementia clinic in one university hospital in southern Taiwan with patients in a community setting, and thus, our COI estimates are not representative of patients living in institutions. Another limitation is that since the cognitive status of our sample came from their medical records, some of them were measured by the CDR but others by the MMSE only. However, it may be of concern that the CDR is a global measure of dementia and should not be equated with MMSE scoring. We therefore recommend that future studies use the CDR as a single measure of severity if such data is available. In fact, we also support the idea of calling for new research into a single measure that would capture three components of disease severity, including functional status and behavior disturbance, to ease the comparisons among different studies (Schaller et al., 2015; Mauskopf et al., 2010).

Conclusions

In conclusion, we found a positive relationship between dementia severity and

the costs of caring for dementia in Taiwan, with a strong association between functional decline and higher total costs. This implies that the provision of rehabilitation intended to patient physical function may reduce the overall cost of dementia. Given that informal care still accounts for the largest share of total costs, the government needs to promote long-term care services to increase the relative contribution of the social care sector related to assisting family caregivers of dementia patients.

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Table 1. Characteristics of dementia patients and their caregivers (N=231)

	N	(%)	Mean(SD)
Patient characteristics			
Age, years		—	80.0(6.9)
Gender (% female)	138	(60%)	—
Years since diagnosis		—	4.6(3.3)
Number of children		—	5.6(2.1)
Education			
No education	57	(25%)	—
Elementary school	108	(47%)	—
Junior high school or above	66	(28%)	—
ADL score (range: 0-100)			69.1(33.4)
NPI score (range: 0-120)			18.0(19.3)
Dementia severity			
Mild	102	(44%)	—
Moderate	88	(38%)	—
Severe	41	(18%)	—
Formal service use			
Hired a foreign caregiver	74	(32%)	—
Hired a domestic caregiver	12	(5%)	—
Home care	15	(6%)	—
Day care center	8	(3%)	—
Short nursing home stay	6	(3%)	—
Caregiver characteristics			
Age		—	61.0(13.2)
Gender (% female)	146	(63%)	—
Years in caregiving		—	4.8(3.1)
Co-resident with patients	175	(76%)	—
Primary caregiver	197	(85%)	—
Employed	97	(42%)	—
Education			
No education	12	(5%)	—
Elementary school	34	(15%)	—
Junior high	22	(10%)	—
Senior high	82	(35%)	—
College or above	81	(35%)	—
Relationship with the patients			
Spouse	88	(38%)	—
Adult children	109	(47%)	—
Children-in-law	29	(13%)	—
Grandchildren	5	(2%)	—
Economic status			
Have difficulty	48	(21%)	—
Have enough money.	147	(63%)	—
Have more than enough money	36	(16%)	—
Informal care (hours/ week)			
ADL		—	6.4(9.0)
IADL		—	15.0(9.9)
Supervision		—	27.2(33.2)
Total hours		—	48.7(40.9)

ADL= Activities of Daily Living; NPI=Neuropsychiatric Inventory;

Table 2. Annual cost per person with dementia by disease severity

Cost category	Mild(n=102)		Moderate(n=88)		Severe(n=41)		p-value
	Mean NT$	SD	Mean NT$	SD	Mean NT$	SD	
Medical costs							
Outpatient	17,303	14,674	17,444	20,509	15,082	20,669	0.258
Drugs	30,065	35,229	25,630	24,427	13,767	9,892	0.002
Inpatient	14,228	45,470	11,591	52,251	8,820	34,480	0.251
OOP	24,093	28,146	27,118	24,831	38,378	41,886	0.195
Total	85,689	87,485	81,782	88,523	76,047	75,240	0.617
Social care costs	41,331	93,568	117,031	146,962	173,079	148,024	<.0001
Informal care costs							
Opportunity cost	91,623	140,151	110,134	131,133	190,846	202,290	0.006
Replacement cost	199,466	149,442	214,784	149,648	231,659	176,141	0.688
Total costs[#]							
Base-case	218,644	199,843	308,947	210,289	439,972	250,254	<.0001
Upper-bound	326,487	193,155	413,598	182,676	480,786	216,198	<.0001

OOP=out-of-pocket costs; 1NT =14.97 US-PPP in 2014

#Total costs base-case estimate included informal care costs valued by the opportunity cost approach; total costs upper-bound included informal care costs valued by the replacement cost approach.

