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Original Article

Risk Factors for Mortality in a Cohort of Older Adults Receiving Home Nursing Care in Taiwan

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SUMMARY

Background: This study aimed to examine causes of death and related risk factors among older adults receiving home nursing care in Taiwan.
Methods: This retrospective cohort study examined data a hospital's home-care initial assessment, admission charts, and death certificates, examining the period from 2010 to 2016. The individuals analyzed were first-time recipients of home nursing services, which they had been receiving for ≥ 90 days. Data analyzed in the initial assessment included Barthel Index, Norton Scale, and Eastern Cooperative Oncology Group Scale of Performance Status scores, and details regarding tube placement. Kaplan-Meier curves were generated and analyzed for all causes of mortality, and multivariate Cox proportional hazards models were used to identify risk factors.
Results: Overall, 1,010 patients were analyzed. Their median age was 81.95 years, and 583 (57.72%) were women. The median duration of home nursing care was 536 days. During the follow-up period, 437 patients (43.27%) died, with a mortality rate of 223.80/1,000 person years. After adjustment with Cox proportional hazard regression models, patients with higher Eastern Cooperative Oncology Group Scale of Performance Status scores (hazard ratio 1.70, p value < 0.01) or lower Barthel Index scores (hazard ratio 1.94, p value < 0.01) showed higher mortality rates.
Conclusion: Patients receiving home nursing care with higher Eastern Cooperative Oncology Group Scale of Performance Status scores or lower Barthel Index scores showed higher mortality risk.

1. Introduction

In Taiwan, the number of disabled older adults is increasing and rose from 427,000 in 2012 to 555,000 in 2018. To meet the resultant growing need, most bachelor nursing education program has offered courses of geriatric nursing or long-term care.[1] National Health Insurance (Taiwan's healthcare system) has begun to provide home nursing services for disabled patients with functional limitations in activities of daily living (ADL) and one or more placements of tubes such as nasogastric, tracheostomy, Foley, or cystostomy tubes.

Although institutional care remains the most common form of care provided to older adults (48,000 patients in 2017), the number of patients receiving such care has increased relatively slowly (by 5,000 between 2013 and 2017).[2] In contrast, the number receiving home nursing has increased rapidly from 1,700 in 2008 to 24,000 in 2015.[3]

Among older adults with disabilities, the mortality rate for those receiving institution- and home-based services is 68 and 258 per 1000 person-years, respectively.[4] However, risk factors related to such mortality remain debated. In Taiwan, disability status involving severe dependency (a Barthel Index score between 21 and 60), total dependency (Barthel Index score between 0 and 20), or an Eastern Cooperative Oncology Group score of ≥ 3 are used to identify individuals eligible for long term care services. In a previous study conducted in the USA, a group of individuals with low baseline ADL scores showed higher mortality rates.[5] Another study in China revealed that impaired ADL and Instrumental Activities of Daily Living (IADL) increased mortality.[6]

Furthermore, other studies conducted in long-term care facilities and hospitals have highlighted the placement of Foley, tracheotomy, and nasogastric tubes as possible risk factors for mortality and the development of pneumonia.[7,8] In contrast, a 5-year cohort study conducted in Taiwan showed significantly lower mortality risk in patients with three tubes or a tracheostomy who were receiving institution-based services.[9]

Few studies have focused on the impact of home nursing on patient mortality. Consequently, the purpose of this study was to examine causes of death and related risk factors among patients receiving home nursing in Taiwan.

2. Methods

2.1. Study population

This retrospective cohort study was conducted in a single hospital in Northern Taiwan, and data from a hospital home-care assessment database were analyzed. The participants or their family

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members provided written informed consent for the initial assessment and subsequent care.

The study period was from January 1, 2010 to December 31, 2016, and the enrollment period was from January 1, 2010 to May 31, 2016. Adult patients who were first-time recipients of home nursing services at a hospital, had received such services for ≥ 90 days or more, and had undergone a home-care initial assessment evaluation were eligible for inclusion in the study. The exclusion criteria were age of < 30 years, receipt of home nursing services for < 90 days, and not having undergone a home-care initial assessment evaluation; further, individuals who died during the study period and for whom a formal death certificate was unavailable were also excluded. The same medical doctor reviewed medical records and death certificates to identify major intrahospital causes of death. All enrolled participants underwent follow-up assessments until December 31, 2016. See Fig. 1 for additional details.

