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Potentially avoidable hospitalizations, non-potentially avoidable hospitalizations and in-hospital deaths among residents of long-term care facilities

Boyoung Jeon,[1,2] Nanako Tamiya,[1,3] Satoru Yoshie,[1,4,5] Katsuya Iijima[4] and Tatsuro Ishizaki[1,6]

[1]Department of Health Services Research, Faculty of Medicine, University of Tsukuba, Tsukuba, Ibaraki, Japan
[2]Division of Health Service for the Disabled, National Rehabilitation Center, Seoul, Republic of Korea
[3]Health Services Research & Development Center, University of Tsukuba, Tsukuba, Ibaraki, Japan
[4]Institute of Gerontology, The University of Tokyo, Tokyo, Japan
[5]Department of Health Policy and Management, School of Medicine, Keio University, Tokyo, Japan
[6]Research Team for Human Care, Tokyo Metropolitan Institute of Gerontology, Tokyo, Japan

Correspondence
Professor Nanako Tamiya MD PhD MSc, Department of Health Services Research, Faculty of Medicine, Health Services Research & Development Center, University of Tsukuba, 1-1-1 Tennodai, Tsukuba City, Ibaraki 305-8577, Japan.
Email: ntamiya@md.tsukuba.ac.jp

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Aim: The present study aimed to examine the percentage of and risk factors for potentially avoidable hospitalizations (PAH), non-PAH and in-hospital deaths among residents of special nursing homes for the elderly (SNH) and geriatric health service facilities (GHSF).

Methods: Long-term care and national health insurance claims data (April 2012 to September 2013) were obtained from a suburban city in Chiba prefecture, Japan. Study participants were aged ≥75 years and resided in either SNH (n = 1138) or GHSF (n = 885). The PAH were defined using 17 medical condition groups, and the percentage of PAH, non-PAH and in-hospital deaths was identified, and associated factors were compared using multilevel logistic regression models for SNH and GHSF, respectively.

Results: A total of 34.5% SNH residents experienced any hospitalization, and this was composed of PAH (16.3%), non-PAH (12.2%) or in-hospital deaths (6.1%). Of the GHSF residents, 23.8% experienced any hospitalization, and this was comprised of PAH (9.5%), non-PAH (10.6%) and in-hospital death (3.7%). More than 70% of the PAH were related to respiratory infections, urinary tract infections or congestive heart failure. In both SNH and GHSF, artificial nutrition was positively associated with PAH and non-PAHs, and male sex was positively associated with non-PAHs and in-hospital deaths. However, there were also discrepancies between SNH and GHSF in terms of risk factors for PAH.

Conclusions: The percentage of PAH was higher in SNH than in GHSF, which might be related to their different personnel and managerial regulations. The linkage of health and long-term care claims data might facilitate data-based evidence on policy-making. **Geriatr Gerontol Int 2018; 18: 1272–1279.**

Keywords: health services research, hospitalization, long-term care, nursing homes, quality of care.

Introduction

In 2014, more than half of healthcare expenditures of individuals who were aged ≥75 years in Japan were related to inpatient care.[1] In addition, hospitalization is associated with increased risks of iatrogenic disorders and cognitive decline among older people, especially individuals who are admitted to nursing homes.[2] Potentially avoidable hospitalizations (PAH) from long-term care facilities (LTCF) can be caused by a wide range of conditions, including ambulatory care-sensitive conditions, inadequate assistance with daily activities, infectious diseases and complications of chronic conditions.[3] Prevention of unnecessary hospitalizations is emphasized; for example, the PAH have been used as one of the domains for a performance-based incentive program in the USA since 2009.[4,5]

In Japan, a mandatory public long-term care insurance (LTCI) system was introduced in 2000,[6] about 40 years after the achievement of universal health coverage in 1961.[7] Approximately 18.2% of individuals aged ≥65 years are eligible for the LTCI system, with 18% of LTCI beneficiaries using facility services, accounting for 34.1% of total LTCI expenditures in 2014.[8] The LTCI system includes three types of LTCF: special nursing homes for the elderly (SNH), geriatric health service facilities (GHSF) and sanatorium-type medical care facilities.[8] The present study focused on SNH and GHSF, because sanatorium-type facilities are operated as “long-term care units” of designated hospitals, and the sample size was <30 in our dataset.[9,10]