Table 3. Generalized linear models on costs of care (N=231)

Variables	Medical care	Social care	Informal care	Total costs
Patient characteristics				
Age	-0.017	0.019	-0.030*	-0.007
	(0.012)	(0.011)	(0.013)	(0.007)
ADL score	-0.005*	-0.004*	-0.008***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.001)
NPI score	-0.004	0.002	-0.000	-0.000
	(0.003)	(0.003)	(0.004)	(0.002)
Dementia severity (reference: mild)				
Moderate	-0.073	0.008	0.345	0.107
	(0.159)	(0.157)	(0.184)	(0.100)
Severe	-0.246	0.050	0.721*	0.196
	(0.185)	(0.170)	(0.288)	(0.132)
Formal service use (reference: no use)	0.128	4.604***	-0.764***	0.343***
	(0.168)	(0.398)	(0.169)	(0.100)
Caregiver characteristics				
Spousal CG (reference: non-spousal CG)	-0.104	0.145	-1.705***	-0.509***
	(0.183)	(0.126)	(0.360)	(0.125)
Senior high school and above	0.171	0.234	0.673*	0.350**
	(0.152)	(0.134)	(0.321)	(0.129)
Econ status (reference: Have enough money)				
Have plenty of money	0.489**	0.010	0.169	0.234*
	(0.161)	(0.119)	(0.234)	(0.107)
Have difficulty	-0.105	-0.656**	0.421*	-0.019
	(0.143)	(0.237)	(0.182)	(0.115)

Notes: All models assumed a log link function and a Poisson distribution after a Park's test.
Standard errors in parentheses.
CG=Caregiver; ADL= Activities of Daily Living; NPI=Neuropsychiatric Inventory
* p<0.05   ** p<0.01   *** p<0.001

Table 4. Marginal estimates of cost of care by dementia severity based on a GLM analysis adjusting for patient and caregiver variables[#]

Cost category	Mild (n= 102) Mean NT$	Moderate (n=88) Mean NT$	Cost difference	*p*-value	Severe (n=41) Mean NT$	Cost difference	*p*-value
Medical costs	88,635	82,358	-6,276	0.64	69,280	-19,355	0.17
Social care costs	91,711	92,408	698	0.96	96,438	4,727	0.77
Informal care costs	86,637	122,363	35,726	0.06	178,141	91,504	0.03
Total costs	266,427	296,611	30,185	0.28	324,244	57,818	0.14

[#]See Table 3 for patient and caregiver characteristics included in the generalized linear model (GLM).

1NT =14.97 US-PPP in 2014

Fig 1. Proportion of medical, social care, and informal care cost in total cost per person with dementia by disease severity
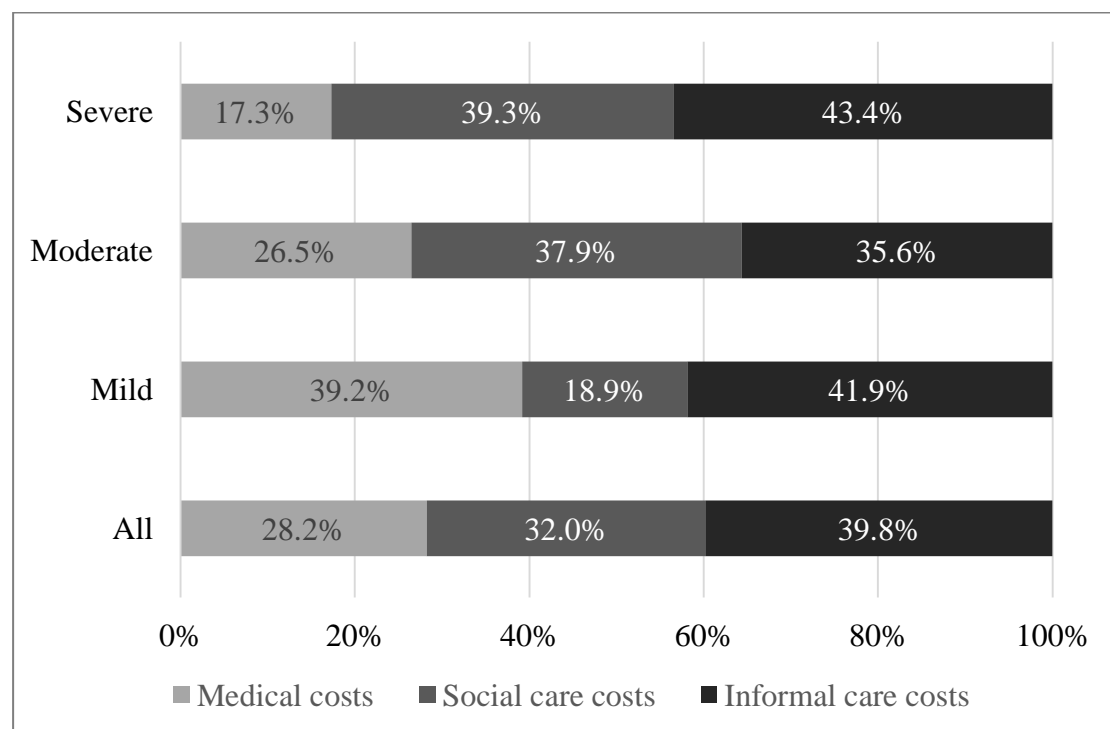
國 立 成 功 大 學 醫 學 院