Upon the initiation of the services, all patients were visited at home by home-care nurses every 2–4 weeks, based on their needs concerning tube replacement. Home-care nurses also performed follow-up assessments via telephone during the third month after services had ceased, to obtain each patient's final status. For participants who died, they were censored at the date of death according to death certificate. For participants who survive during the study period, they were censored on December 31, 2016.

2.2. Home-care initial assessment

All patients underwent a home-care initial assessment when first receiving the services, with further nursing assessments every 90 days thereafter. Home-care initial assessment was designed for recipients of home nursing empirically. It included social, clinical and functional characteristics. Social characteristics consisted of age, sex, marital status, languages, education status, religion, main caregiver, and residential status (e.g., living arrangements and floor of residence). Clinical characteristics were comprised of diagnosis of chronic diseases, vital sign, physical exams, pain score, consciousness status, cognition, tube placement and nutritional status. Functional characteristics included cognition, the Eastern Cooperative Oncology Group Scale of Performance Status, Barthel Index, caring skills and Norton scale. Social characteristics were all reported by patients or their family. Home-care nurses evaluated most clinical and functional characteristics during home visit, except that diagnosis of chronic diseases.

2.3. Covariates

Social characteristics consisted of age, sex, living arrangements (e.g., living with family, friends, or only trained health personnel), floor of residence (e.g., ground floor or upper floors) and main caregiver. To examine the effects of ADL scores and tube placement on mortality, we used Barthel Index, Eastern Cooperative Oncology Group Scale of Performance Status and numbers of tubes. The Norton scale was included for pressure injury risk assessment. Items added after the study had begun were not used, including marital status, education status, consciousness status, cognition and nutritional status. Diagnosis of chronic diseases was not used due to self- or proxy-reported absence of condition diagnosed by a doctor.

2.3.1. Barthel Index

The first evaluation after enrollment performed by home-care nurses were used. Barthel Index[10] consists of 10 items, including feeding, bathing, grooming, dressing, bowel control, bladder control, toilet use, transfers, mobility on level surfaces and stairs. Total scores range from 0 to 100, and higher scores indicate better capacity to perform ADL. Patients scoring between 0 and 20 are regarded as totally dependent, 21–60 as severely dependent, 61–90 as moderately dependent, 91–99 as slightly dependent and 100 as independent.[11]

2.3.2. Eastern Cooperative Oncology Group Scale of Performance

The Taiwanese version of the Karnofsky Scale uses the same content as the Eastern Cooperative Oncology Group Scale of Performance Status, which measures functional status. For ease of application, we used the Karnofsky Scale with the Eastern Cooperative Oncology Group scoring system. In Taiwan, patients with an Eastern Cooperative Oncology Group score of ≥ 3 are eligible for long term care services. Scores range from 0 to 5. Patients scoring 3 are regarded as capable of only limited selfcare and 4 as completely disabled.[12]

2.3.3. Norton Scale

The Norton scale[13] is an indicator of pressure injury and is used to examine physical condition, mental condition, activity, mobility, and incontinence. Scores range from 5 (high risk) to 20 (very low risk), and a total score of ≤ 12 indicates that the patient is at high risk of developing pressure injuries.

2.4. Clinical outcome measurement

Two major clinical outcome indicators were used in the study: mortality and care duration.

