ORIGINAL ARTICLE

Cumulative number of hospital bed days among older adults in the last year of life: A retrospective cohort study

Tatsuro Ishizaki,[1] Masaya Shimmei,[1] Haruhisa Fukuda,[2] Eun-Hwan Oh,[3] Chiho Shimada,[1] Tomoko Wakui,[1] Hiroko Mori[1] and Ryutaro Takahashi[1]

[1]Human Care Research Team, Tokyo Metropolitan Institute of Gerontology, Itabashi, Tokyo, [2]Department of Health Care Administration and Management, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Fukuoka, Japan, and [3]Department of Health Management, Hyupsung University, Hwaseong, Gyeonggi Korea

Aim: To determine whether age, proximity to death and long-term care insurance certification are related to receiving hospital inpatient care; the number of hospital bed days (HBD) among older Japanese adults in the last year of life; and to estimate the total number of HBD.

Methods: Using health insurance claims and death certificate data, the present retrospective cohort study examined the HBD of city residents aged ≥65 years who died between September 2006 and October 2009 in Soma City, Japan. Using a two-part model, factors associated with receiving hospital inpatient care and the total number of HBD in each quarter in the last year of life were examined.

Results: The total number of HBD in the last year of life varied widely; 13% had no admission, and 27% stayed ≥90 days. Younger age, approaching death and having long-term care insurance certification were significantly associated with being more likely to receive hospital inpatient care during each quarterly period in the last year of life. In contrast, having long-term care insurance certification and the last 3-month period before death, compared with the first 3-month period, were significantly associated with a fewer number of HBD.

Conclusions: The present study showed that older age was associated with being less likely to receive hospital inpatient care. The findings regarding the risk of inpatient care and total number of HBD in the last year of life help to understand resource use among older dying adults, and to develop evidence-based healthcare policies within aging societies. Geriatr Gerontol Int 2016; ••: ••–••.

Keywords: aged, death, health resources, hospitalization, time factors.

Introduction

The Japanese Ministry of Health, Labor and Welfare forecasts that there will be 1.6 million decedents in 2030 in Japan.[1] The number of persons aged ≥75 years at the time of death doubled from 445 000 in 1990 to 896 000 in 2012.[2] Approximately 80% of the elderly decedents in 2012 died at hospital and 13% at home.[2] The Ministry is concerned that similar proportions of the place of death and average length of hospital stay in 2030, owing to excessive use of hospital inpatient care at the end of life, will create challenges for >400 000 decedents to die in the hospital; furthermore, hospitals will have no capacity to cope with the demand.[1] Therefore, the Ministry restructured the current medical and long-term care (LTC) system for older people, and promoted home care, to avoid hospital bed unavailability and reduce hospitalization for older dying patients by increasing the number of older patients who die at home or in LTC facilities.

There are two issues with the Ministry's projected hospital bed shortage. First, because their interpretation of the place of death (80% in hospitals) in Japan is based on death certificates, the place of death shows only where physicians confirmed the death,[3] not necessarily the place of residence before death, as found in the USA.[4] Second, many studies from Western countries have explored healthcare expenditure within a certain period before death and the association between age, proximity to death and healthcare expenditure.[5–10] However, a few studies from outside Japan have examined the total number of hospital bed days (HBD) and associated factors before death.[4,11,12] The few published studies involving older Japanese individuals have included small sample sizes (109–154 deceased persons).[13–15] In a related study of resource use during a

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Correspondence: •• Tatsuro Ishizaki MD PhD MPH, Human Care Research Team, Tokyo Metropolitan Institute of Gerontology, 35-2 Sakae-cho, Itabashi-ku, Tokyo 173-0015, Japan. Email: tatsuro.ishizaki@gmail.com

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1-year period among 550 non-surviving patients hospitalized in a Japanese hospital, the median number of cumulative HBD was very similar in the 65–74 years, 75–84 years and ≥85 years age groups.[16]

To date, there have been no reports regarding the association of age, proximity to death and disability with the total number of HBD at the end of life in Japan. It is not only valuable to identify healthcare expenditure during the end-of-life period, but also important to understand hospital bed use before death in aged countries. Because population aging incurs greater LTC requirements because of disability, with greater healthcare expenditure, it is relevant to examine whether older persons with disability stayed a greater number of HBD before death compared with those without disability.[17] Furthermore, it is suggestive for researchers and policy makers, both in Japan and abroad, to examine how strong the association of age, proximity to death and disability with hospital resource use in the last year of life in Japan is, because hospital resource use in the end of life might vary across countries because of variation in healthcare policy.