公 共 衛 生 研 究 所

碩 士 論 文

失智症疾病嚴重度對照顧者負荷的影響：社會支持的角色

The effect of disease severity and social support on caregiver burden of patients with dementia in Taiwan

研究生：施姵宇

指導教授：古鯉榕

共同指導教授:白明奇

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中文摘要

研究背景：

　　2013 年我國衛生福利部公告失智症防治照護政策綱領共七大面向，其一為建立完善社區照護網絡,可見失智症漫長病程下的照顧資源分配是現今政策的重要議題之一。跨國失智症研究追蹤失智症病人 3-5 年後相較收案時需更多照顧資源,又較其他慢性病的失能和依賴程度比例更高,顯示失智症病人會隨著疾病特性越趨於退化而需更多的照顧資源,整體對照顧資源的依賴程度也高,無形中也增加照顧者負荷。

研究目的：

　　探討失智症照顧負荷的主要影響因子為何,以及正式支持在失智症疾病特性對照顧者負荷的影響中所扮演的角色。

研究方法：

　　收案對象為南部地區某醫學中心失智症特別門診的病人與其家庭照顧者共計 182 對,病人的疾病特性測量包含－認知功能、精神行為症狀(NPI)以及日常生活功能(ADL);照顧者接受結構式問卷調查,包含其人口學變項、主觀負荷感受、非正式支持量表以及使用正式支持服務項目。

研究結果：

　　本研究的失智症病人疾病特性分佈：認知功能缺損輕度占 40.2%、中度占 38.6%、重度占 21.2%;精神行為症狀(NPI)平均為 18.5 分(分數範圍 0-120 分);日常生活功能(ADL)平均值為 65.9 分(分數範圍 0-100 分),而失智症照顧者主觀負荷(ZBI)平均值 28.6 分(分數範圍 0-88 分)。階層迴歸分析可見病人疾病特性對照顧者負荷的解釋力 15%最高,其次為照顧關係 10%的解釋力,其中病人子女數和每週照顧時數對負荷有顯著影響。此外探討每週照顧時數作為病人疾病特性和照顧負荷的中介效果分析,顯示每週照顧時數作為病人 ADL 和照顧負荷的中介變項。在台南地區使用正式支持的比例占 42.9%,其中監護工占最多數(28%)並且分析使用正式支持的人口學特性為：病人疾病特性趨於嚴重、女性病人、子女照顧者、未與病人同住及每週照顧時數較少者。分析不使用長照服務的原因以照顧者沒有意識到需要為主(41.9%),其次是已用監護工 37.4%。另外在控制主觀感受非正式支持之下,研究並未發現正式支持的調節效果,即正式支持對於認知嚴重度、NPI 以及 ADL 對照顧負荷的影響在統計上皆未達顯著差異。

討論：

　　在失智症病人漫長的病程中,除了病人疾病特性對照顧負荷的影響,照顧關係也存在舉足輕重的地位,例如每週照顧時數作為病人 ADL 功能和照顧負荷的中介變項,可見當病人在進入失智症晚期發生 ADL 失能,照顧者負荷沈重是由於投入照顧時間長,並且缺乏其他非正式支持而致。現今我國失智症家庭使用長照服務比例偏低,政策建議為應檢討現有長照服務功能是否能因應失智症家庭所需,未來研究需進一步刻畫非正式支持的網絡,分析在控制非正式支持網絡下,正式支持是否可作為調節角色,進而減輕照顧者負荷。