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Characteristics and hospitalization of people living with dementia after home healthcare

A nationwide cohort study

Yi-Chi Wang, MD, MSc[a], Kang-Ting Tsai, MD, MSc[b], Chung-Han Ho, PhD[c,d], Wei-Zhe Tseng, BA[e], Irene Petersen, PhD[f], Yi-Chen Lai, MD[g], Hung-Yi Chiou, PhD[h], Chao A. Hsiung, PhD[h], Sang-Ju Yu, MD, MSc[i,j], Elizabeth L. Sampson, MD[k], Jung-Yu Liao, PhD[l], Ping-Jen Chen, MD, PhD[e,m,n,*]

Abstract

The need for home healthcare (HHC) is increasing among people living with dementia (PLWD) to achieve their desire to age. This study aimed to investigate the determinants of hospitalization among PLWD receiving HHC. This retrospective cohort study used data from the National Health Insurance Research Database of Taiwan from 2007 to 2017. The primary outcome was subsequent hospitalization after HHC for PLWD. Using multivariate Poisson regression, baseline and follow-up HHC-related characteristics were examined as covariates and influencing factors. A total of 95,831 PLWD received HHC (mean age: 80.2 years), and 81.7% had at least one subsequent hospitalization during the follow-up period. Regarding baseline characteristics, prior admission was the strongest determinant of subsequent hospitalization, especially being admitted three to six months before HHC use (aRR = 1.47, 95% confidence interval [CI] 1.39–1.56, $P < .001$), followed by dementia duration from diagnosis to index date more than 3.5 years (aRR = 1.22, 95% CI 1.19–1.24). Among HHC-related characteristics, a higher frequency of HHC visits (more than 2 counts/month) (aRR = 4.81, 95% CI 4.63–5.00) and visits by both physicians and nurses (aRR = 2.03, 95% CI 1.98–2.07) were associated with a higher risk of hospitalization. Our findings suggest that prior admission, longer dementia duration from diagnosis to the index date, and frequency of HHC were positively associated with increased hospitalization. Future interventions and strategies can focus on these factors to decrease hospitalization among PLWD receiving HHC.

Abbreviations: CCI = Charlson Comorbidity Index, ED = emergency department, HHC = home healthcare, (ICD-10-CM) codes = International Classification of Diseases, 10th Revision, Clinical Modification, (ICD-9-CM) codes = International Classification of Diseases, 9th Revision, Clinical Modification, NHIRD = National Health Insurance Research Database, PLWD = people living with dementia, RUG = resource utilization groups.

Keywords: cognitive impairment, home-based medical care, hospital admission, older adult, real-world data

1. Introduction

More than 55 million people living with dementia (PLWD) was estimated worldwide, with 10 million new cases identified annually.[1] In Taiwan, there are 3.6 million people aged 65 years and above, of whom 280,783 have dementia. This implies that for every 12 older Taiwanese people, one person lives with

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[a] Department of Family Medicine, Far Eastern Memorial Hospital, New Taipei City, Taiwan, [b] Department of Geriatrics and Gerontology, Chi-Mei Medical Center, Tainan, Taiwan, [c] Department of Medical Research, Chi-Mei Medical Center, Tainan, Taiwan, [d] Department of Information Management, Southern Taiwan University of Science and Technology, Tainan, Taiwan, [e] Department of Family Medicine and Division of Geriatrics and Gerontology, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan, [f] UCL Department of Primary Care and Population Sciences, University College London, London, UK, [g] Department of Emergency Medicine, An Nan Hospital, China Medical University, Tainan, Taiwan, [h] Institute of Population Health Sciences, National Health Research Institutes, Miaoli County, Taiwan, [i] Taiwan Society of Home Health Care, Taipei, Taiwan, [j] Home Clinic Dulan, Taitung, Taiwan, [k] Department of Psychological Medicine, Royal London Hospital, East London NHS Foundation Trust, London, UK, [l] Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei, Taiwan, [m] National Center for Geriatrics and Welfare Research, National Health Research Institutes, Miaoli, Taiwan, [n] School of Medicine, College of Medicine, National Sun Yat-sen University, Kaohsiung, Taiwan.

** Correspondence: Ping-Jen Chen, Department of Family Medicine and Division of Geriatrics and Gerontology, Kaohsiung Medical University Hospital, Kaohsiung Medical University, 80708 Kaohsiung, Taiwan (e-mail: pingjen.chen@gmail.com).*

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dementia.[2] Dementia is a neurodegenerative disease characterized by progressive decline in cognition. It not only causes disability and death but also increases the risk of hospitalization,[3,4] necessitates nursing home care[5] and contributes to the burden on caregivers.[6] PLWD are at a high risk of hospital admission, which is a safety issue that may lead to poor health outcomes and burden on healthcare systems.[7] Previous studies have revealed that dementia is significantly associated with a 41% to 46% higher risk of hospitalization.[8] Given that PLWD are generally frail and homebound with complex care needs, maintaining them in their homes and avoiding hospitalization is essential for dementia care.

