#### Check for updates

### OPEN ACCESS

EDITED BY Hui Zeng, Xiangya School of Nursing, Central South University, China

REVIEWED BY Felipe Soto-Pérez, University of Salamanca, Spain Xianghua Xu, Hunan Cancer Hospital/The Affiliated Cancer Hospital of Xiangya School of Medicine. China

\*CORRESPONDENCE Hsin-Hung Wu hhwu@cc.ncue.edu.tw

<sup>†</sup>These authors have contributed equally to this work and share first authorship

#### SPECIALTY SECTION

This article was submitted to Psychology of Aging, a section of the journal Frontiers in Psychology

RECEIVED 19 August 2022 ACCEPTED 18 November 2022 PUBLISHED 13 December 2022

#### CITATION

Chen Y-J, Jhang K-M, Wang W-F, Lin G-C, Yen S-W and Wu H-H (2022) Applying Apriori algorithm to explore long-term care services usage status—Variables based on the combination of patients with dementia and their caregivers. *Front. Psychol.* 13:1022860. doi: 10.3389/fpsyg.2022.1022860

#### COPYRIGHT

© 2022 Chen, Jhang, Wang, Lin, Yen and Wu. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms. Applying Apriori algorithm to explore long-term care services usage status—Variables based on the combination of patients with dementia and their caregivers

Yen-Jen Chen<sup>1†</sup>, Kai-Ming Jhang<sup>2†</sup>, Wen-Fu Wang<sup>2,3†</sup>, Guan-Cheng Lin<sup>4†</sup>, Shao-Wei Yen<sup>5</sup> and Hsin-Hung Wu<sup>4,6,7</sup>\*

<sup>1</sup>Department of Psychiatry, Changhua Christian Hospital, Changhua, Taiwan, <sup>2</sup>Department of Neurology, Changhua Christian Hospital, Changhua, Taiwan, <sup>3</sup>Department of Recreation and Holistic Wellness, Ming Dao University, Changhua, Taiwan, <sup>4</sup>Department of Business Administration, National Changhua University of Education, Changhua, Taiwan, <sup>5</sup>Department of Information Management, National Changhua University of Education, Changhua, Taiwan, <sup>6</sup>Department of M-Commerce and Multimedia Applications, Asia University, Taichung, Taiwan, <sup>7</sup>Faculty of Education, State University of Malang, Malang, East Java, Indonesia

**Purpose:** The aim of this study was to identify the combination of patients with dementia and their caregivers' characteristics associated with long-term care (LTC) services usage.

**Patients and methods:** A cross-sectional study was conducted with 475 patients with mild, moderate, and severe dementia at Changhua Christian Hospital, Taiwan. Eleven types of variables from patients with dementia, nine types of variables from patients' caregivers, and 15 types of LTC services were used for this study. The Apriori algorithm was employed to identify the attributes from the patients and their caregivers who used a particular LTC service from a comprehensive viewpoint.

**Results:** A total of 75 rules were generated by the Apriori algorithm with support of 2%, confidence of 80%, and lift >1. Among these rules, 25 rules belonged to home personal care services which were summarized further into four general rules for home personal care services. On the other hand, 50 rules belonged to assistive devices that were summarized further into 21 general rules based on their similarities. Patient's walking ability, patient's emotional liability, unemployed or retired caregivers, caregivers' feelings with either helplessness or hopelessness, and caregivers who cared for patients with dementia solely were found to be the critical variables to use home personal care givers' age, mood, marital status, caregiving burden, and the patient being cared for mainly by a foreign care helper were found to be the critical variables to use the critical variables to use assistive devices.

**Conclusion:** This study showed preliminary results on the LTC service usage from patients with dementia and their caregivers residing in the community. Understanding the patient–caregiver dyad's profile leads the service providers,

policymakers, and the referral team to tailor service provisions better to meet the needs and identify the potential target groups. The findings in this study serve as references to reduce caregivers' burden as well as to improve the quality of care for patients with dementia.

#### KEYWORDS

long-term care services, patients with dementia, caregivers, patient—caregiver dyad, Apriori algorithm, home personal care services, assistive devices

## Introduction

Population aging is one of the major public health issues influencing all developed countries including Taiwan. Taiwan is an aged society in 2022 and is predicted to become a superaged society by 2025. The number of patients with dementia has increased dramatically with rapid growth of the elderly population. In a nation-wide population-based study in Taiwan, the prevalence of dementia increased significantly from 4.7 per 100 people to 7.6 per 100 people from 2004 to 2010, although the incidence of dementia was similar during the same period (Liu et al., 2019). A high incidence of this disease in the older-adult population has a great impact on patients, their family, and the entire society.

The long-term care (LTC) system was set up in Taiwan in 2007 as a response to an aging society. To help families of patients with dementia further, the government in Taiwan established the Long-Term Care (LTC) Act 2.0 in 2017, which covered people with dementia over the age of 50 (Hsu and Chen, 2019). According to the payment categorization in LTC Plan 2.0, long-term care resources were divided into four parts: personal and professional care (including in-home and community-based services such as home personal care or daycare services, home nursing or home rehabilitation services, etc.), transportation services (shuttling from home to hospital), assistive devices (walkers, wheelchairs, commode chairs, relief air mattress, etc.) and in-house barrier-free environment modification (suitable devices that are suggested by therapists and granted partly by the government), and respite care for family caregivers (provided by personal care attendants to allow family caregivers rest for hours to days) (Hsu and Chen, 2019; Yang et al., 2020; Ministry of Health and Welfare, 2022). The goal of LTC Plan 2.0 is to keep aging in place so as to establish an accessible, affordable, and universal long-term care service system. Care management center in the health bureau of each county draws up care plans and links services. Most of the costs are borne by the government (covering by taxes).

Dementia and dependency are predictive factors for LTC service usage and the utilization is related to the level of disability (Wu et al., 2014; Fabius et al., 2022). Older adults' service use patterns partially explain the transitions between community and institutionalization (Chen and Berkowitz, 2012). However,

the decision to move to a nursing home or stay resident in the community is complex and multifactorial. Neuropsychiatric symptoms, walking capability, and living status also contribute to the decision of either nursing home stay or home care assistance (Chen et al., 2022). Use of home care assistance service was postulated to potentially lower the probability of nursing home placement (Greiner et al., 2014).

In Taiwan, the overall LTC service utilization rate for patients with dementia was about one-third and home personal care service and assistive devices were the items commonly applied for (Wang W. F. et al., 2021). Drivers of long-term care considerations may be even more complicated. Factors such as dementia stage, capability of activity daily living (ADL), resource of informal and paid care, relationship between the care provider and the recipient, sociocultural context, and the LTC system design all needed to be considered (Morrisby et al., 2018; Shepherd-Banigan et al., 2021). A national dementia registry enrolled 1,268 Taiwanese and revealed that aberrant motor behaviors, dysfunction in ADLs, higher caregiver burden, not residing with family members, and not employing a migrant caregiver were the factors associated with LTC service usage (Tsai et al., 2022).

Investigating dozens of factors at the same time is sometimes effortful and the interpretations become difficult. However, the Apriori algorithm reveals important statistical correlations from viewpoints involving several dimensions or aspects (Chen et al., 2019, 2021; Yan et al., 2019; Lin et al., 2020). Each attribute is viewed as a dimension by appointing threshold values of support and confidence (Han and Kamber, 2006). Therefore, the aim of the present study was to apply the Apriori algorithm to identify the combination of patients with dementia and their caregivers' characteristics associated with LTC services use, especially home personal care service and assistive device in particular.

### Patients and method

This study included 1,201 patients who were diagnosed with mild cognitive impairment or dementia at the memory clinic of Changhua Christian Hospital from October 2015 to June 2021. The diagnosis of dementia was based on the clinical dementia rating (CDR) scale by clinical psychologists (Morris,