In this context, SNH provide services to older people who have limitations in their daily activities, and physicians work for contract-based visits.[9] Residents who require acute care can freely access outpatient care without financial regulations by the government, and they can return to the original SNH if they are hospitalized for <3 months.[11] In contrast, GHSF employ at least one full-time physician, and their residents have limited access to outpatient care, because they only receive limited benefits from the

Table 1 Definition of potentially avoidable hospitalizations from long-term care facilities

Medical condition groups†	Diagnoses (ICD-10 codes)
Respiratory infection (acute bronchitis, pneumonia)	Acute bronchitis: J20, J21, Pneumonia (bacterial): J11, J12, J13, J14, J15, J16, J17, J18, Pneumonia: J69
Congestive heart failure	I50
Urinary tract infection	Infections of kidney: N11, N15, N28, N12, N16 Cystitis: N30, Urethral abscess: N34, Urethral stricture due to infection: N35, N37, Urinary tract infection: N39, Inflammation of prostate: N41, N51, N42, N43, N45
Weight loss and malnutrition	Anorexia, abnormal weight loss, underweight, feeding difficulties: R63, Dysphagia: R13, Nutritional marasmus: E41, Unspecified protein-calorie malnutrition: E46, Other nutritional deficiencies: E63
Hypertension	I10, I11, I12, I13, I15
Falls or fracture (excluding fracture from motor vehicle accidents)	W01, W05–W08, W10, W18, W19, and S02, S12, S22, S32, S42, S52, S62, S72, S82, S92
Diarrhea, gastroenteritis, *Clostridium difficile*	Diarrhea, gastroenteritis: A02, A03, A05, A06, A07, A09, K52, R19 *C. difficile*: A04
COPD, asthma	J40, J41, J42, J43, J44, J45, J46, J47, J60, J61, J62, J63, J64, J65, J66, J67
Skin ulcers, cellulitis	Skin ulcers: L03, L97, M60, M86, R02, S91, T13, T81, T87 Cellulitis: L03, K12, L04, L08
Altered mental status, acute confusion, delirium, psychosis, agitation, organic brain syndrome	F03, F05, F19, F01, F06, F22, F24, F23, F32, F33, F28, F44, F29
Electrolyte imbalance (dehydration, volume depletion, hyponatremia)	E86, E87
Constipation/fecal impaction/obstipation	K56, K59
Seizures	G40, R56
Sepsis	A40, A41
Diabetes (poor glycemic control)	E10, E11
Anemia	Iron deficiency anemias: D50, Other deficiency anemias: D51, D52, D53, Acute post-hemorrhagic anemia: D62, Anemia of chronic illness: D63
Acute renal failure	N17, N25

†This study used three digits of ICD-10 codes of primary diagnosis information (if a person has multiple primary diagnoses, the maximum of two diagnoses were included) in the Japanese health insurance claims data. The definitions of each medical condition groups were modified from previous studies.[3,11–14]

public health insurance during their GHSF stay.[9] Thus, we hypothesized that SNH residents would have a higher likelihood of hospitalization, compared with GHSF residents.

The linking of LTCI and health insurance claims data is required to make proper evaluations for quality of LTCF, but there were insufficient empirical studies that used both datasets. If there is no linkage between LTCI and health insurance, it shows only a one-sided aspect; for example, whether residents stopped the long-term care service or not, without considering medical needs or transfer to hospitals. As quality of care has become a policy issue, assessment of LTCF by applying health insurance information would provide fruitful evidence for the Japanese LTCI system. Therefore, the present study aimed to identify the percentage of and risk factors for PAH, non-PAH, and in-hospital deaths among residents of SNH and GHSF.

Methods

Data source

The present study used administrative claims data from the LTCI and the medical care system for elderly in the latter stage of life (MSLS), which is covering all individuals aged ≥75 years.[1] These data were collected between April 2012 and September 2013 in a suburban city of Chiba prefecture, Japan, which has a population of approximately 400 000.[12] Among 13 004 individuals on the LTCI database who were aged ≥40 years, we included 2280 individuals who were admitted to LTCF in Chiba prefecture before September 2013. Information on hospitalizations and comorbidities was obtained from health insurance claims data from the MSLS. To define the PAH, we used only inpatient data, whereas to detect comorbidities, both inpatient and outpatient data were used.