The present study aimed to determine whether age, proximity to death and LTC insurance certification were related to receiving hospital inpatient care; the number of HBD among older Japanese adults in the last year of life; and to estimate the total number of HBD.

Methods

Study location

Soma City in Fukushima prefecture in the northeastern area of Honshu, one of the main islands of Japan, had a population of approximately 38,000 in 2010, and 26% were aged ≥65 years. Approximately 90% of the residents were engaged in secondary or tertiary industries. Available healthcare resources included a total of 347 hospital beds in two hospitals in the city.

Data sources

We collected three sets of insurance claims data from the city: (i) a national health insurance plan for citizens; (ii) a health insurance plan for older people; and (iii) a public LTC insurance plan. The data of these claims were developed on a monthly basis for reimbursement purposes, and were extracted, anonymized and added an individual-level unique identification code by the city. Then the utilization datasets were linked with a register of the city's residents, including sex, birthdate, date of move-in and date of move-out or death, using the assigned identification aforementioned code. Finally, this intermediate dataset was merged with death certificates obtained from Japan's Ministry of Health, Labor and Welfare comprising sex, birthdate, date of death, place of death and main cause of death, matching the birthdate, date of move-out or death and sex (the linkage rate was 100%).

Participants

City residents aged ≥65 years who died of an illness between September 2006 and October 2009, and received medical care during the last year of life between October 2005 and October 2009 were included as members of the cohort in the present study. Residents who died of external causes, such as injuries, burns, poisoning, transport accidents, falls, intentional self harm or assault, were excluded.

According to the death certificate data, 1019 residents aged ≥65 years died during the specified period. Of these residents, 888 were matched with data from either the national health insurance plan or the health insurance plan for older people. To avoid underestimation of medical resource use as a result of migration, we included only decedents who lived in the city for ≥12 months before death (n = 882).

Definitions

The demographic variables in the linked data included sex, age 1 year before death, location of death (home, hospital and LTC facility or other), the main cause of death, LTC insurance certification showing a disability (absent or present[18]),and total number of HBD. The main cause of death in the death certificate data was coded based on the International Statistical Classification of Diseases and Related Health Problems, 10th Revision and categorized into five groups: malignant neoplasm (C00-C97); cardiovascular diseases (I01-I02, I05-I09, I20-I25, I27, I30-I52); pneumonia, including aspiration pneumonia (J12-J18, J69); cerebrovascular diseases (I60-I69); and other. In Japan's public LTC insurance system, an insured person's eligibility for insurance benefits is assessed in terms of his/her physical and cognitive function. In the present study, when a person aged ≥65 years was certified as eligible by the local government, he/she was categorized as having a LTC insurance certification.[18] When an individual was not eligible or did not require LTC services, he/she was categorized as not having a LTC insurance certification.

The number of HBD either during the last year before death or during each 3-month period in the last year before death was calculated by summing the number of HBD in each month. Because claims data are billed on a monthly basis, the death date affects the volume of resources used in the last month before death. When a hospitalized person dies on the first day of the month, there is 1 bed day in the last month of life. However, if a hospitalized person dies on the last day of the month, there are 28–30 HBD in the last month of life. Thus, to dilute the effect of the death date on the length of hospital stay in the last month of life, we calculated HBD for every 3-month period in the last year of life (time [T]1 = 10–12, T2 = 7–9, T3 = 4–6, and T4 = 1–3 months before death).