### TABLE 1 Demographic information of the patients and data types.

Age of the care recipiente63 years old347.2167-34 years old7415.627-34 years old20054.7367-34 years old10722.54Cander of the care recipientFundal31566.31Male10035.722Pitlens' narrial statasMarried25535.71Otrosce21244.633Otrosce21244.633Orbitation0043Orbitation0051Orbitation006.30Orbitation306.301Orbitation306.301Type of denoritia1121.711Naced denorita1123.621Maced denorita1123.621Maced denorita1123.631Outers2315.331Outers2431.721Outers2313.213Outers24.831.213Outers23.913.213Outers24.931.213Outers24.931.213Outers24.931.233Outers23.931.233Outers24.931.233 <th>Variables</th> <th></th> <th>Frequency</th> <th>Percentage</th> <th>Data type</th>	Variables		Frequency	Percentage	Data type
Partial Pa	Age of the care recipient	<65 years old	34	7.2	1
Part of the sector of the se		65-74 years old	74	15.6	2
Spandi1072.54Gader of the car equationMain336.31Maria366.33.73.8Parato233.63.73.8Markin214.63.83.8Markin214.63.83.8Markin214.63.83.8Markin214.63.83.8Markin214.63.83.8Markin214.63.83.8Markin214.73.83.8Markin374.73.83.8Markin374.73.83.8Markin374.83.83.8Markin324.83.83.8Markin324.83.83.8Markin334.83.83.8Markin313.83.83.8Markin323.83.83.8Markin323.83.83.8Markin333.83.83.8Markin333.83.83.8Markin333.83.83.8Markin343.83.83.8Markin343.83.83.8Markin343.83.83.8Markin3.83.83.83.8Markin3.83.83.83.8Markin3.83.8<		75-84 years old	260	54.7	3
Gender offer for any set of a set of		$\geq$ 85 years old	107	22.5	4
MainMa	Gender of the care recipient	Female	315	66.3	1
Patienty and and set of the		Male	160	33.7	2
brower     3     6.6     2       Kindensition     3.1     4.6     3       Kindensition     0     0     3       Kindensition     0     0     3       Kindensition     0     0     7       Kindensition     0     0     7       Kindensition     10     10     10       Kindensition     11     23     2       Kindensition     12     23     3       Kindensition     12     3     3       Kindensition     13     3     3       Kindensition     14     3     3       Kindensition     13     3     3       Kindensition	Patients' marital status	Married	255	53.7	1
NameNationNameNameNameNation0000Name00<		Divorce	3	0.6	2
Approx1000000000000000000000000000000000000		Widow/widower	212	44.6	3
4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4		Separate	0	0	4
SingleSingleSingleSingleSingleHanom0000Patenta' loing status10000Homino factor8792011Abienta' dicase712320Albeiner dicase122333Albeiner dicase122333Macia dementia122333Albeiner dicase234233Albeiner dicase132333Albeiner dicase132333Albeiner dicase133233Albeiner dicase133233Albeiner dicase143333Albeiner dicase133233Albeiner dicase133333Albeiner dicase133333Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase133233Albeiner dicase143233		Cohabitation	0	0	5
Platenti living statusUnknownØØØØPatenti living statusAlorAlorAlorAlorAlor di obrarAl'AlorAlorAlorType of dementiaAlorAlorAlorAlorType of dementiaAlorAlorAlorAlorAlor dementi		Single	5	1.1	6
$  4 { beam beam beam beam beam beam beam beam$		Unknown	0	0	7
end for the set of t	Patients' living status	Alone	30	6.3	0
Reserve and the second of th		Live with others	437	92.0	1
Type of elementiaAlziemer's disease27157.11Vacular dementia1223.62Nacular dementia204.23Dementia volta Lewy bodies234.85Indiciona ciascase234.85Incolta chementia006Incontengentegementia102.37Otto facere recipientMid elementia235.121Matere recipientMid elementia1603.722Matere recipientMid elementia7215.13Matere recipientMid elementia213.21Matere recipientMid elementia7215.13Matere recipientMidere recipient132.31Matere recipientMidere recipient132.31Matere recipientMidere recipient133.13Matere recipientMidere recipient132.31Matere recipientMidere recipient133.21Matere recipientMidere recipient133.21Matere recipientMidere recipient133.21Matere recipientMidere recipient133.21Midere recipientMidere recipient133.21Midere recipientMidere recipient133.21Midere recipientMidere recipient133.21Midere recipientMidere recipient <t< td=""><td></td><td>Residential care</td><td>8</td><td>1.7</td><td>2</td></t<>		Residential care	8	1.7	2
NaturalNaturalNaturalNaturalNaturalNaturalNaturalMaced dementia0423Natural Machany Models153.24Natural Machany Maced006Athenson Macea006Natural Machany Maced006Natural Machany Maced006Natural Machany Maced006Natural Machany Maced006Natural Machany Macea102.37Natural Machany Maced102.37Machan Maced Maced103.32Mater Adventation101.32.4Mater Adventation101.33.4Mater Adventation101.33.4Maced Maced Maced143.31Mater Adventation131.31.4Maced Maced Maced131.31.4Mater Adventation131.31.4Maced Macea143.31.4Macea131.31.4Mater Adventation131.31.4Mater Adventation132.61.4Mater Adventation132.61.4Mater Adventation132.61.4Mater Adventation132.61.4Mater Adventation143.61.4Mater Adventation143.61.4Mater Adventation143.61.4<	Type of dementia	Alzheimer's disease	271	57.1	1
Nixed denentia204.23Penentia wil Levy bolies153.24.8Parkinson's disese234.85Parkinson's disese100.06Fontetemporal degeneration112.37Others234.88CDR of the care recipient103.72Madera dementia103.72Ordera dementia103.72Madera dementia215.20Walking ability of the care recipient105.20Madera dementia215.20Walking ability of the care recipient105.20Madera dementia215.20Walking ability of the care recipient105.20Madera dementia215.20Walking ability of the care recipient106.31Madera dementia7.47.33.21Mater care recipient101.33.21Madera dementia7.61.6without symptomsPothological symptoms (multiple choice)101.21Madera dementia7.31.211Mater care care care1.31.21Mater care care care1.31.21Mater care care care care1.31.21Mater care care care care care care care ca		Vascular dementia	112	23.6	2
Image: state of the state of		Mixed dementia	20	4.2	3
Parkinson's disease234.85Alcolois dementia006Fontomporal degeneration112.37Otros234.88CDR of the care recipientMid dementia1603.72Mater dementia1603.720Valleng definition7215.133Mater dementia7215.133Valleng definition737203Mater dementia1430.123Valleng definition7410.123Mater definition731.333Postelosical symptoms (multiple choire)Foldosical symptoms132.83Mater symptoms (multiple choire)Foldosical symptoms132.81Mater symptomsFoldosical symptoms132.811Mater symptomsFoldosical symptomsFoldosical symptoms1.81Mater symptoms<		Dementia with Lewy bodies	15	3.2	4
Akoha cemunia006Fontomporal degeneration112.37Otros234.88CDR of the care recipientMid dematia233.2Molerate dematia725.13Outer dematia725.13Walking ability of the care recipientIndependent care and		Parkinson's disease	23	4.8	5
Frontemporal degeneration112.37Others234.88CDR of the care recipientMid dementia2435.121Moder dementia1603.722Mating ability of the care recipientNodered mentia7215.13Multing ability of the care recipient1400.311Multing ability of the care recipient1400.312Multing ability of the care recipient1410.312Multing ability of the care recipient1430.123Multing ability of the care recipient1300.433Multing ability of the care recipient1312.381: with the symptom; and the symptom; and the symptom is		Alcoholic dementia	0	0	6
Defension234.88CDR of the care recipientMild ementia2435.121Medra dementia1603.7322Managa Bility of the care recipientMider dementia7215.13Malarga Bility of the care recipientMider cance28150.20Melchair4810.1213Melchair4810.1231Pychological symptoms (multiple choice)Polision132381: with the symptom; and 0:Midentiation7616.0without symptom; and 0:1Mod symptoms (multiple choice)Polision3731Midentiation7616.0without symptom; and 0:1Midentiation7616.0without symptom; and 0:1Midentiation7616.0without symptom; and 0:1Midentiation7616.0without symptom; and 0:1Mary Care Symptoms (multiple choice)Polision3731Midentiation7316.1Without symptom; and 0:1Mary Care Symptoms (multiple choice)Polision7411Mary Care Symptoms1716.1Without symptom; and 0:1Mary Care Symptoms1816.1111Mary Care Symptoms1916.1111Mary Care Symptoms1910.1111Mary Care Symptoms19		Frontotemporal degeneration	11	2.3	7
CDR of the care recipientHild dementia24351.21Moderate dementia1603.723Walking ability of the care recipientIndependen28159.20Walking ability of the care recipientMaler or cane14430.31Walking ability of the care recipientWalking ability of the care14430.31Walking ability of the care recipientMaler or cane14430.31Walking ability of the care14930.311Walking ability of the care14930.311Walking ability of the care1320.433Walking ability of the careMaler or cane1323.811Walking ability of the careMaler or cane133.8111Maler or cane1316.0without brymptom; and 0:11111Mod symptoms (multiple choice)Maler or cane124.6111		Others	23	4.8	8
Moderate dementia16033.72Kere dementia7215.13Walking ability of the care recipientIndependent28159.20Malker or cane14430.311Welchair4810.123Pochological symptoms (multiple choire)Delusion1323.81: with the symptom; and 0:Maler or cane7616.0without = symptom; and 0:Moder symptoms (multiple choire)Malerification7661.0without = symptom; and 0:Moder symptoms (multiple choire)Pological crying or laughing224.611Moder symptoms (multiple choire)Malerification7215.21Moder symptoms (multiple choire)Aniety3620.611Moder symptoms (multiple choire)Malerification7316.211Moder symptoms (multiple choire)Malerification7316.211Moder symptoms (multiple choire)Malerification7316.211Maring Symptoms (multiple choire)Malerification7316.211MalerificationMalerification7316.211MalerificationMalerification7316.211MalerificationMalerification7316.211MalerificationMalerification10111MalerificationMalerification1011 <td< td=""><td>CDR of the care recipient</td><td>Mild dementia</td><td>243</td><td>51.2</td><td>1</td></td<>	CDR of the care recipient	Mild dementia	243	51.2	1
Sever dementia721513Haking ability of the care recipientIndependent2815920Waker or cane14430311Waker or cane14430312Porbelogical symptoms (multiple choice)Polision132381:with the symptom; and 0:Mado symptoms (multiple choice)Paloigical crying or laughing224.61Mod symptoms (multiple choice)Polision7215.21Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7315.2111Polision7411111Polision751111		Moderate dementia	160	33.7	2
Waking ability of the care recipientIndependent28159.20Waker orane14430.31Waker orane4810.12Berdiden20.43Pychological symptoms (multiple choice)Delusion1332.3.8Misdentfication567.4100Mod symptoms (multiple choice)Pathological crying or laughing224.6Pychological symptoms (multiple choice)Pological crying or laughing233.6Mod symptoms (multiple choice)Pathological crying or laughing233.6Pychological crying or laughing233.61.0Pychological crying or laughing100.21.0Pychological crying or laughing233.61.0Pychological crying or laughing130.21.0Pychological crying or laughing130.21.0Pychological crying or laughing130.21.0Pychological crying or laughing233.61.0Pychological crying or laughing245.11.0Pychological crying or laughing531.121.0Pychological crying or laughing234.61.0Pychological crying or laughing531.121.0Pychological crying or laughing234.61.0Pychological crying or laughing234.61.0Pychological crying or laughing531.21.0Pychological crying or laughing23		Severe dementia	72	15.1	3
NumberNumberNumberNumberNumberNetchair4810.12Netchair20.43Netchair1323.81: with the symptom; and 0:NumberNisidentification7616.0Nod symptoms (multiple choice)Pahlogical crying or laughing224.6Nod symptoms (multiple choice)Pahlogical crying or laughing233.1Nod symptoms (multiple choice)Pahlogical crying or laughing233.6Nod symptoms (multiple choice)Ning7215.2Norger7215.21.1Norger731.11.1Norger731.11.1Norger531.121.1Norger731.21.1Norger1001.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.21.21.1Norger1.31.21.1Norger1.31.21.1Norger1.31.21.1Norger1.31.21.1 <td< td=""><td>Walking ability of the care recipient</td><td>Independent</td><td>281</td><td>59.2</td><td>0</td></td<>	Walking ability of the care recipient	Independent	281	59.2	0
Weekair4810.12Bedriden20.43Psychological symptoms (multiple choic)Deuson11323.81: with the symptom; and 0:Misidentification7616.0without the symptomMod symptoms (multiple choice)Pathological crying or laughing224.6Pobia10.21Postymina9820.6Distrymina9820.6Portspring7215.2Portspring204.6Protogical crying or laughing938.2Postymina938.2Postymina945.1Portspring20.45.1Portspring10.71.1Portspring5.11.1Postymina5.1 <td></td> <td>Walker or cane</td> <td>144</td> <td>30.3</td> <td>1</td>		Walker or cane	144	30.3	1
Bedridden20.43Psychological symptoms (multiple choice)Delusion11323.81: with the symptom; and 0:Hallucination7616.0without the symptomMood symptoms (multiple choice)Pathological crying or laughing224.6Phobia10.21.0Postymina9820.6Dystymina998.2Poression7215.2More ymptoms (multiple choice)More ymptom97ParticeAnger9720.4Pritability5110.7Emotional liability5311.2Pathonal Liability224.6Pathonal Liability234.2Pathonal Liability214.2Pathonal Liability204.2Pathonal Liability215.2 <t< td=""><td></td><td>Wheelchair</td><td>48</td><td>10.1</td><td>2</td></t<>		Wheelchair	48	10.1	2
Psychological symptoms (multiple choice)Delusion11323.81: with the symptom; and 0:Hallucination7616.0without the symptomMood symptoms (multiple choice)Athological crying or laughing224.6Phobia10.2Posthymia9820.6Dysthymia9820.6Poression7215.2Morey4.65.1Worry245.1Pritability511.2Initiability511.2Aphyna204.6Endenal Liability531.2Apaty204.6Mathiana91.2Mathiana91.2Mathiana91.2		Bedridden	2	0.4	3
Hallucination7616.0without the symptomMood symptoms (multiple choice)Pathological crying or laughing224.6Phobia10.2Poshymia8220.6Dystymia7215.2Anxiety398.2Worry245.1Irritability511.2Anaphy511.2Apaty531.2Apaty224.6Ehavioral symptoms (multiple choice)Aitaina20Apaty234.6Ehavioral symptoms (multiple choice)Aitaina20Apaty203.2Antinian303.2Apaty203.2Antinian303.2Antinian303.2Antinian303.2Antinian303.2Antinian303.2Antinian303.2Antinian303.2Antinian303.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian3.23.2Antinian <td>Psychological symptoms (multiple choice)</td> <td>Delusion</td> <td>113</td> <td>23.8</td> <td>1: with the symptom; and 0:</td>	Psychological symptoms (multiple choice)	Delusion	113	23.8	1: with the symptom; and 0:
Misidentification357.4Mood symptoms (multiple choice)Pathological crying or laughing224.6Phobia10.2Dysthymia9820.6Depression7215.2Anxiety398.2Vorry245.1Anger9720.4Iritability5110.7Apathy511.2Apathy224.6Enearonal lability531.2Apathy204.2Athisia93.2Athisia91.2Andering71.5		Hallucination	76	16.0	without the symptom
Mood symptoms (multiple choice)Pathological crying or laughing224.6Phobia10.2Dyshymia9820.6Depression7215.2Anxiety398.2Worry245.1Anger9720.4Iritability5110.7Endotional liability5311.2Apathy204.6Monty214.6Mathy91.9Mathy91.9Mathy91.9Mathy91.9Mathy91.9Mathy91.9		Misidentification	35	7.4	
Phobia10.2Dyshymia9820.6Depression7215.2Anxiety398.2Worry245.1Anger7720.4Irritability5110.7Emotional liability5311.2Apathy204.6Kathisia91.9Wandering71.5	Mood symptoms (multiple choice)	Pathological crying or laughing	22	4.6	
Pyshymia9820.6Depression7215.2Anxiety398.2Worry245.1Anger9720.4Irritability5110.7Emotional liability5311.2Apathy204.6Kathisia91.9Wandering71.5		Phobia	1	0.2	
Depression7215.2Anxiety398.2Worry245.1Anger9720.4Irritability5110.7Emotional liability5311.2Apathy204.6Kathisia91.9Wandering71.5		Dysthymia	98	20.6	
Anxiety398.2Worry245.1Anger9720.4Irritability5110.7Emotional liability5311.2Apathy204.6Akthisia91.9Wandering71.5		Depression	72	15.2	
Worry245.1Anger9720.4Irritability5110.7Emotional liability5311.2Apathy224.6Atathisia91.9Wandering71.5		Anxiety	39	8.2	
Anger9720.4Irritability5110.7Emotional liability5311.2Apathy224.6Agitation204.2Akathisia91.9Wandering71.5		Worry	24	5.1	
Irritability5110.7Emotional liability5311.2Apathy224.6Behavioral symptoms (multiple choice)Agitation204.2Akathisia91.9Wandering71.5		Anger	97	20.4	
Emotional liability5311.2Apathy224.6Behavioral symptoms (multiple choice)Agitation204.2Akathisia91.9Wandering71.5		Irritability	51	10.7	
Apathy224.6Behavioral symptoms (multiple choice)Agitation204.2Akathisia91.9Wandering71.5		Emotional liability	53	11.2	
Behavioral symptoms (multiple choice)     Agitation     20     4.2       Akathisia     9     1.9       Wandering     7     1.5		Apathy	22	4.6	
Akathisia91.9Wandering71.5	Behavioral symptoms (multiple choice)	Agitation	20	4.2	
Wandering 7 1.5		Akathisia	9	1.9	
		Wandering	7	1.5	