After we merged LTCI and health insurance on the MSLS, we followed the residents' hospitalizations, such as admission to diagnosis procedure combination (DPC) hospitals and non-DPC hospitals, using the information of inpatient date from claims data. We excluded individuals who were aged <75 years (n = 186), had missing LTCI eligibility data (n = 29), resided in sanatorium-type medical care facilities (n = 29), support-needs level (n = 2), had a facility length of stay (LOS) of <2 days (n = 2) or outliers for hospital bed days with >180 days for the first admission (n = 9). Thus, 2023 individuals were included in the final analyses. These individuals were composed of 1138 residents in 49 SNH and 885 residents in 43 GHSF. The study's protocol was approved by the ethics committee of University of Tsukuba (no. 1185).

Dependent variables

Hospitalizations from LTCF were defined as hospitalizations that occurred between the first day of admission to the LTCF and the

Table 2 Baseline characteristics of residents according to facility type

		Special Nursing Homes for the elderly				Geriatric Health Service Facilities			
		All residents (*n* = 1138)		Hospitalized (*n* = 393)		All residents (*n* = 885)		Hospitalized (*n* = 211)	
		n	%	*n*	%	*n*	%	*n*	%
Sex	Men	225	19.8	95	24.2	276	31.2	77	36.5
	Female	913	80.2	298	75.8	609	68.8	134	63.5
Age group	75–84 years	289	25.4	94	23.9	294	33.2	64	30.3
	≥85 years	849	74.6	299	76.1	591	66.8	147	69.7
Income level	Low income	66	5.8	22	5.6	32	3.6	5	2.4
	Middle and high income	1072	94.2	371	94.4	853	96.4	206	97.6
LTCI care needs level†	Care needs level 1	37	3.3	6	1.5	58	6.6	4	1.9
	Care needs level 2	100	8.8	28	7.1	146	16.5	25	11.8
	Care needs level 3	256	22.5	76	19.3	224	25.3	42	19.9
	Care needs level 4	330	29.0	98	24.9	230	26.0	57	27.0
	Care needs level 5	415	36.5	185	47.1	227	25.6	83	39.3
Physical functioning condition	Independent and mild	310	27.2	80	20.4	207	23.4	30	14.2
	Moderate	522	45.9	165	42.0	463	52.3	98	46.4
	Severe	306	26.9	148	37.7	215	24.3	83	39.3
Cognitive condition	Independent and mild	340	29.9	102	26.0	395	44.6	72	34.1
	Moderate	474	41.7	157	39.9	337	38.1	88	41.7
	Severe	324	28.5	134	34.1	153	17.3	51	24.2
Catheter	Yes	39	3.4	22	5.6	56	6.3	10	4.7
Artificial nutrition	Yes	81	7.1	56	14.2	77	8.7	39	18.5
Dialysis‡	Yes	0	0.0	0	0.0	11	1.2	0	0.0
Pressure ulcer	Yes	60	5.3	28	7.1	45	5.1	14	6.6
Eyesight problem	Yes	515	45.3	186	47.3	306	34.6	87	41.2
Hearing problem	Yes	646	56.8	222	56.5	432	48.8	104	49.3
Comorbidities§	None	773	67.9	274	69.7	625	70.6	173	82.0
	One	213	18.7	60	15.3	170	19.2	28	13.3
	Two or more	152	13.4	59	15.0	90	10.2	10	4.7
Prior hospitalizations‡	Yes	36	3.2	0	0.0	161	18.2	3	1.4
Length of stay at facility	<90 days	70	6.2	25	6.4	176	19.9	37	17.5
	90–179 days	88	7.7	20	5.1	129	14.6	23	10.9
	180–359 days	152	13.4	52	13.2	212	24.0	60	28.4
	≥360 days	828	72.8	296	75.3	368	41.6	91	43.1
No. residents		1138	100.0	393	100.0	885	100.0	211	100.0

†Total *n* = 2023. The care needs level was not included in the regression models because of multicollinearity, as it is a composite measure of the other variables. ‡Dialysis and prior hospitalization was not included in the regression models due to the small sample size. §The number of comorbidities was counted among the 15 lists of the Charlson Comorbidity Index,[16] including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, liver disease (mild, moderate/severe), diabetes mellitus (without and with complications), hemiplegia, renal disease (moderate/ severe), any tumor/leukemia/lymphoma, metastatic solid tumor and AIDS.