Data analysis

Frequency tables for discrete variables, and mean and standard deviation or median and interquartile range for continuous variables were calculated to describe participant characteristics. For comparison with previous studies, the categories for the total number of HBD in the last year of life were no admission, and 1–13, 14–27, 28–89, 90–179 and ≥180 days.[19,20]

When we calculated summary statistics for the total number of HBD, we excluded participants with 0 days. When calculating tables for the total number of HBD, we stratified by sex, age group (65–74 years, 75–84 years and ≥85 years) and LTC insurance certification status (absent or present) in each quarterly period.

We used a two-part model to estimate the probability of hospital inpatient care and total number of HBD during each quarter in the last year of life. Because there might be many zero values in the number of HBD at the individual level during the first, second and third quarters of the last year of life, a two-part model is useful.[21] In a two-part model, the first equation estimates the probability that an individual has any use, and the second equation estimates the level of use for those identified as users in the first equation. The expected level of use for a person is then calculated by multiplying these two estimates together.[21] In the present study, each participant had four data points for the four-quarter period. Specifically, this involved both hospital inpatient care (absent or present) and the total number of HBD during each quarterly period (if hospitalized). In the first part of the model, the dependent variable was hospital inpatient care during each 3-month period in the last year of life. When the number of HBD during each quarterly period of a participant was ≥1 day, we regarded this as receiving hospital inpatient care during the period. In the second part of the model, the dependent variable was the total number of HBD during each quarterly period for hospitalized participants. Independent variables in both models were sex, age (for a 1-year increase), time before death (T1, T2, T3, T4) and LTC insurance certification status (absent or present). In the first part of the model, a generalized linear model for data with a binomial distribution with a log-link function was used. The effect size in the first model is shown as odds ratios (OR), indicating the likelihood of hospital inpatient care among participants with a specific condition, relative to those with a referent condition. In the second part of the model, we used a generalized linear model for data with a gamma distribution with a log-link function. The effect size in the second model is shown as risk ratios (RR), indicating the likelihood of the number of HBD among participants with a specific condition, relative to those with a referent condition. Finally, to estimate the predicted number of HBD during each quarterly period, we multiplied the predicted probability of undergoing hospital inpatient care by the predicted number of HBD (given that hospitalization occurred) for each sex, age group and quarterly period. A two-tailed P-value <0.05 was considered statistically significant. All analyses were carried out using SPSS v20.0 (IBM, Armonk, NY, USA). The study was approved by the institutional review board of the Tokyo Metropolitan Institute of Gerontology.

Results

Table 1 shows the basic participant characteristics. On average, women were 4.2 years older than men. The proportions of decedents with no hospital admission and

Table 1 Characteristics of decedent participants

	Total (n = 882)	Men (n = 466)	Women (n = 416)
Age (years)	82.8 (8.2)	80.8 (8.0)	85.0 (7.9)
Age group (years)			
65–74	17.5	23.2	11.1
75–84	38.1	41.8	33.9
≥85	44.4	35.0	55.0
LTC insurance certification status			
Absent	69.2	75.1	62.5
Present	30.8	24.9	37.5
Place of death			
Hospital	83.9	86.3	80.4
Home	11.3	10.7	12.6

LTC facility or other	4.8	2.4	7.0
Main cause of death			
Malignant neoplasms	27.9	31.8	23.6
Cardiovascular diseases	17.0	14.4	20.0
Pneumonia	15.4	15.0	15.0
Cerebrovascular diseases	14.3	12.7	16.1
Other	25.4	26.2	24.5

Values are reported as % or mean (standard deviation). LTC, long-term care hospital stay ≥90 days were 11% and 29% for men, respectively, and 15% and 25% for women, respectively (Table 2). The total number of HBD in the last year of life varied widely; 13% had no admission, and 27% stayed ≥90 days. Among 768 decedents who received hospital inpatient care at least once during the last year of life, the median (interquartile range) number of hospital stays for men and women were 55 (22, 108) and 50 (17, 106), respectively (Table 3). Table 3 also shows the number of HBD during each quarterly period by sex, age group and LTC insurance certification. The median HBD for each age group was 27–40 days, except T1 to T4 among men aged 65–74 years and T1 among women aged 75–84 years. The 75th percentiles of the total number of HBD in T1, T2, and T3 among men and women without LTC insurance certification were ≥90 days. The median HBD in each quarterly period (20–29 days) was stable for both sexes with LTC insurance certification.