PLWD express a preference for residing in their homes as familiar surroundings that help mitigate the adverse effects of deteriorating procedural and emotional memory systems.[9–11] Previous studies have found that PLWD require home healthcare (HHC) services more frequently.[12,13] HHC refers to a diverse range of healthcare provided by multidisciplinary healthcare professionals in individuals' homes.[14] The HHC services involve acute care, post-acute care, and advanced treatment of chronic or terminal illnesses.[15] Previous studies evaluating the impact of HHC have indicated that it could reduce hospitalization, emergency service use, and total health expenditure[16,17] among disabled people and patients after discharge with HHC. Thus, HHC may be a potential solution for mitigating hospitalization in PLWD.

However, it cannot be avoidable that some PLWD may require hospitalization even receiving HHC. Understanding hospitalization among PLWD receiving HHC and exploring the determinants of hospitalization can offer evidence-based insights for targeted preventive efforts. This includes the identification of care needs, facilitating discussions with patients and caregivers, and tailoring individualized goals in HHC provision. While the risk factors for hospitalization among PLWD have been investigated, including sociodemographic characteristics,[8,18–20] medical comorbidities,[7,21–23] and clinical dementia status[7,24–29] little is known about the determinants of hospitalization among frail, homebound PLWD receiving HHC, especially in the Asian context. Therefore, this population-based cohort study aimed to explore the characteristics of hospitalized PLWD receiving HHC and investigate the association between these characteristics and hospitalization. We hypothesized that HHC-related characteristics are associated with hospitalization rates in PLWD receiving HHC.

2. Materials and methods

2.1. Setting and HHC policy

Taiwan is one of the fastest-aging countries and is estimated to become a super-aged society by 2025, with a significant increase in the population of PLWD.[30] HHC services have been reimbursed by the National Health Insurance (NHI) program in Taiwan, which was established in 1995 and requires all Taiwanese residents to participate; therefore, more than 99.9% of the total population has registered to participate in the NHI program.[31] In Taiwan, HHC is reimbursed by payments corresponding to NHI and is provided by nurses and physicians affiliated with hospitals, independent HHC organizations, or community health centers from the public sector.[32] The eligibility criteria for HHC in Taiwan are as follows: limited ability for self-care, for example, requiring help with more than half of their daily activities; definite medical or nursing care needs assessed by both physicians and nurses at outpatient clinics, on hospital admission, or at home; and chronic conditions requiring long-term nursing care or continual post-discharge healthcare needs.[32]

2.2. Data source and ethics

This nationwide population-based cohort study was conducted using data from the National Health Insurance Research Database (NHIRD), which includes claims for inpatient and outpatient services as well as prescription drug use. In the NHIRD, information about any utilization of NHI-reimbursed healthcare services or drug prescriptions for an individual is obtained by tracing specific administrative codes and linked by an encrypted identifier. Disease diagnoses were based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes and 10th Revision (ICD-10-CM) codes before and after 2016. The study protocol was approved by the Research Ethics Committee of the National Health Research Institute of Taiwan (No. EC1090305-E-R2). Informed consent was waived by the Research Ethics Committee of the National Health Research Institutes of Taiwan due to the anonymous nature of the NHIRD analysis. All methods were performed in accordance with the relevant guidelines and regulations.

2.3. Study population

The PLWD from 2006 to 2017 were selected from the NHIRD. To confirm newly diagnosed dementia and have at least one year to identify any chronic comorbidity and previous dementia diagnosis, we included people diagnosed with dementia after January 1, 2007. We also excluded those who had a dementia diagnosis after December 31, 2016, to have at least one year to observe outcome events in the follow-up. PLWD were identified using ICD-9-CM and ICD-10-CM (Table S1, Supplemental Digital Content, http://links.lww.com/MD/O229), followed by at least one inpatient record of dementia code or at least 3 outpatient records within 1 year. Additionally, we excluded PLWD who did not receive HHC; were under 40 years of age or over 105 years of age; and had incomplete or erroneous information regarding sex, place of residence, and death records.

The study cohort included PLWD who received HHC services. The index date was defined as the date of first HHC. A flowchart of the selection of the research subjects is shown in Figure 1.