third day after discharge from the LTCF.[4] Only the first admission was analyzed in cases with multiple hospitalizations. The dependent variables were defined using diagnoses and discharge information. Among multiple claims data within one hospitalization, we picked up only primary diagnosis (if “syusyobyo” = 1). However, there were patients with multiple “primary diagnoses” within a same claim code; for them, a maximum of two diagnoses were included, adopting a former study that used primary/secondary diagnoses.[4] We assumed that the inclusion of two primary diagnoses was valid to define medical condition groups, as majority of patients had one or two diagnoses (452/567, 80%) in non-DPC hospitals. A total of 17 medical condition groups were used to define PAH based on the concepts from the American Centers for Medicare & Medicaid Services.[3,5] Because the Centers for Medicare & Medicaid Services' definition used ICD-9 codes,[3] we redefined them using ICD-10 codes, in accordance with the Japanese health insurance system (Table 1).[3,13–16] In contrast, cases with PAH and coexisting conditions (e.g. cerebrovascular disease, admission to DPC hospitals, cancer or leukemia, ischemic heart disease and peptic ulcer disease) were classified as non-PAH. All other hospitalizations, except for PAH, were defined as non-PAH. In-hospital deaths were identified from death records in the discharge registry.

Independent variables

The independent variables included sociodemographic characteristics, functional and health conditions, and facility LOS. The sociodemographic characteristics were sex, age group and income level. Low income was defined based on stage 1–3 insurance premiums of LTCI, whereas middle and high income was stage ≥4 insurance premiums.

Baseline functional and health conditions were evaluated using LTCI eligibility data (2012–2013). These data were from a nationally standardized needs certification system, which determines the individual care needs level.[17] Physical functioning was divided into independent/mild (J1–A2), moderate (B1–B2) and severe (C1–C2), whereas cognitive functioning was divided into independent/mild (Ia–IIb), moderate (IIIa–IIIb) and severe (IV–M). Medical needs were identified based on the use of catheters (e.g. indwelling catheter, urinary tract stoma etc.), artificial nutrition (e.g. tube feeding or total parenteral nutrition), dialysis and treatment of pressure ulcers. Eyesight problems and hearing problems were treated as

Table 3 Reasons for hospitalizations: Distribution of medical condition groups among residents of special nursing homes for the elderly and geriatric health service facilities

	Special nursing homes for the elderly (n = 1138)		Geriatric health service facilities (n = 885)	
	n	(%)	*n*	(%)
Hospitalizations	393	(34.5)	211	(23.8)
Potentially avoidable hospitalizations	185	(16.3)	84	(9.5)
Non-potentially avoidable hospitalizations	139	(12.2)	94	(10.6)
In-hospital deaths	69	(6.1)	33	(3.7)
Distribution of medical condition groups				
Potentially avoidable hospitalizations	185	(100.0)	84	(100.0)
Respiratory infection (acute bronchitis, pneumonia)	79	(42.7)	43	(51.2)
Urinary tract infection	36	(19.5)	7	(8.3)
Congestive heart failure	19	(10.3)	11	(13.1)
Hypertension	18	(9.7)	6	(7.1)
Falls or fracture (excluding motor vehicle accidents)	15	(8.1)	5	(6.0)
Weight loss and malnutrition	12	(6.5)	5	(6.0)
Diarrhea, gastroenteritis, *Clostridium difficile*	12	(6.5)	2	(2.4)
Chronic obstructive pulmonary disease, asthma	8	(4.3)	3	(3.6)
Skin ulcers, cellulitis	7	(3.8)	4	(4.8)
Altered mental status, acute confusion, delirium, psychosis, agitation, organic brain syndrome	4	(2.2)	6	(7.1)
Electrolyte imbalance (dehydration, volume depletion, hyponatremia)	6	(3.2)	3	(3.6)
Constipation/fecal impaction/obstipation	3	(1.6)	0	(0.0)
Seizures	3	(1.6)	0	(0.0)
Sepsis	1	(0.5)	1	(1.2)
Diabetes (poor glycemic control)	0	(0.0)	1	(1.2)
Anemia	0	(0.0)	0	(0.0)
Acute renal failure	0	(0.0)	0	(0.0)
Non-potentially avoidable hospitalizations	139	(100.0)	94	(100.0)
Cerebrovascular disease	45	(32.4)	31	(33.0)
Admission to DPC hospitals	22	(15.8)	15	(16.0)
Cancer, leukemia	14	(10.1)	9	(9.6)
Ischemic heart disease	10	(7.2)	4	(4.3)
Peptic ulcer disease	6	(4.3)	3	(3.2)
In-hospital deaths	69	(100.0)	33	(100.0)
Deaths within 1 day for in-hospital deaths	8	(11.6)	3	(9.1)

DPC, diagnosis procedure combination.

dichotomous variables. We did not include the care needs level in the regression models because of multicollinearity, as those levels are composite scores of the other variables.