2.5. Statistical analyses

We performed a descriptive analysis of the participants and the causes of death for those who had passed away. We then determined the mortality rate using variables including sex, age, living arrangements, floor of residence, main caregiver, tube types, number of tubes, Barthel Index, Norton scale, and Eastern Cooperative Oncology Group Scale of Performance Status scores. Univariate Cox regression analyses were performed to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs), and ANOVA (analysis of variance) and t tests were performed to determine p values. Trend tests were performed to examine correlations between variates and

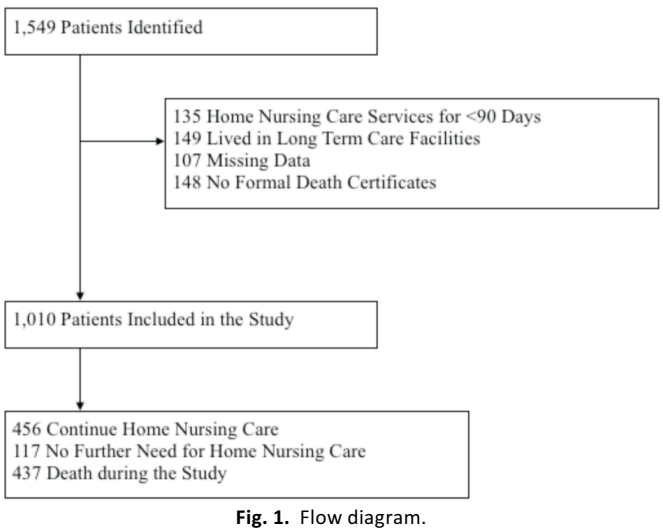

Fig. 1. Flow diagram.

mortality; please refer to supplement 1. Crude survival was estimated using the Kaplan-Meier method, stratified according to different variates including Eastern Cooperative Oncology Group Scale of Performance Status and Barthel Index.

Cox proportional hazard regression analyses were performed using the following three models. Model 1 was constructed using Eastern Cooperative Oncology Group Scale of Performance Status or Barthel Index as the independent variable. It was adjusted for age, sex, main caregiver, living arrangements, and floor of residence. Model 2 was adjusted for the number of tube placements in addition to the independent variables included in Model 1. Model 3 was adjusted for Norton scale scores in addition to the independent variables included in Model 2. The survival time was measured in days. All analyses were performed using IBM SPSS Statistics Version 22 (release 22.0.0.0). p values (two-tailed) of < 0.05 were considered statistically significant.

The study complied with the Declaration of Helsinki, and received approval of the institutional review board at the hospital at which participants were patients (No. 17MMHIS123).

3. Results

In total, data for 1,010 participants were analyzed, and their baseline characteristics are shown in Table 1. Participants' median age was 81.95 years (interquartile range: 75.08–87.13 years). Most participants were women (57.72%) and > 70% were aged ≥ 75 years. The median follow up time was 536 days (interquartile range: 281.75–982.25 days). At the end of the study, 456 patients (45.15%) continued to receive home nursing, 437 had died (43.27%), and 117 did not need further home nursing (11.58%). In addition, 58.42% of patients received care from family members or friends, and > 90% lived with family members or friends.

The home-care initial assessments revealed that 758 patients had Norton scale of ≤ 12 (75.05%), 894 had Barthel Index of 0–20 (88.51%), and 831 had Eastern Cooperative Oncology Group Scale of Performance Status of 4 (82.28%). The most common tube required was the nasogastric tube (66.53%) followed by Foley (48.22%), tracheostomy (6.83%), and cystostomy (2.08%) tubes. Approximately 61.88% of participants had one tube, with a median of 1 tube across the study population.

3.1. Mortality rate for home nursing patients in Taiwan

During the follow-up period (median duration: 536 days, total person years: 1,954), 437 deaths (43.27%) were reported, which corresponded to a mortality rate of 223.80/1,000 person years. Of these, 265 (60.64%), 56 (12.81%), 38 (8.70%), 24 (5.49%), 22 (5.03%), 15 (3.43%), 17 (3.89%) were due to infectious disease, cancer, heart disease, kidney disease, respiratory disease, cerebrovascular disease, and other causes, respectively.