2.4. Outcome measurement and exposure variables

The primary outcome of this study was subsequent hospitalization after receiving HHC services. All individuals in the study cohort were followed up from the index date until death or December 31, 2017. We examined the impact of baseline and follow-up HHC-related characteristics on subsequent hospitalizations in our cohort. The baseline characteristics of the study cohort included age, sex, personal income, urbanization level of residence, comorbidities, Charlson Comorbidity Index (CCI) score, acute physical illness, utilization of interventional tubes, and acute healthcare such as intensive care unit admission and emergency department (ED) visit. The follow-up HHC-related characteristics of the cohort study included the time, duration, and frequency of HHC, types of HHC provisions, and types of HHC agencies.

Personal income was classified into four groups according to salary-based health insurance premiums: dependent, less than New Taiwan Dollars (NT$) 20,000, NT$ 20,001 to 40,000, and NT$ 40,000. Urbanization was divided into urban, suburban, and rural based on population density, percentage of residents with college-level or higher education, percentage of residents aged > 65 years, percentage of residents who are agricultural workers, and number of physicians per 100,000 patients.[33]

Comorbidities, CCI score[34] and acute illness were defined using ICD-9-CM or ICD-10-CM (Table S1, Supplemental Digital Content, http://links.lww.com/MD/O229). Comorbidities and diseases related to CCI scores were identified with at least three outpatient visits or one inpatient record within one year before

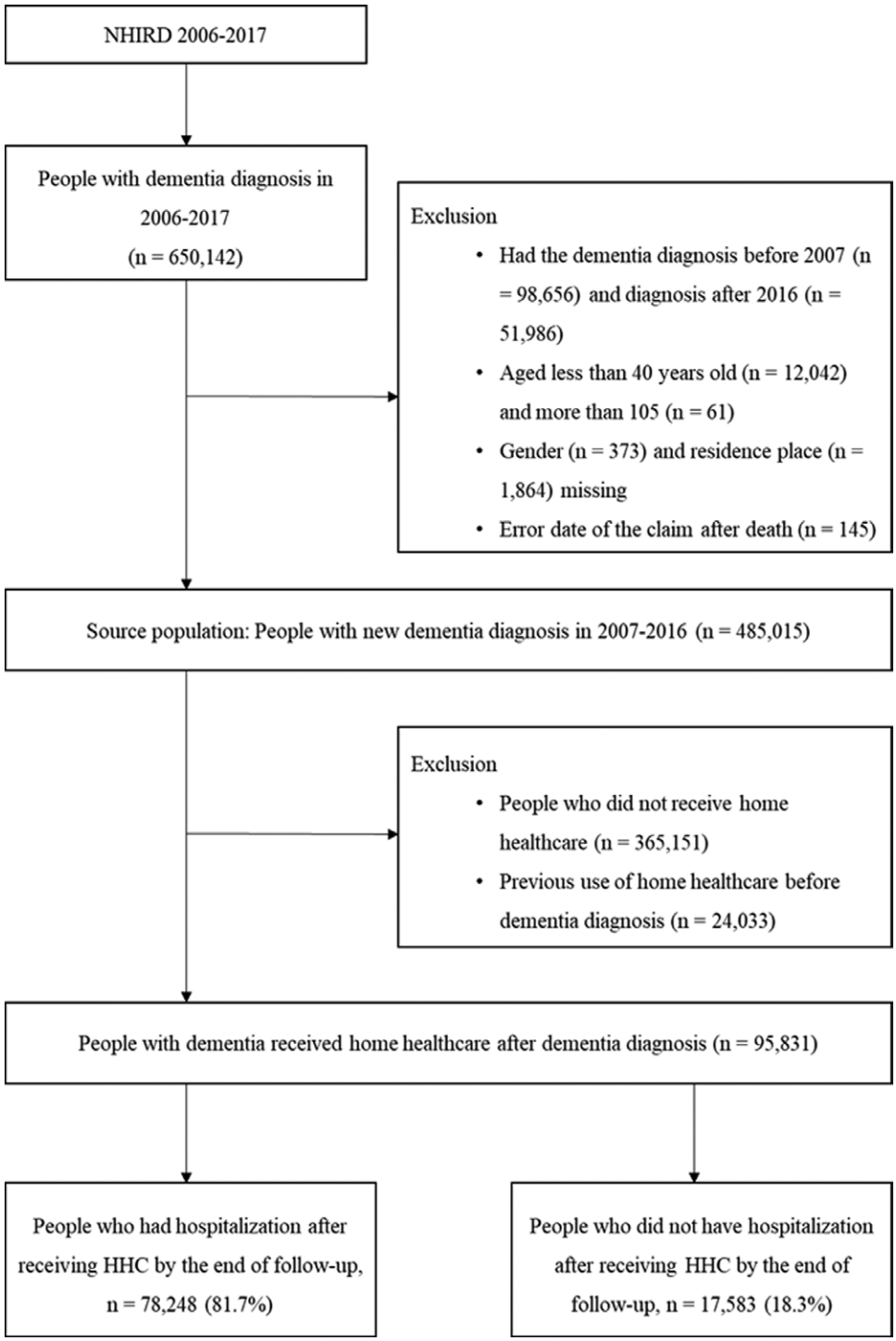

Figure 1. Schematic illustration of the study population selection.