Variables		Frequency	Percentage	Data type
	Screaming	0	0	
	Curse	14	3.0	
	Shadowing	4	0.8	
	Aggression (verbal/body)	24	5.1	
	Disinhibition	4	0.8	
	Akinesia	26	5.5	
	Nighttime behavior	35	7.4	
	Aberrant motor behavior (stereotype)	10	2.1	

CDR, clinical dementia rating.

Mood and behavioral symptoms were determined by clinical psychologists through neuropsychiatric inventory (NPI). Symptoms outside NPI were evaluated by trained nursing case managers with a binary (yes/no) affirmative response from caregivers: pathological crying/laughing: frequent, brief, intense paroxysms of uncontrollable crying and/or laughing; phobia: fear, dislike, aversion; dysthymia: low grade depressive symptoms; worry: unhappy, frightened; anger: annoyance, displeasure, or hostility; emotional liability: rapid, exaggerated changes in mood; akathisia: restlessness, inability to sit still; wandering: roams around and confused about their location; curse: using more foul language; shadowing: follows someone around like a shadow; akinesia: decreased ability to move voluntarily.

1997). Based on the collected data, the use of long-term care services was low among patients with very mild dementia (CDR = 0.5). In order to draw up rules on the usage of LTC services by caregivers with stronger demands, this study excluded the data from patients with very mild dementia. In contrast, this study focused on patients with mild, moderate, and severe dementia, and a total of 475 valid data sets were finally used. The clinical trial number was CCH IRB 220225, which was approved by the Institutional Review Board of Changhua Christian Hospital. In addition, this study used the retrospective study design, while the need for informed consent was waived off by the Institutional Review Board of Changhua Christian Hospital. All data were recorded in the electronic medical chart with the highest confidentiality and compliance with the Declaration of Helsinki.

The variables from patients with dementia consisting of age, gender, marital status, living status, type of dementia, CDR, walking ability, psychological symptoms, mood symptoms, and behavioral symptoms are summarized in Table 1. The care recipient's mood and behavioral and psychological symptoms of dementia (BPSD) for the patients were assessed by using a two-point scale to record the data (1 if the mood/symptom was applied; 0 if not). The presence of BPSD was evaluated by psychologists or trained nursing case managers. Most of the BPSDs listed in the neuropsychiatric inventory (NPI) were recorded by clinical psychologists (Cummings et al., 1994). Other abnormal behaviors, such as pathological crying or laughing, akathisia, wandering, cursing others, and akinesia which were frequently observed in patients with dementia, were also noted by trained nursing case managers. Emotional liability refers to emotional and uncontrollable emotions, and/or emotions that are out of proportion to circumstances, defined by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (American Psychiatric Association, 2013).

The variables from caregivers including the age, relation to the patient with dementia, employment, marital status, education, type of primary care, frequency of care, caregiver's mood, and Zarit burden interview (ZBI) caregiving burden are summarized in Table 2. The caregiver's mood was assessed by the 12-item Chinese Health Questionnaire (CHQ-12), which is a short, self-administered screening tool for general mental health (Chong and Wilkinson, 1989). Emotional liability included in this study was selected, if rapid, exaggerated changes in the caregiver's mood were noted. The caregiver's mood was assessed by using a two-point scale to record the data, i.e., 1 if the mood was applied; 0 if not. Besides, the ZBI caregiving burden assessed by the Zarit burden interview (ZBI) (Bédard et al., 2001) had four categories, including little or no burden (0-20 points), mild to moderate burden (21-40 points), moderate to severe burden (41-60 points), and severe burden (61-88 points).

Fifteen long-term care services for older patients with dementia are depicted in Table 3. If patients and their caregivers used a particular LTC service, a value of 1 is assigned. If not, a value of 0 is given. Based on Table 3, assistive devices (27.8%), home personal care services (19.2%), and community care centers (13.1%) were the top three LTC services utilized by patients with dementia and their caregivers.

The purpose of this study was to identify which attributes from patients and/or caregivers could result in different usages of the LTC services. The Apriori algorithm has been proven to be very effective in identifying statistical correlations from a multidimensional viewpoint in dementia-related areas by setting up support, confidence, and lift (Jhang et al., 2019, 2020; Chang et al., 2021). Thus, the Apriori algorithm was used in this study. The definitions and formulas of support, confidence, and lift are given below (Chang et al., 2021; Jhang et al., 2021). The support of an association rule  $A \Rightarrow B$  is defined by calculating the percentage of transactions containing both A and B in the

Variables		Frequency	Percentage	Data type
Age of the caregiver	<50 years old	94	19.8	1
	50–59 years old	183	38.5	2
	60–69 years old	107	22.5	3
	$\geq$ 70 years old	91	19.2	4
Relation to the VCI	Himself/herself	0	0	0
patient	Spouse	132	27.8	1
	Partner	0	0	2
	Child	274	57.7	3
	Brothers/sisters	3	0.6	4
	Other relatives	65	13.7	5
	Male friends or neighbors	0	0	6
	Female friends or neighbors	0	0	7
	Male foreign worker or household	0	0	8
	Female foreign worker or household	1	0.2	9
Employment	Unemployed or retired	242	50.9	0
	Employed	233	49.1	1
Caregiver's marital status	Married	391	82.3	1
	Divorce	8	1.7	2
	Widow/widower	6	1.3	3
	Separate	0	0	4
	Cohabitation	0	0	5
	Single	68	14.3	6
	Unknown	2	0.4	7
Caregiver's education	Elementary school or below (0-6 years)	78	16.4	1
-	Junior high school (7–9 years)	49	10.3	2
	Senior high school (10–12 years)	149	31.4	3
	College and above ( $\geq 13$ years)	199	41.9	4
Type of primary care	Sole caregiver	165	34.7	1
	Shared caregiving by a caregiver and a foreign worker/household	161	33.9	2
	Shared caregiving by different relatives	11	2.3	3
	Caregiving by a foreign worker	93	19.6	4
	Other	45	9.5	5
Frequency of care	1–2 days per week	36	7.6	1
	3–5 days per week	49	10.3	2
	≥6 days per week	390	82.1	3
Caregiver's mood	Helplessness	76	16.0	1: with the mood; and 0: without
(multiple choice)	Loneliness	20	4.2	the mood
*	Depression	35	7.4	
	Anxiety	59	12.4	
	Frustration	52	10.9	
	Nervousness	125	26.3	
	Anger	115	24.2	
	Sadness	23	4.8	
	Emotional liability	51	10.7	
	Troublesome	133	28.0	
	Hopelessness	99	20.8	
ZBI caregiving burden	Little or no burden	136	28.6	1
	Mild to moderate burden	216	45.5	2
	Moderate to severe burden	99	20.8	3
	Severe burden	24	5.1	4
				-

TABLE 2 Demographic information of the caregivers and data types.