3.2. Risk factors for mortality

HRs and 95% CIs for the associations between the variables and all causes of mortality are reported in Table 2. Patients who were men (HR = 1.39, 95% CI = 1.15–1.68), were older (HR = 1.02, 95% CI = 1.01–1.03), had lower Barthel Index (0–20, HR = 1.49, 95% CI = 1.07–2.08), and had higher Eastern Cooperative Oncology Group Scale of Performance Status (4, HR = 1.40, 95% CI = 1.07–1.83) were at greater risk of mortality. There were no significant differences according to tube type or number, main caregiver, living arrangements, or floor of residence.

Fig. 2 shows the Kaplan-Meier survival curve for the lower and higher Barthel Index groups (i.e., scores of 0–20 and 21–60, respectively) over time. Although both curves decreased throughout the follow-up period, the reduction in the lower Barthel Index group was greater relative to that observed in the higher Barthel Index group (p value for log-rank test = 0.02). Fig. 3 shows the Kaplan-Meier survival curve for the Eastern Cooperative Oncology Group groups (i.e., scores of 3 and 4, respectively) over time. As with the overall results, both curves decreased over the observation period; however, the reduction observed in participants with higher Eastern Cooperative Oncology Group Scale of Performance Status was greater relative that observed in participants with lower scores (p value for the log-rank test = 0.01).

3.3. Multivariate analysis

To control for the influence of various covariates on mortality, we constructed and analyzed three Cox proportional hazard regression models; the results are shown in Table 3.

Table 1
Subjects' basic characteristics.

Baseline characteristics	Total	Percentage
n (%)	1,010	(100%)
Sex		
Female	583	(57.72%)
Male	427	(42.28%)
Age, median (interquartile range)	81.95	(75.08–87.13)
Age groups		
< 75 y	250	(24.75%)
75–84 y	411	(40.69%)
≥ 85	349	(34.55%)
Care duration (median number of days; interquartile range)	536	(281.75–982.25)
At the end of study		
Continue home nursing care	456	(45.15%)
No further need for home nursing care	117	(11.58%)
Death	437	(43.27%)
Main caregivers		
Family or friends	590	(58.42%)
Trained health personnel	420	(41.58%)
Living arrangement		
With family or friends	916	(90.69%)
Only with trained health personnel	94	(9.31%)
Floor of residence		
Ground floor	263	(26.04%)
Second floor or higher with elevator access	374	(37.03%)
Second floor or above without elevator access	373	(36.93%)
Norton scale score		
> 12	252	(24.95%)
≤ 12	758	(75.05%)
Barthel Index score		
0–20	894	(88.51%)
21–60	116	(11.49%)
ECOG score		
3	179	(17.72%)
4	831	(82.28%)
Tubes		
NG	672	(66.53%)
Foley	487	(48.22%)
Cystostomy	21	(2.08%)
Tracheostomy	69	(6.83%)
Number of tubes		
0	85	(8.42%)
1	625	(61.88%)
2	276	(27.33%)
3	24	(2.38%)

Table 2
Unadjusted mortality according to sociodemographic characteristics and risk factors.

Variables	Total	Death no. (%)	Mortality rate (/1,000 person-years)	HR (95% CI)	p value
Age (Continuous variable)				1.02 (1.01–1.03)	< 0.01
Sex					
Female	583	232 (39.8)	194.95	1.00	
Male	427	205 (48.0)	268.81	1.39 (1.15–1.68)	< 0.01
Types of tubes					
Nasogastric tubes	672	291 (43.3)	223.92	1.00 (0.82–1.22)	0.99
Without nasogastric tubes	338	146 (43.2)	223.57		
Foley	487	208 (42.7)	221.85	0.98 (0.82–1.19)	0.89
Without Foley	523	229 (43.8)	225.60		
Cystostomy	21	7 (33.3)	181.60	0.83 (0.39–1.75)	0.62
Without cystostomy	989	430 (43.5)	224.65		
Tracheostomy	69	32 (46.4)	234.55	1.05 (0.74–1.51)	0.78
Without tracheostomy	941	405 (43.0)	222.99		
No. of tube placements					
0	85	42 (49.4)	265.39		
1	625	262 (41.9)	214.63	0.82 (0.59–1.13)	0.22
2	276	123 (44.6)	232.28	0.89 (0.62–1.26)	0.49
3	24	10 (41.7)	226.71	0.85 (0.43–1.69)	0.64
Barthel index score					
0–20	894	399 (44.6)	233.41	1.49 (1.07–2.08)	0.02
21–60	116	38 (32.8)	156.24		
Norton scale score					
> 12	252	108 (42.9)	219.81		
≤ 12	758	329 (43.4)	225.14	1.02 (0.82–1.27)	0.85
ECOG					
3	179	62 (34.6)	169.44		
4	831	375 (45.1)	236.33	1.40 (1.07–1.83)	0.01
Main caregivers					
Family or friends	590	258 (43.7)	233.33		
Trained health personnel	420	179 (42.6)	211.36	0.90 (0.74–1.09)	0.26
Living arrangement					
With family or friends	916	400 (43.7)	227.11		
Only with trained health personnel	94	37 (39.4)	193.33	0.84 (0.60–1.18)	0.32
Floor of residence					
Ground floor	263	114 (43.3)	222.46		
Second floor or above with elevator access	374	167 (44.7)	241.40	1.10 (0.86–1.39)	0.45
Second floor or above without elevator access	373	156 (41.8)	208.44	0.93 (0.73–1.19)	0.57