the index date. Acute physical illness, including pneumonia, urinary tract infection, and hip fracture, was defined as any event within three months before the index date. Furthermore, HHC is classified by resource utilization groups (RUG) from levels one to four. The primary tier of RUG is designed for individuals who solely require ordinary healthcare at their residences, whereas RUG levels two–four cater to the needs of those who require one, two, three, or more specialized care services, respectively. Each category of HHC has a fixed reimbursement amount identical to that regulated by the government in Taiwan (Table S2, Supplemental Digital Content, http://links.lww.com/MD/O229).

2.5. Statistical analysis

The distributions of continuous variables were described as means and standard deviations (SDs) or medians and interquartile ranges (IQR), whereas categorical variables were presented as numbers with percentages. To compare the differences in baseline and follow-up HHC-related characteristics between PLWD who had subsequent hospitalization and those who did not, we applied the *t* test, chi-square test, and Wilcoxon rank-sum test. The incidence rate ratio (IRR) of hospitalization among PLWD receiving HHC was estimated using Poisson regression, with total person-years as an offset variable. Univariate RR and

Table 1

The baseline characteristics of hospitalization + group and hospitalization–group

Variables	Total n = 95,831	Hospitalization + n = 78,248	Hospitalization– n = 17,583	*P*
Age, mean (SD)	80.2 (8.6)	80.3 (8.5)	80.0 (8.8)	<.001
Gender (female), n (%)	51,338 (53.6)	40,538 (51.8)	10,800 (61.4)	<.001
Income (NT$), n (%)				<0.001
Dependent	35,000 (36.5)	28,072 (35.9)	6928 (39.4)	
<20,000	57,454 (60.0)	47,567 (60.8)	9890 (56.3)	
20,001-40,000	2414 (2.5)	1887 (2.4)	527 (3.0)	
≥40,001	960 (1.0)	722 (0.9)	238 (1.4)	
Urbanisation, n (%)				<0.001
Urban	43,856 (45.8)	35,598 (45.6)	8258 (47.0)	
Sub-urban	40,844 (42.6)	33,508 (42.8)	7336 (41.7)	
Sub-rural	9363 (9.8)	7731 (9.9)	1632 (9.3)	
Rural	1768 (1.8)	1411 (1.8)	357 (2.0)	
CCI, mean (SD)	3.2 (1.7)	3.3 (1.8)	3.0 (1.7)	<.001
Comorbidities within 1 year before Index date, n (%)				
Cancer	9332 (9.7)	7663 (9.8)	1669 (9.5)	.22
Heart failure	12,399 (12.9)	10,424 (13.3)	1975 (11.2)	<.001
COPD	27,627 (28.8)	23,691 (30.3)	3936 (22.4)	<.001
Liver disease	563 (0.6)	486 (0.6)	77 (0.4)	.004
Renal failure	10,139 (10.6)	8636 (11.0)	1503 (8.6)	<.001
Cerebrovascular disease	46,542 (48.6)	38,567 (49.3)	7975 (45.4)	<.001
Coronary artery disease	15,756 (16.4)	13,176 (16.8)	2580 (14.7)	<.001
Atrial fibrillation	6261 (6.5)	5166 (6.6)	1095 (6.2)	.07
Hypertension	57,648 (60.2)	47,593 (60.8)	10,055 (57.2)	<.001
Diabetes	30,953 (32.3)	25,765 (32.9)	5188 (29.5)	<.001
LUTS	8962 (9.4)	7369 (9.4)	1593 (9.1)	.140
Pressure sores	9452 (9.9)	7698 (9.8)	1754 (10.0)	.580
Malnutrition	1056 (1.1)	856 (1.1)	200 (1.1)	.620
Recent acute events (within 3 months before Index date), n (%)				
Pneumonia	50,734 (53.1)	41,947 (53.8)	8787 (50.2)	<.001
UTI	47,913 (50.2)	39,758 (51.0)	8155 (46.6)	<.001
Hip fracture	4940 (5.2)	3982 (5.1)	958 (5.5)	.047
Interventional tubes use within 6 months before Index date, n (%)	78,529 (82.0)	64,752 (82.8)	13,777 (78.4)	<.001
Duration of dementia to Index date (yr)				<0.001
≤0.5	30,045 (31.4)	25,936 (33.2)	4109 (23.4)	
0.6–2.0	26,059 (27.2)	21,794 (27.9)	4265 (24.3)	
2.1–3.5	11,555 (12.1)	9391 (12.0)	2164 (12.3)	
>3.5	28,172 (29.4)	21,127 (27.0)	7045 (40.1)	
Previous hospital use before index date	93,153 (97.2)	76,174 (97.3)	16,979 (96.6)	<.001
Duration from the discharge date of the latest hospitalization to Index date, median	22 (10–52)	22 (10–47)	25 (11–69)	<.001
(Q1–Q3)	Missing, n = 249	Missing, n = 194	Missing, n = 55	
≤30 days	58,809 (63.3)	48,399 (63.7)	10,410 (61.5)	<.001
31–90 days	19,417 (20.9)	16,067 (21.1)	3350 (19.8)	
91–180 days	4961 (5.3)	4122 (5.4)	839 (5.0)	
181–365 days	3269 (3.5)	2656 (3.5)	613 (3.6)	
>365 days	6448 (7.0)	4734 (6.3)	1714 (10.1)	
ICU admission before Index date, n (%)	43,550 (45.4)	35,757 (45.7)	7793 (44.3)	<.001
ED visit before Index date, n (%)	90,573 (94.7)	73,957 (94.5)	16,796 (95.5)	<.001