ZBI, Zarit burden interview.

Variables		Frequency	Percentage	Data type
Long-term	Home personal	91	19.2	1: with the
care services	care services			care service;
				and 0:
	Respite care	30	6.3	without the
	Home nursing care	22	4.6	care service
	Community care	62	13.1	
	centers			
	Home	23	4.8	
	rehabilitation			
	Assistive devices	132	27.8	
	Adult day care	53	11.2	
	Resettlement	18	3.8	
	Adult foster care	3	0.6	
	Home meal	18	3.8	
	delivery			
	Transportation	48	10.1	
	services			
	Mobile shower	6	1.3	
	Support care for	17	3.6	
	caregivers			
	Barrier-free	27	5.7	
	environment			
	School of wisdom	3	0.6	

TABLE 3 Long-term care (LTC) services for older patients with dementia.

database depicted in Equation (1):

Support 
$$(A \Rightarrow B) = P(A \cap B)$$
  
=  $\frac{\text{number of transactions containing both A and B}}{\text{total number of transactions}}$ . (1)

The confidence of the association rule  $A \Rightarrow B$  is used to compute the percentage of transactions containing A and also containing B simultaneously in the database in Equation (2):

Confidence 
$$(A \Rightarrow B) = P(B|A) = \frac{P(A \cap B)}{P(A)}$$
  
=  $\frac{\text{number of transactions containing both A and B}}{\text{number of transactions containing A}}$ . (2)

Lift measures the correlation between A and B, as shown in Equation (3). If a lift has a value of 1, A and B are independent and no rule will be generated. If a lift has a value >1, A and B are dependent and correlated positively.

$$\operatorname{Lift}(A,B) = \frac{P(A \cup B)}{P(A) P(B)}.$$
(3)

The Apriori algorithm in IBM SPSS Modeler 18 was employed. Data type for each variable was defined by the numerical values as shown in Tables 1, 2 for patients with dementia and their caregivers, respectively. The input variables for antecedents from Table 1 were care recipient's age, gender, marital status, living status, type of dementia, CDR, walking ability, three types of psychological symptoms, 10 types of mood symptoms, and 11 types of behavioral symptoms. In addition, the caregiver's age, relation to the patient, employment, marital status, education, type of primary care, frequency of care, 11 types of caregiver's moods, and ZBI caregiving burden from Table 2 were input variables for antecedents. On the other hand, 15 types of LTC services were the input variables for the consequent. Due to the heterogeneous data, the minimum support was set to 2%, whereas the minimum confidence was set to 80% with a lift > 1.

### Results

The major characteristics of patients with dementia depicted in Table 1 were female (66.3%), aged 75–84 years (54.7%), and who had Alzheimer's disease (57.1%) with mild dementia (51.2%). In addition, nearly 60% of the patients with dementia could walk independently. On the other hand, 38.5% of the caregivers were aged 50–59 years, and nearly 60% of the caregivers were the children of the patients based on Table 2. More than 80% of the caregivers were married, and 50.9% of the caregivers were unemployed or retired. The type of primary care for care recipient was either sole caregiver (34.7%) or shared caregiving by a caregiver and a foreign worker/household (33.9%). Frequency of care  $\geq 6$  days per week was the majority (82.1%). Additionally, the caregiving burden mainly fell into either mild to moderate burden (45.5%) or little or no burden (28.6%).

There were 75 rules generated by the Apriori algorithm with support of 2%, confidence of 80%, and lift >1. Among these rules, 25 belonged to home personal care services and 50 belonged to assistive devices. Based on these 25 rules, four general rules were summarized, based on their similarities to home personal care services. On the other hand, based on these 50 rules, 21 general rules were summarized, based on their similarities to assistive devices.

The first general rule depicted in Table 4 indicated that home personal care services would be required when a sole caregiver whose age was  $\geq$ 70 years with a mood of helplessness took care of a patient with dementia, regardless of a mix of patient's living status, patient's marital status, caregiver's marital status, frequency of care, or relation to the patient. The second general rule showed that when a sole caregiver who had a mood of helplessness took care of a patient with dementia who had the walking ability by a walker or cane, home personal care services would be needed. The variables of frequency of care and patient's living status were not the critical determinants for home personal care services. For the third general rule, home personal care services would be needed when a sole

TABLE 4 Four general rules for home personal care services.

General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
1	Type of primary care: Sole caregiver	10	2.11	80.00	4.18
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Patients' living status: Live with others	10	2.11	80.00	4.18
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Patients' marital status: Married	10	2.11	80.00	4.18
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Patients' marital status: Married	10	2.11	80.00	4.18
	Type of primary care: Sole caregiver				
	Caregivers' marital status: Married				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Patients' marital status: Married	10	2.11	80.00	4.18
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Helplessness				
	Patients' living status: Live with others	10	2.11	80.00	4.18
	Patients' marital status: Married				
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Type of primary care: Sole caregiver	10	2.11	80.00	4.18
	Caregivers' marital status: Married				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Type of primary care: Sole caregiver	10	2.11	80.00	4.18
	Caregivers' marital status: Married				
	Age of the caregiver: $\geq /0$ years old				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Helplessness	10	2.11	80.00	4.10
	Time of primery care, Cale constitute	10	2.11	80.00	4.18
	Caraginary care: Sole caregiver				
	Age of the caregivers >70 years old				
	Age of the caregiver: 270 years of				
	Type of primary care: Sole caregiver	10	2 11	80.00	4 18
	Age of the caregiver: >70 years old	10	2.11	00.00	1.10
	Frequency of care: $>6$ days per week				
	Caregiver's mood. Helplessness				
	Patients' living status: I ive with others	10	2.11	80.00	4 18
	a aconto nying status. Live with others	10	2.11	00.00	1.10

General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Helplessness				
	Relation to the patient: Spouse	10	2.11	80.00	4.18
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Relation to the patient: Spouse	10	2.11	80.00	4.18
	Caregivers' marital status: Married				
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
	Patients' living status: Live with others	10	2.11	80.00	4.18
	Relation to the patient: Spouse				
	Type of primary care: Sole caregiver				
	Age of the caregiver: $\geq$ 70 years old				
	Caregiver's mood: Helplessness				
2	Walking ability of the care recipient: Walker or cane	11	2.32	81.82	4.27
	Type of primary care: Sole caregiver				
	Caregiver's mood: Helplessness				
	Walking ability of the care recipient: Walker or cane	11	2.32	81.82	4.27
	Type of primary care: Sole caregiver				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Helplessness				
	Patients' living status: Live with others	11	2.32	81.82	4.27
	Walking ability of the care recipient: Walker or cane				
	Type of primary care: Sole caregiver				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Helplessness				
	Patients' living status: Live with others	11	2.32	81.82	4.27
	Walking ability of the care recipient: Walker or cane				
	Type of primary care: Sole caregiver				
	Caregiver's mood: Helplessness				
3	Type of primary care: Sole caregiver	12	2.53	83.33	4.35
	Caregiver's mood: Hopelessness, Nervousness, and				
	Troublesome				
	Type of primary care: Sole caregiver	12	2.53	83.33	4.35
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Hopelessness, Nervousness, and				
	Troublesome				
	Patients' living status: Live with others	12	2.53	83.33	4.35
	Type of primary care: Sole caregiver				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Hopelessness, Nervousness, and				
	Troublesome				

General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
4	Mood symptoms of the care recipient: Emotional liability	10	2.11	80.00	4.18
	Caregiver's employment: Unemployed or retired				
	Caregiver's mood: Hopelessness				
	Mood symptoms of the care recipient: Emotional liability	10	2.11	80.00	4.18
	Caregiver's employment: Unemployed or retired				
	Frequency of care: $\geq 6$ days per week				
	Caregiver's mood: Hopelessness				

caregiver who had moods of hopelessness, nervousness, and troublesome took care of a patient with dementia, regardless of the frequency of care and patient's living status. Finally, the fourth general rule indicated that when a caregiver was unemployed or retired and had a mood of hopelessness but who needed to take care of a patient with dementia with a mood symptom of emotional liability, home personal care services should be provided. In addition, frequency of care was not a critical variable to determine the use of home personal care services.

As shown in Table 5, assistive devices were needed when a patient with dementia needed a wheelchair and was cared for by a foreign worker with a frequency of  $\geq 6$  days per week (first general rule); when a patient with dementia whose age was 75-84 years had a psychological symptom of hallucination along with a caregiver's mood of troublesome (second general rule); when a female patient with moderate dementia was cared for by a foreign worker (third general rule); when an employed person who had mild to moderate burden needed to provide care for a patient with dementia cared for by a foreign worker (fourth general rule); when a patient with moderate dementia whose age was ≥85 years was cared for by an unemployed or retired caregiver whose age was 60-69 years with mild to moderate caregiving burden (fifth general rule); when a female patient with severe dementia living with others was cared for by a caregiver who had mild to moderate caregiving burden (sixth general rule); when an employed person whose age was 50-59 years with the education of college and above needed to provide care for a patient with dementia cared for by a foreign worker (seventh general rule); when an employed person whose age was 50-59 years provided care for a patient with dementia but whose marital status was widow or widower cared for by a foreign worker (eighth general rule); and when a child provided care for a married patient with Alzheimer's disease cared for by a foreign worker (ninth general rule).

Moreover, assistive devices were needed when a female patient with dementia whose age was 75–84 years with the walking ability by a walker or cane was cared for by a caregiver whose mood was hopelessness (tenth general rule); when a patient with moderate dementia whose marital status was widow or widower with the walking ability by a walker or cane was cared for by a caregiver whose mood was troublesome (eleventh general rule); when a female and married patient with dementia who had the walking ability by a walker or cane was cared for by a caregiver whose education was senior high school (twelfth general rule); when a patient with moderate dementia whose marital status was widow or widower was cared for by his or her child whose age was 50-59 years with the mood of troublesome (thirteenth general rule); when a patient with moderate dementia with the age of 75-84 years whose marital status was widow or widower was cared for by a caregiver whose mood was troublesome by a frequency of  $\geq 6$  days per week (fourteenth general rule); when a patient with dementia whose age was 75-84 years was cared for by his or her child who had mild to moderate caregiving burden and the mood of hopelessness with the frequency of  $\geq 6$  days per week (fifteenth general rule); and when a patient with dementia with the age of 75-84 years who had the walking ability by a walker or cane was cared for by a caregiver who had mild to moderate burden with the mood of troublesome (sixteenth general rule).

From seventeenth to twenty-first general rules as shown in Table 5, each general rule only consisted of one rule due to its rule dissimilarities. When a patient with dementia living with others who needed a wheelchair was cared for by a caregiver whose age was 50-59 years with the education of college and above, assistive devices were required (seventeenth general rule). A female and married patient with dementia who had the walking ability by a walker or cane was cared for by a married caregiver and a foreign worker/household needed assistive devices (eighteenth general rule). When a child who had mild to moderate burden provided care for a patient with Alzheimer's disease was cared for by a foreign worker with the frequency of  $\geq 6$  days per week, assistive devices were needed (nineteenth general rule). Assistive devices were required when a male patient with Alzheimer's disease was cared for by an unemployed or retired caregiver who had the moods of TABLE 5 Twenty-one general rules for assistive devices.

Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Type of primary care: Caregiving by a forigin worker     15     3.16     80.00     2.88       Caregiver maintal status: Married     15     3.16     80.00     2.88       Caregiver maintal status: Married     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheekhair     12     2.42     81.82     2.94       Walking ability of the care recipient: Wheekhair     11     2.52     81.82     2.94       Walking ability of the care recipient: Wheekhair     11     2.52     81.82     2.94       Walking ability of the care recipient: Wheekhair     11     2.52     81.82     2.94       Walking ability of the care recipient: Wheekhair     11     2.52     81.82     2.94 <th>General rule no.</th> <th>Antecedent</th> <th>No. of the cases in the database</th> <th>Support (%)</th> <th>Confidence (%)</th> <th>Lift</th>	General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
Type of primary care: Caregiseing by a foreign workerIt is a start of the start of t	1	Walking ability of the care recipient: Wheelchair	15	3.16	80.00	2.88
Frequency of care: ≥6 days per weck:         3.16         3.60         2.88           Caregiseria mutial status Married         3.16         3.60         2.88           Frequency of care: ≥6 days per weck         3.16         8.000         2.88           Walking ability of the care recipient: Wheekhair         15         3.16         8.000         2.88           Prequency of care: ≥6 days per weck         7.97         9.100         2.88         3.16         8.000         2.88           Walking ability of the care recipient: Wheekhair         7.97         9.100         3.16         8.000         2.88           Caregiseri matrial status Married         7.97         7.97         9.100         3.16         8.000         2.88           Que of the care recipient: Wheekhair         7.97         7.97         9.100         3.16         8.000         2.88           Que of the care recipient: Wheekhair         7.97         7.97         9.100         3.10         2.32         8.182         2.94           Que of the care recipient: Wheekhair         7.97         7.97         9.100         3.10         2.32         8.182         2.94           Que of the care recipient: Wheekhair         7.97         9.97         9.97         9.97         9.97         9		Type of primary care: Caregiving by a foreign worker				
Walking ability of the care recipient: Wheelchair153.1680.092.88Caregiverii martial status: Karried		Frequency of care: $\geq 6$ days per week				
Caregiver' martial status Married Type of primary care. Careginging by a foreign worker Progumery of are. '2 of days per work Regimery of are. '2 of days per w		Walking ability of the care recipient: Wheelchair	15	3.16	80.00	2.88
Type of primary care: 26 days per web.153.1680.002.88Walking shilly of the care recipient: Wheehair153.1680.002.88Type of primary care: Caregiving by a foreign worker53.1680.002.88Walking shilly of the care recipient: Wheehair153.1680.002.88Walking shilly of the care recipient: Wheehair153.1680.002.88Walking shilly of the care recipient: Wheehair13.2281.822.94Walking shilly of the care recipient: Wheehair13.2281.822.94Walking shilly of the care recipient: Wheehair13.2281.822.94Walking shilly of the care recipient: 75-84 years old113.2281.822.94Walking shilly of the care recipient: 75-84 years old113.2281.822.94Walking shilly of the care recipient: 75-84 years old113.2281.822.94Walking shilly of the care recipient: 75-84 years old113.2281.822.94Age of the care recipient: 75-84 years old113.2481.822.94Age of the care recipient: 75-84 years old113.24 <t< td=""><td></td><td>Caregivers' marital status: Married</td><td></td><td></td><td></td><td></td></t<>		Caregivers' marital status: Married				
Prequency of care :≥6 days per week       81.00       8.000       2.83         Walking ability of the care recipient: Wheekbahar       7.950       3.16       80.00       2.88         Prequency of care: 26 days per week       8.900       2.88       3.16       80.00       2.88         Walking ability of the care recipient: Wheekbahar       15       3.16       80.00       2.88         Type of primary care: Caregiving by a foreign woeker       7.950		Type of primary care: Caregiving by a foreign worker				
Patienti Ining staus: Live with others153.1680.002.88Walking ability of the care recipient: Wheel-hair		Frequency of care: $\geq 6$ days per week				
Walking ability of the care recipient: WheelchairType of primary care: Caregiving by a foreign workerPetenency fore: 5 days per weekCaregivers' marital status: MariedType of primary care: Caregiving by a foreign workerType of primary care: Caregiving by a fore		Patients' living status: Live with others	15	3.16	80.00	2.88
Type of primary care: Caregiving by a foreign worker       80,000       2,88         Frequency of care: ≥ 6 days per week       80,000       2,88         Walking ability of the care recipient: Xheekhair       7,990       9,111,000       2,320       81,82       2,94         Type of primary care: Caregiving by a foreign worker       7,990       7,990       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Walking ability of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Age of the care recipient: 75-84 years old       11       2,32       81,82       2,94         Patienti' living status: Live with others       12       2,32       81,82       2,94         Age of the care recipient: 75-84 years old       11       2,32		Walking ability of the care recipient: Wheelchair				
Prequency of care: ≥6 days per weck       15       3.16       80.00       2.88         Walking ability of the care recipient: Wheelchair       7 <t< td=""><td></td><td>Type of primary care: Caregiving by a foreign worker</td><td></td><td></td><td></td><td></td></t<>		Type of primary care: Caregiving by a foreign worker				
Patients' living status: Live with others     15     3.16     80.00     2.88       Walking ability of the care recipient: Wheelchair     Interpreterm marked status: Married     Interpreterm marked status: Marked status: Married     Interpreterm marked status: Marked status: Married     Interpreterm marked status:		Frequency of care: $\geq 6$ days per week				
Number of the care recipient: WheekhairNumber of the care recipient: WheekhairType of primary care: Caregiving by a foreign worker12.3281.822.94Prequency of care: 26 days per week12.3281.822.94Walking ability of the care recipient: Wheekhair7.979.979.979.979.979.97Prequency of care: 26 days per week7.979.97 </td <td>Patients' living status: Live with others</td> <td>15</td> <td>3.16</td> <td>80.00</td> <td>2.88</td>		Patients' living status: Live with others	15	3.16	80.00	2.88
Caregiver's marital status: Maried Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient. 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Prequency of care: 26 days per week Age of the care recipient 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Prequency of care: 26 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Prequency of care: 26 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Prequency of care: 26 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Pychological symptoms of the care recipient: Helechair Type of primary care: Caregiving by a foreign worker True Caregiver's mode: Troublesome Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Pychological symptoms of the care recipient: Helechair		Walking ability of the care recipient: Wheelchair				
Type of primary care: Caregiving by a foreign worker         Frequency of care 26 days per week         Age of the care recipient: Wheelchair         Type of primary care: Caregiving by a foreign worker         Frequency of care 26 days per week         Age of the care recipient: Wheelchair         Type of primary care: Caregiving by a foreign worker         Frequency of care 26 days per week         Age of the care recipient: Wheelchair         Caregivers' marital status: Maried         Type of primary care: Caregiving by a foreign worker         Frequency of care: 26 days per week         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       81.82       2.94         Patients' living status: Live with others       2.94       9.94       9.94       9.94		Caregivers' marital status: Married				
Frequency of Care: ≥6 days per week         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Walking ability of the care recipient: Wheelchair		Type of primary care: Caregiving by a foreign worker				
Age of the care recipient: 73–84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient: Wheelchair Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: Wheelchair Caregivers' marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Walking ability of the care recipient: Wheelchair Caregivers' marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Patients' living status: Live with others Valking ability of the care recipient: Wheelchair Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Patients' living status: Live with others Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Patients' living status: Live with others Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: Seven Sold 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Caregiver's moo		Frequency of care: $\geq 6$ days per week				
Walking ability of the care recipient: Wheelchair Type of primary care: Caregiving by a foreign worker Frequency of care: ≥ 6 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Walking ability of the care recipient: Wheelchair Caregivers' marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: ≥ 6 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Valking ability of the care recipient: Wheelchair Type of primary care: Caregiving by a foreign worker Frequency of care: ≥ 6 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Age of the care recipient: 75-84 years old 71 72 72 81.82 72 81		Age of the care recipient: 75–84 years old	11	2.32	81.82	2.94
Type of primary care: Caregiving by a foreign worker         Frequency of care: ≥6 days per week         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Walking ability of the care recipient: Medichair		Walking ability of the care recipient: Wheelchair				
a Prequency of care: ≥6 days per week       2.32       81.82       2.94         Walking ability of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Walking ability of the care recipient: Wheelchair       2.32       81.82       2.94         Type of primary care: Caregiving by a foreign worker       7       7       81.82       2.94         Patients' living status: Live with others       3       81.82       2.94       81.82       2.94         Patients' living status: Live with others       7       7       81.82       2.94         Patients' living status: Live with others       7       81.82       2.94         Patients' living status: Live with others       81.82       2.94         2       Age of the care recipient: Wheelchair       7       7       81.82       2.94         Psychological symptoms of the care recipient: Pheelchair       7       81.82       2.94         Psychological symptoms of the care recipient: T5-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient: T5-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       7       7       9       2.94         Patients' living st		Type of primary care: Caregiving by a foreign worker				
Age of the care recipient: 75–84 years old Walking ability of the care recipient: Wheelchair Caregivers' marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: $\geq$ 6 days per week Age of the care recipient: 75–84 years old Patients' living status: Live with others Walking ability of the care recipient: Wheelchair Type of primary care: $\geq$ 6 days per week 2 Mage of the care recipient: SP-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Frequency of care: $\geq$ 6 days per week 2 Mage of the care recipient: SP-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Age of the care recipient: SP-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Age of the care recipient: SP-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Type of primary care: Caregiving by a foreign worker 3 Gender of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker CDR of the care recipient: Female Type of primary care: Caregiving by a foreign worker		Frequency of care: $>6$ days per week				
Walking ability of the care recipient: Wheelchair Caregivers' marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week 2 Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others 4 Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Fenale 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Fenale 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Fenale 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Fenale 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: DDR of the care recipient: Fenale 11 2.32 81.82 2.94 Patients' living status: Live with others DDR of the care recipient: Fenale 11 2.32 81.82 2.94 Patients' living status: Live with others DDR of the care recipient: Fenale 11 2.32 81.82 2.94 Patients' living status: Live with others DDR of the care recipient: Fenale 11 2.32 81.82 2.94 Patients' living status: Live with others DDR of the care recipient: Fenale 11 2.32 81.82 2.94 Patients' living status: Live with others DDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Age of the care recipient: 75–84 years old	11	2.32	81.82	2.94
Caregiver's marital status: Married Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Walking ability of the care recipient: Wheelchair Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week 2 Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Hoderate dementia Type of primary care: Caregiving by a foreign worker 3 Gender of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker 3 DR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker 3 DR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others DCPA of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Patients' living status: Live wit		Walking ability of the care recipient: Wheelchair				
Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week 2 Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75-84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker Patients' living status: Live with others CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Patients' living status:		Caregivers' marital status: Married				
Frequency of care: ≥6 days per week         Age of the care recipient: 75–84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       Type of primary care: Caregiving by a foreign worker       Type of primary care: Caregiving by a foreign worker       Type of primary care: Caregiving by a foreign worker         2       Age of the care recipient: 75–84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Trequency of care: ≥6 days per week       2       81.82       2.94         Psychological symptoms of the care recipient:       Trequency of care: ≥6 days per week       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Trequency of care: ≥6 days per week       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Trequency of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       Trequency of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Trequency of the care recipient: 75-84 years old       11       2.32       81.82       2.94         So Gender of the care recipient: Female       11       2.32       81.8		Type of primary care: Caregiving by a foreign worker				
Age of the care recipient: 75-84 years old112.3281.822.94Patients' living status: Live with othersWalking ability of the care recipient: WheelchairIII2.3281.822.94Type of primary care: Caregiving by a foreign workerFrequency of care: ≥6 days per weekIII2.3281.822.942Age of the care recipient: 75-84 years old112.3281.822.94Psychological symptoms of the care recipient:III2.3281.822.94HallucinationCaregiver's mood: TroublesomeIII2.3281.822.94Age of the care recipient: 75-84 years old112.3281.822.94Patients' living status: Live with othersIII2.3281.822.94Patients' living status: Live with othersIII2.3281.822.943Gender of the care recipient: Female112.3281.822.944CDR of the care recipient: Female112.3281.822.944Patients' living status: Live with othersIII2.3281.822.944CDR of the care recipient: Female112.3281.822.944CDR of the care recipient: Female112.3281.822.94 <td></td> <td>Frequency of care: <math>\geq 6</math> days per week</td> <td></td> <td></td> <td></td> <td></td>		Frequency of care: $\geq 6$ days per week				
Patients' living status: Live with others         Walking ability of the care recipient: Wheelchair         Type of primary care: Caregiving by a foreign worker         Frequency of care: ≥6 days per week         2       Age of the care recipient: 75–84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Hallucination       2       2.32       81.82       2.94         Reg of the care recipient: 75–84 years old       11       2.32       81.82       2.94         Age of the care recipient: 75–84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       2.32       81.82       2.94         Patients' living status: Live with others       2.32       81.82       2.94         Patients' living status: Live with others       2.32       81.82       2.94         Same Caregiver's mood: Troublesome       11       2.32       81.82       2.94         Age of the care recipi		Age of the care recipient: 75–84 years old	11	2.32	81.82	2.94
Walking ability of the care recipient: Wheelchair         Type of primary care: 26 days per week         2       Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Hallucination       2       31       2.32       81.82       2.94         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       11       2.32       81.82       2.94         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       Patients' living status: Live with othe		Patients' living status: Live with others				
Type of primary care: Caregiving by a foreign worker Frequency of care: ≥6 days per week 2 Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others Type of primary care: Caregiving by a foreign worker CDR of the care recipient: Female 11 2.32 81.82 2.94		Walking ability of the care recipient: Wheelchair				
Frequency of care: ≥6 days per week         2       Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Hallucination       2       81.82       2.94         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Psychological symptoms of the care recipient:       Hallucination       2.32       81.82       2.94         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       Psychological symptoms of the care recipient:       11       2.32       81.82       2.94         Age of the care recipient: 75-84 years old       11       2.32       81.82       2.94         Patients' living status: Live with others       Psychological symptoms of the care recipient:       11       2.32       81.82       2.94         34       Gender of the care recipient: Female       11       2.32       81.82       2.94         7ype of primary care: Caregiving by a foreign worker       Gender of the care recipient: Female       11       2.32       81.82       2.94         Patients' living status: Live with others       CDR of the care recipient: Female       11       2.32       81.8		Type of primary care: Caregiving by a foreign worker				
2 Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others		Frequency of care: $>6$ days per week				
Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others	2	Age of the care recipient: 75–84 years old	11	2.32	81.82	2.94
Hallucination Caregiver's mood: Troublesome Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Psychological symptoms of the care recipient:				
Caregiver's mood: Troublesome112.3281.822.94Age of the care recipient: 75-84 years old112.3281.822.94Patients' living status: Live with othersPsychological symptoms of the care recipient:11<		Hallucination				
Age of the care recipient: 75–84 years old 11 2.32 81.82 2.94 Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Female 11 2.32 81.82 2.94		Caregiver's mood: Troublesome				
Patients' living status: Live with others Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Age of the care recipient: 75–84 years old	11	2.32	81.82	2.94
Psychological symptoms of the care recipient: Hallucination Caregiver's mood: Troublesome 3 Gender of the care recipient: Female 11 2.32 81.82 2.94 CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Patients' living status: Live with others				
Hallucination         Caregiver's mood: Troublesome         3       Gender of the care recipient: Female       11       2.32       81.82       2.94         CDR of the care recipient: Moderate dementia         Type of primary care: Caregiving by a foreign worker         Gender of the care recipient: Female       11       2.32       81.82       2.94         Patients' living status: Live with others       11       2.32       81.82       2.94         Patients' living status: Live with others       CDR of the care recipient: Moderate dementia       11       2.32       81.82       2.94         Patients' living status: Live with others       Type of primary care: Caregiving by a foreign worker       11       2.94       11 <td></td> <td>Psychological symptoms of the care recipient:</td> <td></td> <td></td> <td></td> <td></td>		Psychological symptoms of the care recipient:				
Caregiver's mood: Troublesome3Gender of the care recipient: Female112.3281.822.94CDR of the care recipient: Moderate dementiaType of primary care: Caregiving by a foreign worker112.3281.822.94Patients' living status: Live with others112.3281.822.94CDR of the care recipient: Moderate dementia112.3281.822.94Patients' living status: Live with others11111111CDR of the care recipient: Moderate dementia11111111Type of primary care: Caregiving by a foreign worker11111111CDR of the care recipient: Moderate dementia1111111111Type of primary care: Caregiving by a foreign worker111111111111Type of primary care: Caregiving by a foreign worker11		Hallucination				
3Gender of the care recipient: Female112.3281.822.94CDR of the care recipient: Moderate dementiaType of primary care: Caregiving by a foreign workerGender of the care recipient: Female112.3281.822.94Patients' living status: Live with othersCDR of the care recipient: Moderate dementiaType of primary care: Caregiving by a foreign workerType of primary care: Caregiving by a foreign workerType of primary care: Caregiving by a foreign worker		Caregiver's mood: Troublesome				
CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker Gender of the care recipient: Female 11 2.32 81.82 2.94 Patients' living status: Live with others CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker	3	Gender of the care recipient: Female	11	2.32	81.82	2.94
Type of primary care: Caregiving by a foreign worker         Gender of the care recipient: Female       11       2.32       81.82       2.94         Patients' living status: Live with others         CDR of the care recipient: Moderate dementia         Type of primary care: Caregiving by a foreign worker		CDR of the care recipient: Moderate dementia				
Gender of the care recipient: Female       11       2.32       81.82       2.94         Patients' living status: Live with others       CDR of the care recipient: Moderate dementia       11       2.94         Type of primary care: Caregiving by a foreign worker       11       2.94       11       2.94		Type of primary care: Caregiving by a foreign worker				
Patients' living status: Live with others CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Gender of the care recipient: Female	11	2.32	81.82	2.94
CDR of the care recipient: Moderate dementia Type of primary care: Caregiving by a foreign worker		Patients' living status: Live with others				
Type of primary care: Caregiving by a foreign worker		CDR of the care recipient: Moderate dementia				
		Type of primary care: Caregiving by a foreign worker				