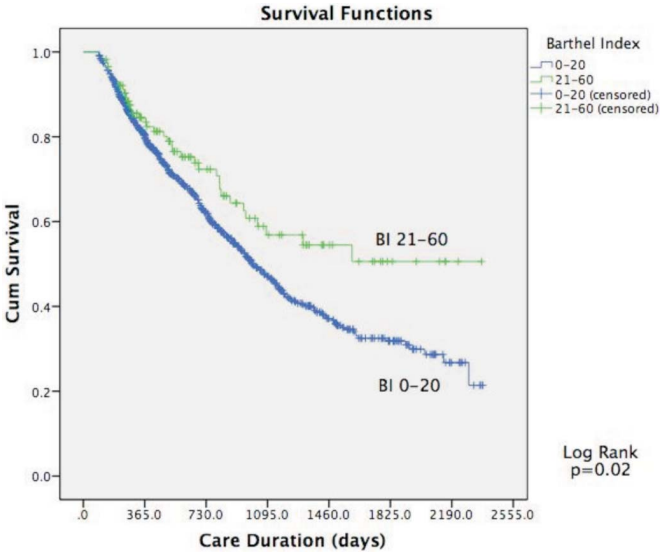

Fig. 2. Kaplan-Meier survival curves for patients' Barthel Index scores. Follow-up began on the 90th day of home nursing service use.

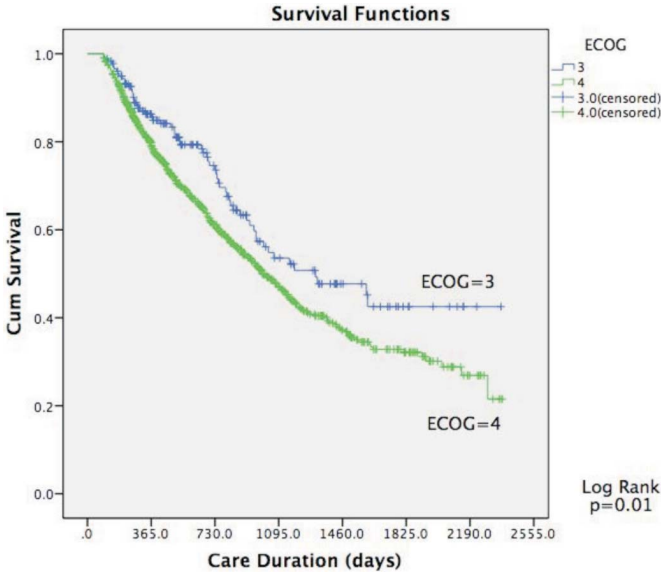

Fig. 3. Kaplan-Meier survival curves for patients' Eastern Cooperative Oncology Group Scale of Performance Status scores. Follow-up began on the 90th day of home nursing service use.