CCI = Carlson's comorbidity index, COPD = chronic obstructive pulmonary disease, ED = emergency department, ICU = intensive care unit, LUTS = lower urinary tract symptoms, UTI = urinary tract infection.

adjusted RR with 95% confidence interval (CI) for the adjustment of the selected variables were estimated. All statistical analyses were performed using SAS software (version 9.4; SAS Institute Inc., Cary). Statistical significance was set at $P < .05$.

3. Results

During 2007 to 2016, a total of 95,831 PLWD who received HHC were included in the study cohort. During follow-up, 81.7% of the cohort had subsequent hospitalizations (n = 78,248/95,831). The characteristics of the participants and the 2 groups with and without subsequent hospitalization after HHC are shown in Table 1. The mean age of the study cohort was 80.2 years, and 53.6% were female. Multimorbidity was common, with the five most prevalent diseases being hypertension (60.2%), cerebrovascular disease (48.6%), diabetes (32.3%), COPD (28.8%), and coronary artery disease (16.4%). Approximately 29.4% of the cohort had a dementia diagnosis for more than 3.5 years, and a significant percentage of the cohort had previous acute hospital use before the index date. Most PLWD (97.2%) had previous hospital use prior to the index date. Among 93,153 PLWD receiving HHC who experienced hospital use before the index date, 16,979 PLWD (18.2%) were never hospitalized after the index date.

The HHC-related characteristics after the diagnosis of dementia in the two groups with and without subsequent hospitalization are shown in Table 2. The median total count of HHC received was three counts per person, the duration of HHC was 58 days, and the frequency of HHC was 1.3 counts per month. Most PLWD received more than 2 specialized care services for the first HHC (74.5% RUG 2, 20.1% RUG 3, 0.9% RUG

Table 2

The follow-up HHC-related characteristics of hospitalization + group and hospitalization–group

Variables	Total n = 95,831	Hospitalization + n = 78,248	Hospitalization– n = 17,583	*P*
Times of HHC (total counts/person), median (Q1–Q3)	3 (1–8)	3 (1–7)	5 (2–13)	<.001
Duration of HHC (d), median (Q1–Q3)	58 (0–203)	50 (0–176)	107 (20–369)	<.001
Frequency of HHC (counts/month–person), median (Q1–Q3)	1.3 (1.1–1.9)	1.3 (1.1–1.8)	1.4 (1.1–3.9)	<.001
RUG of first HHC, n (%)	Missing = 292 (0.3)	Missing = 132 (0.2)	Missing = 160 (0.9)	<.001
RUG 1	4055 (4.2)	3129 (4.0)	926 (5.3)	
RUG 2	71,380 (74.5)	58,254 (74.5)	13,126 (74.7)	
RUG 3	19,253 (20.1)	16,027 (20.5)	3226 (18.4)	
RUG 4	851 (0.9)	706 (0.9)	145 (0.8)	
Type of HHC provision, n (%)	Missing = 292 (0.3)	Missing = 132 (0.2)	Missing = 160 (0.9)	<.001
By nurse only	13,550 (14.1)	10,009 (12.8)	3541 (20.1)	
By both physician and nurse	81,989 (85.6)	68,107 (87.0)	13,882 (79.0)	
Level of HHC agency, n (%)				<.001
Community home care institution	47,048 (49.1)	38,188 (48.8)	8860 (50.4)	
Hospital	45,700 (47.7)	37,461 (47.9)	8239 (46.9)	
Others	3083 (3.2)	2599 (3.3)	484 (2.8)	

HHC = home healthcare, RUG = resource utilization group.