Table 4 shows the two-part model results. The first part of the model showed that approaching death (T2, OR 1.50, $P < 0.001$; T3, OR 2.42, $P < 0.001$; T4, OR 16.32, $P < 0.001$) was significantly associated with receiving inpatient care. Older age was significantly associated with less risk of receiving hospital inpatient care (OR for a 1-year increase 0.97, $P < 0.001$). In the second part of the model, having LTC insurance certification (RR 0.61, $P < 0.001$) and T4 compared with T1 (RR 0.87, $P = 0.007$) were significantly associated with fewer HBD. The predicted number of HBD increased as death approached in any age group for both sexes (Fig. 1). Participants with LTC insurance certification were more likely to have fewer total HBD during each quarterly period than those without certification.

Discussion

In the present study, the total number of HBD in the last year of life among participants who died in the hospital varied widely. Younger age, approaching death and having LTC insurance certification were significantly associated with being more likely to receive hospital inpatient care during each quarterly period in the last year of life. In contrast, having LTC insurance certification and the last 3-month period before death, compared with the first 3-month period, were significantly associated with a lower number of HBD.

Older age was significantly associated with a lower risk of receiving hospital inpatient care, but was not significantly associated with the number of HBD in each 3-month period in the last year of life. Previous studies from the UK[19] and Australia[20] showed that older adults aged ≥85 years were less likely to be hospitalized, and more likely to have a greater number of total HBD in the last year of life than younger patients. Another study from Sweden confirmed, using multiple logistic regression analysis, that approaching death was associated with being more likely to receive hospital inpatient care, and increasing age was associated with longer hospital stays.[22] Despite different healthcare systems, the findings were similar to the present study in that older dying individuals were less likely to receive hospital inpatient care. Physicians in the USA believe that hospital inpatient care for frail older patients is not always superior to outpatient care because of the higher risk of iatrogenic disorders, such as delirium, falls, functional decline, cognitive decline and medication error.[23] We speculate that physicians in Japan might also be reluctant to hospitalize very old frail patients.

Table 2 Hospital bed days in the last year of life by sex, age group and place of death

		Not admitted	1–13 days	14–27 days	28–89 days	90–179 days	≥180 days
Total (n = 882)		114 (12.9%)	139 (15.8%)	99 (11.2%)	293 (33.2%)	138 (15.6%)	99 (11.2%)
Sex and age group (years)							
Men	65–74 (n = 108)	11 (10.2%)	13 (12%)	9 (8.3%)	30 (27.8%)	23 (21.3%)	22 (20.4%)
	75–84 (n = 195)	18 (9.2%)	36 (18.5%)	23 (11.8%)	69 (35.4%)	29 (14.9%)	20 (10.3%)
	Total (n = 466)	52 (11.2%)	70 (15%)	54 (11.6%)	156 (33.5%)	75 (16.1%)	59 (12.7%)
Women	65–74 (n = 46)	2 (4.3%)	4 (8.7%)	6 (13%)	18 (39.1%)	9 (19.6%)	7 (15.2%)
	75–84 (n = 141)	20 (14.2%)	31 (22%)	12 (8.5%)	41 (29.1%)	21 (14.9%)	16 (11.3%)
	≥85 (n = 229)	40 (17.5%)	34 (14.8%)	27 (11.8%)	78 (34.1%)	33 (14.4%)	17 (7.4%)
	Total (n = 416)	62 (14.9%)	69 (16.6%)	45 (10.8%)	137 (32.9%)	63 (15.1%)	40 (9.6%)
Place of death							
Hospital (n = 740)		39 (5.3%)	126 (17%)	84 (11.4%)	260 (35.1%)	132 (17.8%)	99 (13.4%)
Home (n = 100)		54 (54.0%)	10 (10.0%)	7 (7.0%)	24 (24.0%)	5 (5.0%)	0 (0.0%)
LTC facility or other (n = 42)		21 (50.0%)	3 (7.1%)	8 (19.0%)	9 (21.4%)	1 (2.4%)	0 (0.0%)