General rule	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
no.					
4	Age of the caregiver: 50–59 years old	11	2.32	81.82	2.94
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	ZBI caregiving burden: Mild to moderate burden				
	Patients' living status: Live with others	11	2.32	81.82	2.94
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	ZBI caregiving burden: Mild to moderate burden				
	Age of the caregiver: 50–59 years old	10	2.11	80.00	2.88
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	Frequency of care: $\geq 6$ days per week				
	ZBI caregiving burden: Mild to moderate burden				
5	Age of the care recipient: $\geq$ 85 years old	11	2.32	81.82	2.94
	CDR of the care recipient: Moderate dementia				
	Age of the caregiver: 60–69 years old				
	Caregiver's employment: Unemployed or retired				
	ZBI caregiving burden: Mild to moderate burden				
	Age of the care recipient: $\geq$ 85 years old	11	2.32	81.82	2.94
	CDR of the care recipient: Moderate dementia				
	Relation to the patient: Child				
	Caregiver's employment: Unemployed or retired				
	ZBI caregiving burden: Mild to moderate burden				
6	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' living status: Live with others				
	CDR of the care recipient: Severe dementia				
	ZBI caregiving burden: Mild to moderate burden				
	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' living status: Live with others				
	CDR of the care recipient: Severe dementia				
	Caregivers' marital status: Married				
	ZBI caregiving burden: Mild to moderate burden				
7	Age of the caregiver: 50–59 years old	10	2.11	80.00	2.88
	Caregiver's employment: Employed				
	Caregiver's education: College and above				
	Type of primary care: Caregiving by a foreign worker				
	Age of the caregiver: 50-59 years old	10	2.11	80.00	2.88
	Caregiver's employment: Employed				
	Caregivers' marital status: Married				
	Caregiver's education: College and above				
	Type of primary care: Caregiving by a foreign worker				
	Patients' living status: Live with others	10	2.11	80.00	2.88
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				

General rule	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
no.					
	Caregiver's education: College and above				
	Type of primary care: Caregiving by a foreign worker				
8	Patients' marital status: Widow/widower	11	2.32	81.82	2.94
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	Patients' marital status: Widow/widower	11	2.32	81.82	2.94
	Patients' living status: Live with others				
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	Age of the care recipient: 75–84 years old	10	2.11	80.00	2.88
	Patients' marital status: Widow/widower				
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	Gender of the care recipient: Male	10	2.11	80.00	2.88
	Patients' marital status: Widow/widower				
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Type of primary care: Caregiving by a foreign worker				
	Patients' marital status: Widow/widower	10	2.11	80.00	2.88
	Age of the caregiver: 50–59 years old				
	Caregiver's employment: Employed				
	Caregivers' marital status: Married				
	Type of primary care: Caregiving by a foreign worker				
9	Patients' marital status: Married	15	3.16	80.00	2.88
	Type of dementia: Alzheimer's disease				
	Relation to the patient: Child				
	Type of primary care: Caregiving by a foreign worker				
	Patients' marital status: Married	10	2.11	80.00	2.88
	Type of dementia: Alzheimer's disease				
	Relation to the patient: Child				
	Caregiver's employment: Unemployed or retired				
	Type of primary care: Caregiving by a foreign worker				
10	Age of the care recipient: 75-84 years old	10	2.11	80.00	2.88
	Gender of the care recipient: Female				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' mood: Hopelessness				
	Age of the care recipient: 75-84 years old	10	2.11	80.00	2.88
	Gender of the care recipient: Female				
	Walking ability of the care recipient: Walker or cane				
	Frequency of care: $\geq$ 6 days per week				
	Caregivers' mood: Hopelessness				
	Age of the care recipient: 75-84 years old	10	2.11	80.00	2.88
	Gender of the care recipient: Female				