In Model 1, we analyzed HRs for mortality, including Barthel Index and Eastern Cooperative Oncology Group Scale of Performance Status scores, after adjusting for age, sex, main caregiver, living arrangements, and floor of residence. The mortality risk increased with age (Barthel Index groups: HR = 1.03, 95% CI: 1.02–1.04; similar results were observed in the Eastern Cooperative

Table 3
Risk factors for mortality with Cox regression analysis

	Unadjusted		Model 1		Model 2		Model 3	
	HR[‡] (95% CI[§])	p value	HR (95% CI)	p value	HR (95% CI)	p value	HR (95% CI)	p value
BI[†]: 0–20 (ref 21–60)	1.49 (1.07–2.08)	0.02	1.59 (1.14–2.22)	< 0.01	1.75 (1.23–2.50)	< 0.01	1.97 (1.33–2.93)	< 0.01
	Unadjusted		Model 1		Model 2		Model 3	
	HR (95% CI)	p value	HR (95% CI)	p value	HR (95% CI)	p value	HR (95% CI)	p value
ECOG[¶]: 4 (ref: 3)	1.40 (1.07–1.83)	0.01	1.46 (1.11–1.91)	< 0.01	1.54 (1.16–2.04)	< 0.01	1.71 (1.23–2.36)	< 0.01

Model 1: adjusted for age, sex, main caregiver, living arrangements, and floor of residence.
Model 2: Model 1 + adjusted for the number of tubes.
Model 3: Model 2 + adjusted for Norton scale scores.
[†]: Barthel Index, [‡]: hazard ratio, [§]: confidence interval, [¶]: Eastern Cooperative Oncology Group score.

Oncology Group groups), and male sex was also associated with higher risk of mortality (HR: 1.59, 95% CI: 1.31–1.93 in the Barthel Index groups; similar results were observed in the Eastern Cooperative Oncology Group groups). After adjusting for age, sex, main caregiver, living arrangements, and floor of residence, the risk of mortality remained higher in the lower Barthel Index (reference range: 20–60; HR for 0–20 = 1.59, 95% CI: 1.14–2.22) and higher Eastern Cooperative Oncology Group (reference range: 3; HR for 4 = 1.46, 95% CI: 1.11–1.91) groups, relative to those observed in the higher Barthel Index and lower Eastern Cooperative Oncology Group groups, respectively.

To examine the effects of tube placement on mortality, we included the number of tubes in Model 2 and found that this was not a risk factor for mortality. The effects of most other covariates remained similar; however, the HRs for Barthel Index and Eastern Cooperative Oncology Group Scale of Performance Status increased with the inclusion of the number of tubes. In Model 3, which included Norton scale, the results were similar to those of Model 2; therefore, these scores were not a risk factor for mortality. Model validation showed that the ratio of the hazards is constant over time, please refer to supplement 1.

4. Discussion

The survey data were used to estimate the study population's mortality rate (223.80/1,000 person years) and revealed that poorer functional status was associated with higher all-cause mortality in patients receiving home nursing. Most long-term care recipients in Taiwan prefer living at home, as opposed to long term care facilities; therefore, these findings could make an important contribution to the development of health-care policies regarding populations receiving home nursing.

4.1. Mortality rate

Previous studies have shown that risk factors for mortality differed between home-care and institutional populations. The mortality rate for home nursing patients in the current study was similar to that reported in a previous Taiwanese study with a mortality rate of 258/1,000 person years.[4] In contrast, institutional residents in Taiwan exhibit lower mortality rates, which range from 68 to 220.0/1,000 person years;[4,14] however, studies conducted in the UK have reported the opposite, in that institutional residents exhibited higher mortality rates.[15,16] There are several possible reasons for this discrepancy. For example, the health conditions of Taiwanese home nursing patients were poorer relative to those of UK patients, as the latter had fewer diseases, were prescribed fewer classes of drugs, and were younger relative to the former;[17] moreover, UK home-care patients' ADL scores were similar to those of institutionalized Taiwanese patients,[2,5] which could be explained by the care preferences of Taiwanese patients. In addition, the basic characteristics of the study populations, including race, demographic and socioeconomic conditions; medical systems; and care cost and quality, differed between countries.