4) and were visited by both physicians and nurses (85.6%). Approximately half of the PLWD (49.1%) received HHC from a community-level agency, and the others (47.7%) by a hospital-level agency.

Using the multivariate Poisson regression model, we evaluated the risk of hospitalization after HHC for PLWD (Table 3). Prior admission was a strong predictor, especially in those who were admission within 3 to 6 months before HHC use (aRR = 1.47, 95% CI 1.39–1.56). Compared to PLWD with a duration from diagnosis to the index date of less than half a year, those with dementia duration more than 3.5 years from diagnosis to the index date had a higher hospitalization risk (aRR = 1.22, 95% CI 1.19–1.24).

Regarding HHC-related characteristics, a higher frequency of HHC visits of more than 2 counts/month (aRR = 4.81, 95% CI 4.63–5.00) and visits by both physicians and nurses (aRR = 2.03, 95% CI 1.98–2.07) were associated with a higher risk of hospitalization. Additionally, PLWD cared for by a hospital-level HHC agency was associated with a reduced risk of hospitalization (aRR = 0.91, 95% CI 0.89–0.92).

As readmission is an important issue in dementia care, we found that 97.3% of hospitalized PLWD (n = 76,174/78,248) were readmitted. We further analyzed the cumulative incidence of readmission during the first year of follow-up after HHC, stratified by the duration from the latest admission to the index date. Compared with the other 2 groups, PLWD who had a recent hospital admission within 30 days before receiving HHC had the highest cumulative incidence rate of readmission in the first-year follow-up after HHC (75.1%), and a significant group difference was found (Fig. 2).

4. Discussion

To the best of our knowledge, this is the first national-level population-based cohort study to investigate the determinants of the rate of hospitalization among PLWD, including baseline and HHC-related characteristics. The results revealed that the hospitalization rate remained high among PLWD who received HHC. During the follow-up period of more than ten years (median: 2.1 years), we identified that male sex, older age, living in urban areas, higher CCI score, longer duration from diagnosis to the index date of dementia, shorter interval between previous hospital admission and HHC service, higher RUG level, higher frequency of HHC visits, and HHC provided by community HHC agencies were associated with a higher risk of subsequent hospitalization. These findings enable clinicians and policymakers to effectively allocate resources to target groups to prevent avoidable hospitalization.

Prior admission is a strong predictor of subsequent hospitalization, especially in those admitted within one year of HHC use. This implies that readmission is an important issue among PLWD, even after receiving HHC, which requires effective preventive intervention. An American prospective cohort study found that prior acute hospitalization increased the risk of subsequent hospital admission during a median of 3 years follow period.[35] Another study conducted on Australian PLWD demonstrated similar results.[27] While HHC has been applied as a resolution for readmission in PLWD, its effectiveness varies across studies due to differences in sample selection, duration of HHC, follow-up, and components of HHC.[32,36–38] A cohort study in the US showed that comprehensive dementia care at home for PLWD is associated with a lower risk of subsequent long-term care home admission, but neutral in hospitalization or 30-days readmission, compared to the control group.[36] Our previous study in Taiwan revealed that PLWD in the HHC group, compared with the control group, was associated with a higher risk of hospital transition in the last 90 days of life but a lower risk in the last 3 days of life.[32] Other HHC programs focusing on acute illness management, such as "Hospital at Home," may have beneficial effects on reducing hospital admissions.[39] Alternatively, individualized treatment planning and advanced decisions for hospitalization or specific interventions could be discussed and documented during HHC services.[37] Further longitudinal research on the impact of HHC on acute hospital utilization is required to identify the effective ingredients of HHC.

Characteristics related to HHC, including frequency, RUG, providing professionals, and level of HHC agency, may be critical for hospitalization outcomes but are seldom analyzed in the current literature. In this study, we found that a frequency of HHC visits of > 2 times/month was associated with a significant risk of hospitalization. This was consistent with a study indicating that a care plan requiring more provider visits per week was related to an increased risk of hospitalization[40] because a higher intensity of visits usually implies more complicated conditions. Moreover, our results revealed that PLWD patients who received only one HHC visit had the highest hospitalization risk because they had higher disease severity and an extremely short survival period.