Health insurance claims data on the MSLS were used to identify the number of comorbidities based on the Charlson Comorbidity Index lists, with the numbers categorized as 0, 1 or ≥2.[18] These comorbidities were identified during the 1 year before facility admission, in both inpatient and outpatient care.[19] Because there were difficulties in separating "diabetes without or with complications" and "mild or moderate/severe liver disease," we counted the comorbidities among 15 medical condition groups, instead of applying the Charlson Comorbidity Index scores. Prior hospitalization was defined as any hospitalization 90 days before the LTCF admission.[19] Facility LOS was classified as <90 days, 90–179 days, 180–359 days or ≥ 360 days. In cases with hospitalization during their facility admission, the number of hospital bed days was subtracted from the facility LOS.

Statistical analysis

The percentage of PAH, non-PAH and in-hospital deaths was identified in SNH and GHSF. Among residents who experienced PAH or non-PAH, we examined the distributions of medical condition groups, as well as the proportion of deaths within 1 day for in-hospital deaths. For examining risk factors for PAH, non-PAH and in-hospital deaths, we checked whether multilevel modeling was required or not, by estimating how much variation in the dependent variable exists between facility units (level 2) at an unconditional model.[20] After we checked model fit and consistency in single and multilevel logistic regressions, we decided to use a multilevel logistic model as fixed effects for level 1 and random intercept only for level 2.[20] Data processing was carried out using SAS (version 9.3; SAS Institute, Cary, NC, USA) and Stata (version 14.0; StataCorp, College Station, TX, USA).

Results

Table 2 shows that the hospitalized individuals had higher proportions of severe limitations in physical and cognitive functioning, and artificial nutrition. No residents with prior hospitalization were re-hospitalized from SNH, and just three residents were re-hospitalized from GHSF as a result of short follow-up periods.

Table 3 shows that 34.5% of SNH residents experienced hospitalization, comprising 16.3% PAH, 12.2% non-PAH and 6.1% in-hospital deaths. A total of 23.8% of GHSF residents experienced hospitalization, comprising 9.5% PAH, 10.6% non-PAH and 3.7% in-hospital deaths. Compared with the SNH residents, whose average hospital bed days for PAH was 28.1 days, the GHSF residents had more hospital bed days (34.3 days) for PAH (data not shown). In contrast, among in-hospital deaths of residents, the proportion of PAH was higher in SNH; that is, 59.4% compared with 51.5% in GHSF (data not shown). The most common condition of PAH was respiratory infections (42.7% in SNH and 51.2% in GHSF), which was followed by urinary tract infections (UTI; 19.5% in SNH and 8.3% in GHSF) and congestive

Table 4 Factors associated with potentially avoidable hospitalizations, non-potentially avoidable hospitalizations and in-hospital deaths among residents of special nursing homes for the elderly (multilevel model)