4.2. Risk factors for mortality

Previous survival models have shown that ADL-limitation stages predicted mortality, even after adjusting for the effects of sex, cancer, stroke, and ADL performance.[5] Further, several factors, including sex, age, comorbidity, number of previous hospital admissions, and the severity of pressure injuries, have been found to exert a significant effect on mortality risk in home-care patients.[4,18] Moreover, factors influencing mortality risk in institution-based patients include sex, age, number of tubes, and level of functional disability.[4,9,19]

4.3. Barthel Index (ADL)

According to the multiple logistic regression analyses, the HR for individuals with poorer ADL performance was higher. Studies conducted in the USA and China revealed that ADL and IADL influenced both short- and long-term mortality.[5,6] In the current study, after adjusting for the number of tubes needed, living arrangements, main caregiver, and the quality of care, the effect of ADL on mortality increased. Due to limitation of our database, data of IADL was unavailable. Further research is required to analyze the effect of IADL on mortality.

4.4. Eastern Cooperative Oncology Group

To our knowledge, this was the first study to examine associations between Eastern Cooperative Oncology Group performance status and mortality in a long-term care population. After adjusting for multiple variables, the effect of Eastern Cooperative Oncology Group performance status was found to increase. In Taiwan, Eastern Cooperative Oncology Group Scale of Performance Status score (≥ 3) is one of the criteria used to determine whether patients require long term care. It is important that models that predict mortality in long term care populations are developed in future. Such models could be useful in planning long term care services' scope and identifying high-risk individuals.

4.5. Tubes

Unlike previous studies that reported that the number of tubes influenced mortality risk,[9,20] the current results showed that this effect was nonsignificant. Studies conducted in Israel, Korea, Japan,

and Poland have reported higher incidence of pneumonia, higher mortality rates, and lower functional levels in individuals who had Foley, tracheotomy, and/or nasogastric tubes in long term care facilities or hospitals.[7,8,21,22] Further, a 5-year cohort study conducted in Taiwan showed that patients receiving institution-based services who had a higher number of tubes exhibited a significantly higher mortality risk relative to those of other patients.[9] However, in the current study, the effect of tube placement remained non-significant after adjusting for age, sex, main caregiver, living arrangements, and care quality. Further prospective studies are required to clarify the clinical impact of tube placement on individuals receiving home nursing.

4.6. Environment

In the current study, living arrangements, floor of residence, and main caregiver did not exert significant effects on mortality. The Swiss National Cohort reported that mortality rates decreased as floor of residence increased; this effect was significant when comparing individuals who lived on the ground floor with those who lived on the eighth floor or above.[23] However, in the current study, home nursing patients were categorized into those who lived on the ground floor, those who lived on the second floor or higher with access to an elevator, and those who lived on the second floor or higher without access to an elevator.

Furthermore, previous studies have shown that mortality was affected by living arrangements, particularly living alone, in older adults and community-dwelling individuals.[24,25] Long term care patients usually live with family members or trained health personnel and seldom live alone; however, few studies have examined living arrangements or caregiver situations in long term care populations. Thus, further research is required to clarify this.

The study was subject to some limitations that should be noted. For example, the reported mortality rate could have been underestimated, as patients without formal death certificates were excluded from the analysis; however, we felt that it was important to examine accurate causes of death. Further, additional variables, such as baseline diagnosis of chronic diseases, IADLs, marital status, education status, cognition, nutritional status and history of falls could have been associated with the outcomes, but this information was not available in our dataset as mentioned before. Our data exclusively came from administrative data, which may have limited the reliability. Moreover, the results apply only to Northern Taiwanese, community-dwelling adults receiving home nursing and cannot be generalized to other populations, as this was a regional, single-center study. Individuals living in other areas could exhibit different mortality and lesser healthcare-service utilization rates.[26] Due to limited data about mortality in the target population, we could not further present how representative our study is.