General rule	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
no.					
	Deticute? living status Live with athens				
	Walking shility of the care recipiont, Walker or care				
	Constitution of the care recipient: walker of care				
11	Caregivers mood: Hopelessness	11	2.22	01.02	2.04
11	Patients marital status: widow/widower	11	2.32	81.82	2.94
	CDR of the care recipient: Moderate dementia				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' mood: Troublesome				
	Patients' marital status: Widow/widower	10	2.11	80.00	2.88
	Patients' living status: Live with others				
	CDR of the care recipient: Moderate dementia				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' mood: Troublesome				
12	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' marital status: Married				
	Walking ability of the care recipient: Walker or cane				
	Caregiver's education: Senior high school				
	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' marital status: Married				
	Walking ability of the care recipient: Walker or cane				
	Caregiver's education: Senior high school				
	Frequency of care: $\geq 6$ days per week				
	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' marital status: Married				
	Patients' living status: Live with others				
	Walking ability of the care recipient: Walker or cane				
	Caregiver's education: Senior high school				
	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' marital status: Married				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' marital status: Married				
	Caregiver's education: Senior high school				
13	Patients' marital status: Widow/widower	10	2.11	80.00	2.88
	CDR of the care recipient: Moderate dementia				
	Age of the caregiver: 50–59 years old				
	Relation to the patient: Child				
	Caregivers' mood: Troublesome				
	Patients' marital status: Widow/widower	10	2.11	80.00	2.88
	CDR of the care recipient: Moderate dementia				
	Age of the caregiver: 50–59 years old				
	Relation to the patient: Child				
	Frequency of care: >6 days per week				
	Caregivers' mood: Troublesome				
14	Age of the care recipient: 75-84 years old	10	2 11	80.00	2.88
	Patients' marital status: Widow/widower	10	<i>2</i> ,11	00.00	2.00
	CDR of the care recipient. Moderate dementia				
	Erequency of care: >6 days per week				
	requency of care. 20 days per week				

(Continued)

13

General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
	Caregivers' mood: Troublesome				
	A set of the second sec	10	2.11	00.00	2.00

	Age of the care recipient: 75–84 years old	10	2.11	80.00	2.88
	Patients' marital status: Widow/widower				
	CDR of the care recipient: Moderate dementia				
	Age of the caregiver: 50–59 years old				
	Frequency of care: $\geq 6$ days per week				
	Caregivers' mood: Troublesome				
15	Age of the care recipient: 75-84 years old	11	2.32	81.82	2.94
	Relation to the patient: Child				
	Frequency of care: $\geq 6$ days per week				
	ZBI caregiving burden: Mild to moderate				
	burden				
	Caregivers' mood: Hopelessness				
	Patients' marital status: Married	11	2.32	81.82	2.94
	Relation to the patient: Child				
	Age of the caregiver: 50–59 years old				
	Frequency of care: $\geq 6$ days per week				
	Caregivers' mood: Hopelessness				
16	Age of the care recipient: 75–84 years old	10	2.11	80.00	2.88
	Walking ability of the care recipient: Walker or cane				
	Caregivers' mood: Troublesome				
	ZBI caregiving burden: Mild to moderate burden				
	Age of the care recipient: 75–84 years old	10	2.11	80.00	2.88
	Gender of the care recipient: Female				
	Relation to the patient: Child				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' mood: Troublesome				
17	Patients' living status: Live with others	11	2.32	81.82	2.94
	Walking ability of the care recipient: Wheelchair				
	Age of the caregiver: 50–59 years old				
	Caregiver's education: College and above				
18	Gender of the care recipient: Female	10	2.11	80.00	2.88
	Patients' marital status: Married				
	Walking ability of the care recipient: Walker or cane				
	Caregivers' marital status: Married				
	Type of primary care: Shared caregiving by a caregiver				
	and a foreign worker/household				
19	Type of dementia: Alzheimer's disease	10	2.11	80.00	2.88
	Relation to the patient: Child				
	Type of primary care: Caregiving by a foreign worker				
	Frequency of care: $\geq 6$ days per week				
	ZBI caregiving burden: Mild to moderate burden				
20	Gender of the care recipient: Male	10	2.11	80.00	2.88
	Type of dementia: Alzheimer's disease				
	Caregiver's employment: Unemployed or retired				
	Caregivers' mood: Troublesome and hopelessness				

General rule no.	Antecedent	No. of the cases in the database	Support (%)	Confidence (%)	Lift
21	Mood symptoms of the care recipient: Anger	10	2.11	80.00	2.88
	Walking ability of the care recipient: Walker or cane				
	Caregivers' marital status: Married				
	Caregiver's employment: Unemployed or retired				
	Frequency of care: $\geq 6$ days per week				

troublesome and hopelessness (twentieth). Finally, twenty-first general rule indicated that assistive devices were needed when a patient with dementia with the mood symptom of anger who had the walking ability by a walker or cane was cared for by a married and unemployed or retired caregiver with the frequency of  $\geq 6$  days per week.

### Discussion

This study identified certain combinations of the patient– caregiver dyads which resort to either home personal care services or assistive devices for patients with dementia in Taiwan.

In general, patient's living status, patient's walking ability, and mood condition with caregivers' age, caregiving frequency, and employment status were associated with the use of home personal care services. Patients who were taken care of by informal caregivers with the frequency of  $\geq 6$  days per week and the caregivers who experienced helplessness or hopeless mood were associated with the use of home personal care services. Patients with emotional liability or being taken care of by their spouses who were aged  $\geq$ 70 years or unemployed caregivers were also associated with the use of home personal care services. On the other hand, patient's age, marital status, dementia severity, and ambulatory status as well as caregivers' age, type of primary care, frequency of care, caregivers' mood, and caregivers' burden were associated with the use of assistive devices. People living with dementia applying assistive devices were older (≥75 years old), had moderate to severe dementia, needed assistance in walking or were wheelchair bound, and were being cared for mainly by a foreign care helper.

As in Western countries, LTC service is a complex package in Taiwan that is allocated to use different services in the same manner regarding the severity of disability and dementia (Feldman et al., 2021; Van Cleve and Degenholtz, 2022). Our findings provided a glimpse of the LTC service usage among patient–caregiver dyads of patients with dementia in Taiwan. Generosity and accessibility of the LTC service also contribute to the results (Wysocki et al., 2015; Wang S. et al., 2021).

Factors that are related to institutionalization and assisted living service in community sometimes overlapped. Physical function, cognition, and mood condition are worthy of keeping an eye on. Not surprisingly, the health profiles including age, dementia severity, and walking ability are associated with the LTC service usage (Liu et al., 2018). Care recipient's dependency is positively correlated with the utilization of LTC services (Feldman et al., 2021; Van Cleve and Degenholtz, 2022). This profile may drive the LTC service to fit their users better.

Caregivers' employment status also appears to be in relation to the association rules. Feldman et al. (2021) also found caregivers not working had a greater likelihood of service usage. Behavioral and psychological symptoms presented in 80% of the dementia population from the onset of cognitive dysfunction lead to heavy burden on both the patients and their caregivers (Lyketsos et al., 2002; Baharudin et al., 2019). Home health aides and home personal care services are reported to reduce caregivers' burden in mean caregiver strain scores (Reckrey et al., 2021). Patients with emotional liability, anxiety mood, and hallucination are found to be associated with the LTC usage in the present study. Our study also reveals that the picture of higher strain of caregiving presenting as a feeling of being over relied on may force the patients and their caregivers to resort to both services. It is worth considering the need of social services, physical function, cognition, and mood condition. Mood conditions of both patients and their caregivers are worth recording and intervention. Non-pharmacological and pharmacological treatments for BPSD, as well as the caregiver support group and education to relieve caregiver's helplessness, are important assistance measures for caregivers who take care of people with dementia (Livingston et al., 2005; McLoughlin, 2022).

The strength of the present study includes comprehensive characteristics of people living with dementia and their caregivers, as well as care mode and care load. Another strength of the present study is the fact that through using the Apriori algorithm, the caring scenario associated with the LTC service usage could be elucidated. However, there are some study limitations. First, when applying the Apriori algorithm, there is no universal approach to set up support and confidence values in order to generate association rules. In general, a higher confidence value, say 90% or above, is recommended when a conditional probability is applied to study the associations of attributes. In contrast to confidence, setting a support value is usually correlated with the diversity of factors included in the analysis. Higher support values reduce the number of rules and easily summarize meaningful results, whereas lower support values help in generating some essential rules with low frequencies. Because of the heterogeneity between patients' and caregivers' characteristics and the usage of LTC services, the confidence and support values were set as 80% and 2% in order to generate association rules. No rules could achieve above 90% confidence value, which weakened the conditional probability of associations. Second, some important factors associated with LTC service usage, including average family income and accessibility of the LTC service, were not included in the present study. Third, the cross-sectional design made it difficult to determine the causal relationship between the correlates and the usage of LTC services.

This study provides preliminary results on the LTC service usage from people living with dementia and their caregivers residing in the community. Understanding the patient–caregiver dyad's profile leads the service providers, policymakers, and the referral team to tailor service provisions better to meet the needs and identify the potential target groups.

# Conclusion

This study identified 75 rules on the usage of LTC services by a comprehensive analysis of the characteristics of patients with dementia and their caregivers. There were 25 rules belonging to home personal care services, which could be summarized further into four general rules. Patient's walking ability (by a walker or cane), patient's emotional liability, unemployed or retired caregivers, caregivers' feelings with either helplessness or hopelessness, and caregivers who cared for the patients with dementia solely were found to be the critical variables to use home personal care services. On the contrary, patient's walking ability (mainly by a walker or cane), age, and severity as well as caregivers' age, mood, marital status, caregiving burden, and the patient being cared for mainly by a foreign care helper were found to be the critical variables to use assistive devices services. Aside from each patient's and caregiver's basic characteristics and caregiving load, the present study highlighted that mood conditions of both patients and caregivers were associated with LTC services usage. It is worthy to check and give an appropriate intervention for the abnormal mood status of people with dementia and their caregivers. These general rules serve as references to provide either home personal care services or assistive devices to reduce caregivers' burden as well as to improve the quality of care for patients with dementia.