		Potentially avoidable hospitalizations *vs* none			Non-potentially avoidable hospitalizations *vs* none			In-hospital deaths *vs* none		
		Estimate	(SE)	*P*-value	Estimate	(SE)	*P*-value	Estimate	(SE)	*P*-values
Level 1: fixed effects										
Sex	Male (ref.)									
	Female	−0.348	(0.247)	0.160	−0.899	(0.252)	0.000	−0.884	(0.303)	0.004
Age group	75–84 years (ref.)									
	≥85 years	0.049	(0.228)	0.828	0.157	(0.251)	0.533	0.833	(0.363)	0.022
Income level	Middle and high income (ref.)									
	Low income	−0.209	(0.388)	0.591	0.0003	(0.441)	1.000	−0.220	(0.627)	0.726
Physical functioning condition	Independent and mild (ref.)									
	Moderate	0.732	(0.246)	0.003	0.220	(0.276)	0.426	0.403	(0.345)	0.244
	Severe	1.226	(0.310)	<0.0001	1.298	(0.331)	<0.0001	0.567	(0.451)	0.209
Cognitive condition	Independent and mild (ref.)									
	Moderate	−0.064	(0.233)	0.783	−0.144	(0.260)	0.581	0.060	(0.330)	0.857
	Severe	0.154	(0.273)	0.574	−0.189	(0.309)	0.541	0.216	(0.377)	0.567
Catheter	Yes (ref. = no)	0.997	(0.495)	0.044	0.869	(0.535)	0.104	0.983	(0.582)	0.092
Artificial nutrition	Yes (ref. = no)	1.408	(0.404)	0.001	1.703	(0.391)	<0.0001	1.252	(0.502)	0.013
Pressure ulcer	Yes (ref. = no)	−0.035	(0.415)	0.932	0.661	(0.417)	0.114	−0.075	(0.617)	0.903
Eyesight problem	Yes (ref. = no)	−0.006	(0.199)	0.977	−0.161	(0.238)	0.499	−0.344	(0.287)	0.232
Hearing problem	Yes (ref. = no)	−0.073	(0.201)	0.717	−0.426	(0.239)	0.076	−0.413	(0.283)	0.145
Comorbidities†	None (ref.)									
	1	−0.400	(0.259)	0.123	−0.334	(0.312)	0.286	−0.541	(0.382)	0.157
	≥2	0.097	(0.293)	0.740	0.675	(0.319)	0.035	−0.522	(0.479)	0.276
Length of stay at facility‡	<90 days (ref.)									
	90–179 days	−0.434	(0.578)	0.454	0.676	(0.937)	0.471			
	180–359 days	0.211	(0.482)	0.661	1.447	(0.833)	0.083			
	≥360 days	0.427	(0.435)	0.326	2.096	(0.796)	0.009			
Level 2: error variance										
Intercept		1.120	(0.512)	0.014	0.509	(0.278)	0.033	0.095	(0.144)	0.255
Model fit	−2 Log likelihood	808.9			647.4			439.3		
No. residents		930			884			814		
No. facilities		48			49			48		

†The number of comorbidities was counted among the 15 lists of the Charlson Comorbidity Index,[16] including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, liver disease (mild, moderate/severe), diabetes mellitus (without and with complications), hemiplegia, renal disease (moderate/ severe), any tumor/ leukemia/ lymphoma, metastatic solid tumor and AIDS. ‡When the dependent variable was in-hospital deaths, we did not include length of stay at facility due to reverse causality. SE, standard error.

Table 5 Factors associated with potentially avoidable hospitalizations, non-potentially avoidable hospitalizations and in-hospital deaths among residents of geriatric health service facilities (multilevel model)

		Potentially avoidable hospitalizations *vs* none			Non-potentially avoidable hospitalizations *vs* none			In-hospital deaths *vs* none		
		Estimate	(SE)	*P*-values	Estimate	(SE)	*P*-value	Estimate	(Standard Error)	*P*-values
Level 1: fixed effects										
Sex	Male (ref.)									
	Female	–0.447	(0.293)	0.127	–0.589	(0.267)	0.028	–1.202	(0.401)	0.003
Age group	75–84 years (ref.)									
	≥85 years	0.418	(0.295)	0.157	0.201	(0.265)	0.449	0.372	(0.438)	0.396
Income level†	Middle and high income (ref.)									
	Low income	0.305	(0.665)	0.647	–0.573	(0.789)	0.468			
Physical functioning condition	Independent and mild (ref.)									
	Moderate	0.199	(0.363)	0.583	0.295	(0.348)	0.397	0.492	(0.540)	0.364
	Severe	0.712	(0.439)	0.105	0.906	(0.417)	0.030	1.075	(0.644)	0.096
Cognitive condition	Independent and mild (ref.)									
	Moderate	0.473	(0.282)	0.094	0.187	(0.289)	0.519	0.154	(0.420)	0.714
	Severe	–0.041	(0.448)	0.928	0.723	(0.359)	0.044	0.304	(0.575)	0.598
Catheter	Yes (ref. = no)	–0.350	(0.565)	0.536	–0.849	(0.611)	0.165	–1.443	(1.131)	0.203
Artificial nutrition	Yes (ref. = no)	0.915	(0.450)	0.043	1.320	(0.405)	0.001	–0.611	(0.880)	0.488
Pressure ulcer	Yes (ref. = no)	–0.069	(0.532)	0.896	–1.709	(0.815)	0.036	1.294	(0.598)	0.031
Eyesight problem	Yes (ref. = no)	0.201	(0.277)	0.469	0.112	(0.267)	0.677	–0.443	(0.456)	0.332
Hearing problem	Yes (ref. = no)	–0.011	(0.261)	0.967	–0.400	(0.254)	0.116	0.160	(0.401)	0.690
Comorbidities‡	None (ref.)									
	1	–0.768	(0.374)	0.041	–0.683	(0.362)	0.060	–0.990	(0.578)	0.087
	≥2	–1.420	(0.630)	0.025	–0.636	(0.477)	0.183	–1.704	(1.045)	0.103
Length of stay at facility†	<90 days (ref.)									
	90–179 days	0.371	(0.468)	0.429	–0.209	(0.537)	0.697			
	180–359 days	0.624	(0.409)	0.128	0.820	(0.391)	0.037			
	≥360 days	0.381	(0.388)	0.326	0.537	(0.368)	0.145			
Level 2: error variance										
Intercept		0.627	(0.473)	0.092	0.020	(0.137)	0.441	0.232	(0.284)	0.207
Model fit	–2 Log likelihood	479.1			495.5			238.0		
No. residents		758			768			707		
No. facilities		42			41			40		