Regarding the level of HHC agencies, hospital-level agencies are associated with a reduced risk of hospitalization compared with community-level agencies. This might be because physicians and nurses working in hospitals are usually more familiar with emergency and critical care, thus providing timely and adequate

Table 3

Influence of baseline characteristics and HHC-related characteristics on the subsequent hospitalization after HHC receiving in PLWD by using multivariate Poisson regression model

	Univariate model			Full model*		
Variables	**IRR**	**(95% CI)**	***P***	**aIRR**	**(95% CI)**	***P***
Duration of dementia to index date (yr)						
≤0.5		[Reference]			[Reference]	
0.6–2.0	1.17	(1.15–1.19)	<.001	1.06	(1.05–1.08)	<.001
2.1–3.5	1.17	(1.14–1.20)	<.001	1.11	(1.09–1.14)	<.001
>3.5	1.24	(1.22–1.27)	<.001	1.22	(1.19–1.24)	<.001
Duration from the discharge date of the latest hospitalization to the index date (d)						
No admission		[Reference]			[Reference]	
≤ 30	1.98	(1.90–2.07)	<.001	1.27	(1.20–1.34)	<.001
31–90	1.82	(1.74–1.91)	<.001	1.31	(1.24–1.38)	<.001
91–180	1.79	(1.70–1.89)	<.001	1.47	(1.39–1.56)	<.001
181–365	1.64	(1.55–1.74)	<.001	1.37	(1.29–1.45)	<.001
>365	1.36	(1.29–1.43)	<.001	1.17	(1.11–1.23)	<.001
ICU admission before Index date						
No		[Reference]			[Reference]	
Yes	1.26	(1.24–1.28)	<.001	1.08	(1.07–1.10)	<.001
ED visit before Index date						
No		[Reference]			[Reference]	
Yes	1.45	(1.41–1.50)	<.001	1.17	(1.11–1.23)	<.001
Frequency of HHC (counts/month–person)						
≤ 1.0		[Reference]			[Reference]	
1.1–1.5	1.90	(1.83–1.96)	<.001	1.82	(1.76–1.88)	<.001
1.6–2.0	3.70	(3.56–3.84)	<.001	3.73	(3.59–3.88)	<.001
> 2.0	4.77	(4.60–4.95)	<.001	4.81	(4.63–5.00)	<.001
Only one count	5.30	(5.12–5.48)	<.001	6.02	(5.81–6.23)	<.001
Resource utilization group of first HHC						
RUG 1		[Reference]			[Reference]	
RUG 2	1.02	(0.99–1.06)	0.19	1.05	(1.01–1.09)	0.013
RUG 3	1.15	(1.11–1.20)	<.001	1.07	(1.02–1.11)	0.002
RUG 4	1.15	(1.06–1.25)	0.006	0.91	(0.84–0.99)	0.035
Type of HHC provision						
By nurse only		[Reference]			[Reference]	
By both physician and nurse	1.27	(1.25–1.30)	<.001	2.03	(1.98–2.07)	<.001
Level of HHC agency						
Community home care institution		[Reference]			[Reference]	
Hospital	0.87	(0.86–0.88)	<.001	0.91	(0.89–0.92)	<.001
Others	0.98	(0.94–1.02)	0.22	0.98	(0.94–1.02)	0.37

ED = emergency department, HHC = home healthcare, ICU = intensive care unit, RUG = resource utilization group.

*The full model was adjusted simultaneously for age, sex, income, urbanization, Carlson's comorbidity index, comorbidities, recent acute events, and interventional tube use.

management of acute illnesses. Additionally, hospital-level agencies in Taiwan usually have a higher probability of multidisciplinary consultations with social workers, psychologists, and specialist physicians. Multidisciplinary management of dementia care plays an important role and is beneficial for PLWD and their caregivers.

Dementia duration from diagnosis to the index date is also an important determinant for predicting hospitalization, especially longer than 3.5 years. As dementia is a neurodegenerative disease, its severity increases over time, resulting in a loss of capacity for independent living and rapid functional deterioration in PLWD.

Regarding the clinical implications of our research, preventing readmission is crucial for PLWD, necessitating effective preventive interventions during the provision of HHC services at the policy level. First, emphasizing awareness and education regarding advance care planning, including preferences regarding hospital transitions, is essential in home settings. Second, enhancing acute illness management at home is important for PLWD receiving HHC. Third, promoting transmural medical care between hospital- and community-level agencies is worthy of attention with the aim of enhancing the care quality of HHC.

Our study has several strengths. First, this was a real-world nationwide cohort study with a large sample size, adequate follow-up period, high consistency, and a very low attrition rate. This decreases selection bias, and the results are representative of the Taiwanese universal healthcare system. Second, our study investigated the association between HHC-related characteristics and hospitalization risk, which has been reported less frequently in previous HHC studies. This work serves as an exploratory study, providing a foundation for future in-depth research, such as causal analyses among PLWD with and without HHC, as well as investigations into long-term outcomes following hospitalization, including mortality rates.