In conclusion, the current results showed that higher Eastern Cooperative Oncology Group Scale of Performance Status scores, lower Barthel Index scores, older age, and male sex were associated with higher mortality risk. In addition, Eastern Cooperative Oncology Group Scale of Performance Status scores could be suitable for use in developing models to predict mortality in long term care populations. Moreover, tube placement did not affect mortality for any variables, which was inconsistent with the findings of previous studies.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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Supplement 1

Trend tests for covariates

Trend tests for number of tube placement were performed with ANOVA to show significant changes between groups (p trend between groups, linear, unweighted). For Barthel Index, ECOG and Norton score, t tests were performed.

Table S1
Trend tests for covariates with the mortality

	p trend
Number of tubes	0.92
Barthel Index	0.19
ECOG	0.25
Norton score	0.83

Proportional hazards assumptions of Cox regression

The proportional hazards assumptions of Cox regression mean that the ratio of the hazards for any two individuals is constant over time. Figs. S1 and S2 show Log Minus Log functions for model validation in the Barthel Index and the Eastern Cooperative Oncology Group scale groups. The two curves are parallel, then the hazards can be considered proportional.

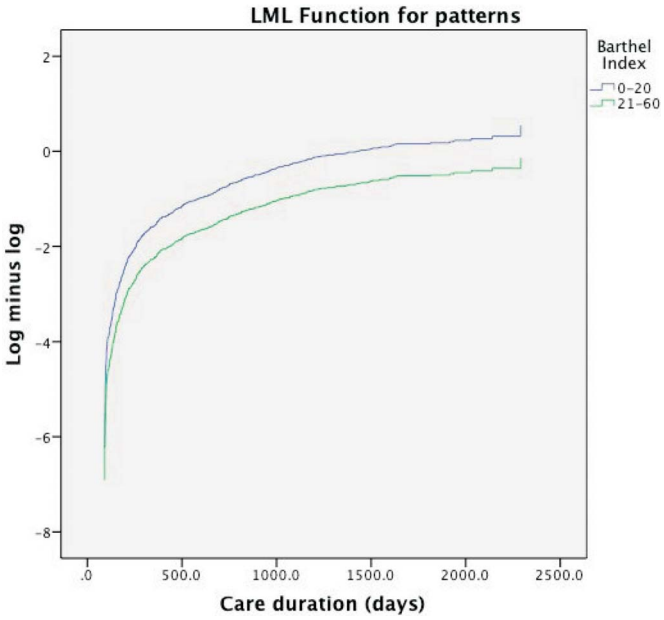

Fig. S1. Log Minus Log Function for Cox regression in the Barthel Index group.

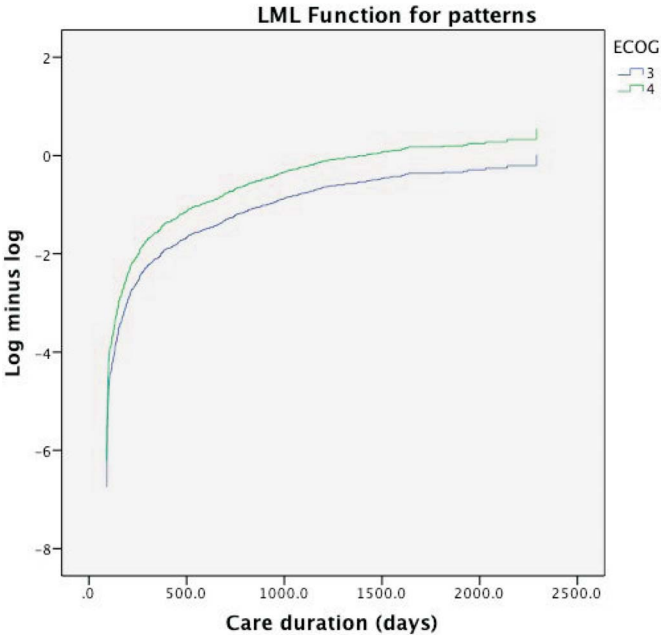

Fig. S2. Log Minus Log Function for Cox regression in the Eastern Cooperative Oncology Group scale group.