†When the dependent variable was in-hospital deaths, income level was not included in the regression model due to the small sample size. And we did not include length of stay of facility due to reverse causality. ‡The number of comorbidities was counted among the 15 lists of the Charlson Comorbidity Index,[16] including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, liver disease (mild, moderate/severe), diabetes mellitus (without and with complications), hemiplegia, renal disease (moderate/ severe), any tumor/leukemia/ lymphoma, metastatic solid tumor and AIDS. SE, standard error.

heart failure (CHF; 13.1% in GHSF and 10.3% in SNH). These three conditions accounted for >70% of PAH. The most common conditions of non-PAH were cerebrovascular disease, admission to DPC hospitals and cancer or leukemia. Approximately 10% of deaths occurred during the first day of hospitalization, implying a possibility of dead on arrival.

Among SNH residents, we found that the probability of PAH and non-PAH varied considerably across facilities (level 2 intercept was statistically significant), but in-hospital deaths did not vary by facilities. In the level 1 model, limited physical functioning was positively associated with PAH and non-PAH, whereas artificial nutrition was positively associated with PAH, non-PAH and in-hospital deaths. Having two or more comorbidities was associated with a higher risk of non-PAH, and male sex was associated with higher risks of non-PAH and in-hospital deaths (Table 4). Among GHSF residents, the level 2 intercept was not statistically significant for all dependent variables, implying the outcomes might not vary by facilities. In the level 1 model, having comorbidities was negatively associated with PAH, and pressure ulcers were negatively associated with non-PAH, but positively associated with in-hospital deaths (Table 5).

Discussion

The present study identified the percentage of and risk factors for PAH, non-PAH and in-hospital deaths among LTCF residents. We found that 34.5% of SNH residents and 23.8% of GHSF residents had been hospitalized, and that PAH were mainly related to respiratory infections, UTI and CHF. Furthermore, use of artificial nutrition was a risk factor for PAH and non-PAH in both settings.

The present study identified that PAH accounted for 47.1% of hospitalizations from SNH and 39.8% of hospitalizations from GHSF. Similarly, a previous report showed that PAH accounted for 46.6% of hospitalizations from Medicaid nursing facility services and 42.1% of hospitalizations from Medicare skilled nursing facilities.[3] Respiratory infections accounted for half of PAH and CHF accounted for >10%, whereas UTI accounted for 19.5% in SNH and 8% in GHSF. Similar trends have been observed, the leading causes of PAH among nursing home residents were pneumonia (30–50%), CHF (15–18%) and UTI (12–24%).[21–23] The similar results as previous studies imply that the concept of Centers for Medicare & Medicaid Services' PAH is valid in Japanese LTCF settings as well.[3,21–23] Nevertheless, the present study might underestimate the proportion of PAH, as we included a maximum of two diagnoses for those with multiple diagnoses, and applied a strict definition of PAH for patients with coexisting conditions.