This study had some limitations. First, this was an observational study; therefore, the actual causation of our results requires further clarification. Second, hospitalization was defined using the NHIRD database; therefore, we could not determine whether hospitalization was unplanned or avoidable. Third, some important confounders could not be identified in the database, which may have led to residual confounding and biases, including selection bias and information bias. These unmeasured factors include dementia severity, functional dependency, lifestyle factors, medication compliance, and caregiver support. In the future, prospective studies are needed and beneficial to validate and strengthen these findings.

5. Conclusions

Our study indicates that prior admission, longer dementia duration from diagnosis to the index date, and higher HHC

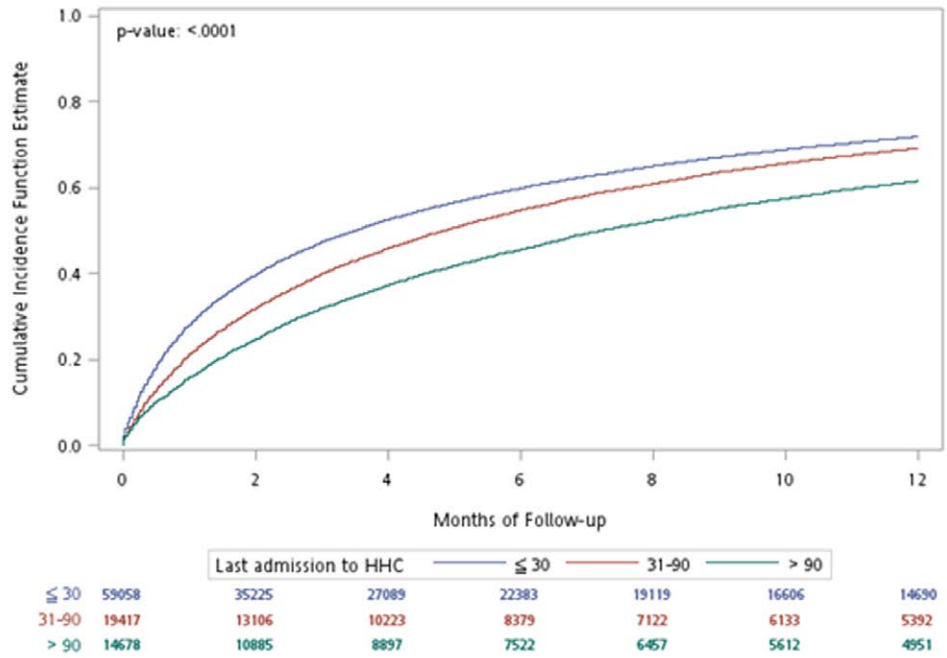

Figure 2. The cumulative incidence of readmission in the first-year follow-up after home healthcare, stratified by the duration from Index date to the latest admission.

visits and frequency are associated with increased hospitalization. Understanding the determinants of hospitalization among PLWD receiving HHC is crucial for identifying specific risks and needs, facilitating discussion with PLWD and their caregivers, and establishing strategies for hospitalization prevention.

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Author contributions

Conceptualization: Yi-Chi Wang, Kang-Ting Tsai, Irene Petersen, Jung-Yu Liao, Ping-Jen Chen.
Data curation: Chung-Han Ho, Wei-Zhe Tseng, Jung-Yu Liao.
Formal analysis: Chung-Han Ho, Wei-Zhe Tseng, Jung-Yu Liao.
Funding acquisition: Kang-Ting Tsai, Hung-Yi Chiou, Ping-Jen Chen.
Methodology: Chung-Han Ho, Irene Petersen, Yi-Chen Lai, Chao A. Hsiung, Sang-Ju Yu, Elizabeth L. Sampson, Jung-Yu Liao, Ping-Jen Chen.
Project administration: Jung-Yu Liao.
Resources: Sang-Ju Yu, Elizabeth L. Sampson.
Supervision: Ping-Jen Chen.
Validation: Yi-Chi Wang, Hung-Yi Chiou, Chao A. Hsiung.
Visualization: Wei-Zhe Tseng.
Writing – original draft: Yi-Chi Wang, Kang-Ting Tsai, Wei-Zhe Tseng, Jung-Yu Liao, Ping-Jen Chen.
Writing – review & editing: Chung-Han Ho, Irene Petersen, Yi-Chen Lai, Hung-Yi Chiou, Chao A. Hsiung, Sang-Ju Yu, Elizabeth L. Sampson.

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