## Data availability statement

The datasets presented in this article are not readily available because following our hospital's regulation, individual deidentified data should pass both the Research and Development Committee and Institutional Review Board (IRB). Researchers should write a research proposal and apply a clinical trial for the IRB of our hospital. All data listed in the present manuscript can be obtained through email if both committees agree the application. Further inquiries can be directed to the corresponding author.

## **Ethics statement**

The Clinical Trial Number was CCH IRB 220225, which was approved by the Institutional Review Board of Changhua Christian Hospital. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

# Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Funding

This study was supported by grants from the National Health Research Institutes, Taiwan (PH-111-GP-08).

# **Conflict of interest**

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

# Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

# References

American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders: DSM-5, 5th. Edition. Washington, DC: American Psychiatric Publishing. doi: 10.1176/appi.books.9780890425596

Baharudin, A. D., Din, N. C., Subramaniam, P., and Razali, R. (2019). The associations between behavioral-psychological symptoms of dementia (BPSD) and coping strategy, burden of care and personality style among low-income caregivers of patients with dementia. *BMC Public Health.* 19, 447. doi: 10.1186/s12889-019-6868-0

Bédard, M., Molloy, D. W., Squire, L., Dubois, S., Lever, J. A., O'Donnell, M., et al. (2001). The Zarit burden interview: a new short version and screening version. *Gerontologist.* 41, 652–657. doi: 10.1093/geront/41.5.652

Chang, C. C., Wang, W. F., Li, Y. Y., Chen, Y. A., Chen, Y. J., Liao, Y. C., et al. (2021). Using the Apriori algorithm to explore caregivers' depression by the combination of the patients with dementia and their caregivers. *Risk Manag. Healthc. Policy*. 14, 2953–2963. doi: 10.2147/RMHP.S316361

Chen, W. J., Wang, W. F., and Liu, Y. H. (2019). Using Apriori algorithm to explore the influence of pressure from patients with dementia on caregivers from a medical center in Taiwan. J. Qual. 26, 395–418. doi: 10.6220/joq.201912\_26(6).0004

Chen, Y. A., Chang, C. C., Wang, W. F., Lin, Y. S., Jhang, K. M., Lo, T. Y., et al. (2021). Association between caregivers' burden and neuropsychiatric symptoms in female patients with Alzheimer's disease with varying dementia severity. J. Multidiscip. Healthc. 14, 929–940. doi: 10.2147/JMDH.S298196

Chen, Y. J., Wang, W. F., Jhang, K. M., Chang, M. C., Chang, C. C., Liao, Y. C., et al. (2022). Prediction of institutionalization for patients with dementia in Taiwan according to condition at entry to dementia collaborative care. *J. Appl. Gerontol.* 41, 1357–1364. doi: 10.1177/07334648211073129

Chen, Y. M., and Berkowitz, B. (2012). Older adults' home- and communitybased care service use and residential transitions: a longitudinal study. *BMC Geriatr.* 12, 44. doi: 10.1186/1471-2318-12-44

Chong, M. Y., and Wilkinson, G. (1989). Validation of 30- and 12-item versions of the Chinese Health Questionnaire (CHQ) in patients admitted for general health screening. *Psychol Med.* 19, 495–505. doi: 10.1017/S0033291700012526

Cummings, J. L., Mega, M., Gray, K., Rosenberg-Thompson, S., Carusi, D. A., Gornbein, J., et al. (1994). The neuropsychiatric inventory: comprehensive assessment of psychopathology in dementia. *Neurology*. 44, 2308–2314. doi:10.1212/WNL.44.12.2308

Fabius, C. D., Okoye, S. M., Mulcahy, J., Burgdorf, J. G., and Wolff, J. L. (2022). Associations between use of paid help and care experiences among medicaremedicaid enrolled older adults with and without dementia. *J. Gerontol. B Psychol. Sci. Soc. Sci.* doi: 10.1093/geronb/gbac072

Feldman, S. J., Solway, E., Kirch, M., Malani, P., Singer, D., Roberts, J. S., et al. (2021). Correlates of formal support service use among dementia caregivers. *J. Gerontol. Soc. Work.* 64, 135–150. doi: 10.1080/01634372.2020.1816589

Greiner, M. A., Qualls, L. G., Iwata, I., White, H. K., Molony, S. L., Sullivan, M. T., et al. (2014). Predicting nursing home placement among home- and community-based services program participants. *Am. J. Manag. Care.* 20, e535–536.

Han, J., and Kamber, M. (2006). Data Mining: Concepts and Techniques, 2nd ed. New York: Morgan Kaufmann Publishers.

Hsu, H. C., and Chen, C. F. (2019). LTC 2.0: the 2017 reform of homeand community-based long-term care in Taiwan. *Health Policy*. 123, 912–916. doi: 10.1016/j.healthpol.2019.08.004

Jhang, K. M., Chang, M. C., Lo, T. Y., Lin, C. W., Wang, W. F., Wu, H. H., et al. (2019). Using the Apriori algorithm to classify the care needs of patients with different types of dementia. *Patient Prefer Adherence* 13, 1899–1912. doi: 10.2147/PPA.S223816

Jhang, K. M., Wang, W. F., Chang, H. F., Chang, M. C., and Wu, H. H. (2021). Characteristics predicting a high caregiver burden in patients with vascular cognitive impairment: using the Apriori algorithm to delineate the caring scenario. *Risk Manag. Healthc. Policy* 14, 1335–1351. doi: 10.2147/RMHP.S297204

Jhang, K. M., Wang, W. F., Chang, H. F., Liu, Y. H., Chang, M. C., Wu, H. H., et al. (2020). Care needs of community-residing male patients with vascular cognitive impairment. *Neuropsychiatr. Dis. Treat.* 16, 2613–2621. doi: 10.2147/NDT.S277303

Lin, Y. S., Wang, W. F., and Liu, Y. H. (2020). The study of care targets combination in women with Alzheimer's disease: a case study in a medical center in Taiwan. J. Qual. 27, 1–25. doi: 10.6220/joq.202002\_27(1).0001

Liu, C. C., Li, C. Y., Sun, Y., and Hu, S. C. (2019). Gender and age differences and the trend in the incidence and prevalence of dementia and Alzheimer's disease in Taiwan: a 7-year national population-based study. *Biomed. Res. Int.* 2019, 5378540. doi: 10.1155/2019/5378540

Liu, L. F., Wang, W. M., and Chen, Y. J. (2018). The effectiveness of home services in Taiwan: a people-centered approach. *Int. J. Environ. Res. Public Health.* 15, 2605. doi: 10.3390/ijerph15112605

Livingston, G., Johnston, K., Katona, C., Paton, J., and Lyketsos, C. G. (2005). Systematic review of psychological approaches to the management of neuropsychiatric symptoms of dementia. *Am. J. Psychiatry.* 162, 1996–2021. doi: 10.1176/appi.ajp.162.11.1996

Lyketsos, C. G., Lopez, O., Jones, B., Fitzpatrick, A. L., Breitner, J., DeKosky, S., et al. (2002). Prevalence of neuropsychiatric symptoms in dementia and mild cognitive impairment: results from the cardiovascular health study. *JAMA*. 288, 1475–1483. doi: 10.1001/jama.288.12.1475

McLoughlin, B. (2022). Group-based interventions for carers of people with dementia: a systematic review. *Innov. Aging.* 6:igac011. doi: 10.1093/geroni/ igac011

Ministry of Health and Welfare (2022). Long-Term Care Service Application and Payment (in Chinese). Taiwan: Ministry of Health and Welfare. Available online at: https://1966.gov.tw/LTC/cp-4010-42524-201.html (accessed June 10, 2022).

Morris, J. C. (1997). Clinical dementia rating: a reliable and valid diagnostic and staging measure for dementia of the Alzheimer type. *Int. Psychogeriatr.* 9, 173–176. discussion 177–178. doi: 10.1017/S1041610297004870

Morrisby, C., Joosten, A., and Ciccarelli, M. (2018). Do services meet the needs of people with dementia and carers living in the community? A scoping review of the international literature. *Int. Psychogeriatr.* 30, 5–14. doi: 10.1017/S1041610217001491

Reckrey, J. M., Boerner, K., Franzosa, E., Bollens-Lund, E., and Ornstein, K. A. (2021). Paid caregivers in the community-based dementia care team: do family caregivers benefit? *Clin Ther.* 43, 930–941. doi: 10.1016/j.clinthera.2021. 03.022

Shepherd-Banigan, M., James, H. J., Smith, V. A., Plassman, B. L., Jutkowitz, E., Belanger, E., et al. (2021). Drivers of long-term care considerations by persons with cognitive impairment. *J. Appl. Gerontol.* 40, 648-660. doi: 10.1177/0733464820903908

Tsai, C. F., Huang, M. H., Cheng, C. M., Lee, J. J., Wang, W. F., Huang, L. C., et al. (2022). Determinants of long-term care service use by persons with dementia: A national dementia registry study conducted in Taiwan. *Int. J. Geriatr. Psychiatry.* 37, 5719. doi: 10.1002/gps.5719

Van Cleve, R., and Degenholtz, H. B. (2022). Patterns of home and community based service use by beneficiaries enrolled in the Pennsylvania medicaid aging waiver. *J. Appl. Gerontol.* 2022, 7334648221094578. doi: 10.1177/07334648221094578

Wang, S., Yan, D., Temkin-Greener, H., and Cai, S. (2021). Nursing home admissions for persons with dementia: role of home- and community-based services, Health Serv Res. 56, 1168-1178. doi: 10.1111/1475-6773.13715

Wang, W. F., Su, Y. Y., and Jhang, K. M. (2021). Patterns of homeand community-based services in older adults with dementia: an analysis of the long-term care system in Taiwan. *BMC Geriatr.* 21, 290. doi: 10.1186/s12877-021-02231-9

Wu, C. Y., Hu, H. Y., Huang, N., Fang, Y. T., Chou, Y. J., and Li, C. P. (2014). Determinants of long-term care services among the elderly: a populationbased study in Taiwan. *Plos ONE.* 9, e89213. doi: 10.1371/journal.pone.00 89213

Wysocki, A., Butler, M., Kane, R. L., Kane, R. A., Shippee, T., Sainfort, F., et al. (2015). Long-term services and supports for older adults: a review of home and community-based services versus institutional care. *J. Aging Soc. Policy.* 27, 255–279. doi: 10.1080/08959420.2015.1024545

Yan, G. J., Wang, W. F., Jhang, K. M., Lin, C. W., and Wu, H. H. (2019). Association between patients with dementia and high caregiving burden for caregivers from a medical center in Taiwan. *Psychol. Res. Behav Manag.* 12, 55–65. doi: 10.2147/PRBM.S187676

Yang, C. C., Hsueh, J. Y., and Wei, C. Y. (2020). Current status of long-term care in Taiwan: transition of long-term care plan from 1.0 to 2.0. *Int. J. Health Policy Manag.* 9, 363–364. doi: 10.15171/ijhpm.2019.115