The percentage of overall hospitalizations and PAH was lower in GHSF than in SNH, which is expected, as SNH do not provide onsite clinical interventions. However, this does not necessarily mean that GHSF provide a better quality of medical care, as GHSF residents have limited coverage from the health insurance system. In addition, it is difficult to determine whether GHSF actively prevent PAH conditions or simply treat conditions without hospital transfers.[23]

Male sex was a risk factor for non-PAH and in-hospital deaths among residents of SNH and GHSF.[3,21] In previous studies, men had shorter times to hospitalization from a nursing home,[24] and were more likely to be transferred to a hospital during the last 3 days of life.[25] Inevitably, older age was a risk factor for in-hospital deaths among residents of SNH.[23]

Severe limitations in physical functioning was a risk factor for PAH and non-PAH from SNH, and for non-PAH from GHSF. Nursing homes with high hospitalization rates showed a high number of of residents with limited activities or who were bedridden.[26] Severe impairment of cognitive function was a risk factor for non-PAH in GHSF, as a former study showed that dementia was associated with an increased risk of non-potentially preventable hospitalizations.[23]

Use of a catheter was a risk factor of PAH in SNH, as residents with indwelling urinary catheters are at higher risk for catheter-associated UTI.[27] In nursing home settings, the prolonged duration might be accompanied by unnecessary antibiotic use.[27] In addition, use of artificial nutrition in SNH was a risk factor for PAH, non-PAH and in-hospital deaths, as well as a risk factor for PAH and non-PAH in GHSF. Although it is recommended that tube feeding is overseen by a nurse or dietitian, several SNH provide tube feeding by care workers without training programs, which might be related to a low quality control of tube feeding.[28]

Pressure ulcers were negatively associated with non-PAH, but positively associated with in-hospital deaths among GHSF residents. Because pressure ulcer treatment is covered by LTCI benefits, it might lead residents to receive onsite treatment.[9] Whereas, severe pressure ulcers might reflect an individual's functional condition, and can be a risk factor for in-hospital death.[25]

We found that having two or more comorbidities was positively associated with non-PAH in SNH.[23,24] However, having comorbidities was negatively associated with PAH in GHSF. These conflicting findings might reflect staffing characteristics, as GHSF must employ a full-time physician who provides regular treatments and prescriptions.[29] It is also possible that they are related to measurement issues, as approximately 18% of GHSF residents had prior hospitalizations, and a considerable number of their comorbidities were identified during those prior hospitalizations. Nevertheless, the incidence of re-hospitalization was very low among the residents with prior hospitalizations, during the study period. When we included prior hospitalization as an independent variable, the effect of comorbidities became insignificant (data not shown). Therefore, careful interpretation is required for the relationship between comorbidities and PAH among GHSF residents, as the short observation period might have caused bias.

Prolonged LOS was significantly associated with a higher risk of non-PAH, which might be related with functional deteriorations of the long-stay residents. However, prolonged LOS was not related with PAH, this is because if potentially avoidable conditions could be managed properly, the LOS also could be lengthened without occurrence of PAH.

The present study had several limitations. First, we could not apply detailed characteristics of facility level (e.g. number of beds or staffs) because of limited information. Even though we used a multilevel model to account for the nesting effect, the facility level's quality of care might have an effect on the frequency of PAH. Second, this study included two primary diagnoses, when patients had multiple primary diagnoses. However, the concept of "primary/secondary diagnosis" varies between countries or data, and there is no common guidance for selecting a primary diagnosis under the current claims data system in Japan.[30] Furthermore, this study could not utilize specific diagnoses for the DPC hospitals, as our DPC database did not have diagnostic classification records. Owing to the aforementioned limitations, there is the possibility of under-/overestimation of PAH. Third, the observation period was 1.5 years, which might have led to undercounting of re-hospitalizations among residents with prior hospitalization. Finally, the results might not reflect the situation throughout Japan, as there are regional variations in capacities of LTCF and acute hospitals.[12] Therefore, further studies are required to accompany facility-level characteristics, and a standard definition of primary diagnoses; specific diagnoses for DPC database, longer period, with nationally representative data.

In conclusion, the present study elucidated the percentage of and risk factors for PAH, non-PAH, and in-hospital deaths among residents of SNH and GHSF. The linking of LTCI and health insurance claims data provided meaningful information regarding hospitalizations from SNH and GHSF, which could help to guide policy-making in quality assessment of LTCF settings in Japan and other Asian countries.

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Disclosure statement

The authors declare no conflict of interest.

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