LTC = long-term care

Table 3 Hospital bed days in the last year of life by sex, age group and long-term care insurance certification

	Men (n = 466)				Women (n = 416)			
	Not receiving hospital care	Hospital care	Not receiving hospital care		Hospital care			
	n (%)	n (%)	Mean	Median (IQR)	n (%)	n (%)	Mean	Median (IQR)
During a 12-month period in the last year of life								
Total	52 (11.2)	414 (88.8)	86.2	55 (22–108)	62 (14.9)	354 (85.1)	77.7	50 (17–106)
Age group (years)								
65–74	11 (10.2)	97 (89.8)	113.3	74 (30–170)	2 (4.3)	44 (95.7)	95.3	58 (35–152)
75–84	18 (9.2)	177 (90.8)	75.4	46 (18–94)	20 (14.2)	121 (85.8)	78.9	51 (11–121)
≥85	23 (14.1)	140 (85.9)	72.7	46 (20–94)	40 (17.5)	189 (82.5)	72.7	46 (20–94)
LTC insurance certification								
Absent	34 (11.3)	268 (88.7)	89.8	57 (19–108)	23 (11.3)	180 (88.7)	82.4	46 (16–114)
Present	18 (11.0)	146 (89.0)	79.8	53 (26–109)	39 (18.3)	174 (81.7)	72.8	54 (23–99)
During each 3-month period in the last year of life								
Total								
T1	351 (75.3)	115 (24.7)	45.1	36 (14–89)	333 (80.0)	83 (20.0)	46.7	38 (16–91)
T2	308 (66.1)	158 (33.9)	40.5	32 (11–66)	307 (73.8)	109 (26.2)	42.6	33 (17–73)
T3	258 (55.4)	208 (44.6)	45.4	39 (14–89)	261 (62.7)	155 (37.3)	42.9	31 (16–70)
T4	76 (16.3)	390 (83.7)	38.9	35 (13–66)	80 (19.2)	336 (80.8)	37.8	33 (14–64)
Age group (years)								
65–74 T1	75 (69.4)	33 (30.6)	51.7	49 (16–91)	33 (71.7)	13 (41.3)	50.8	35 (18–92)
T2	63 (56.8)	45 (43.2)	44.3	38 (16–79)	27 (58.7)	19 (47.8)	45.4	37 (17–79)
T3	51 (47.2)	57 (52.8)	52.8	53 (18–91)	24 (52.2)	22 (91.3)	44.1	34 (10–76)
T4	17 (15.7)	91 (84.3)	47.0	55 (17–71)	4 (8.7)	42 (18.4)	40.5	40 (16–62)
75–84 T1	141 (72.3)	54 (27.7)	40.6	30 (14–65)	115 (81.6)	26 (29.8)	50.1	47 (20–81)
T2	136 (69.7)	59 (30.3)	40.4	31 (12–64)	99 (70.2)	42 (41.1)	42.2	33 (16–70)
T3	111 (56.9)	84 (43.1)	39.9	27 (11–66)	83 (58.9)	58 (80.1)	43.3	34 (15–73)
T4	28 (14.4)	167 (85.6)	33.4	28 (9–59)	28 (19.9)	113 (19.2)	36.6	33 (11–61)
≥85 T1	135 (82.8)	28 (17.2)	45.9	33 (11–91)	185 (80.8)	44 (19.2)	43.5	31 (13–92)
T2	109 (66.9)	54 (33.1)	37.6	28 (10–67)	181 (79.0)	48 (21.0)	41.8	31 (22–71)
T3	96 (58.9)	67 (41.1)	46.0	33 (13–91)	154 (67.2)	75 (32.8)	42.1	31 (17–68)
T4	31 (19.0)	132 (81.0)	40.2	37 (13–68)	48 (21.0)	181 (79.0)	38.0	32 (14–66)
LTC insurance certification								
Absent T1	265 (75.7)	85 (24.3)	49.6	45 (16–91)	212 (81.5)	48 (18.5)	58.8	69 (26–92)
T2	229 (66.8)	114 (33.2)	43.8	33 (12–90)	197 (79.4)	51 (20.6)	50.8	39 (26–91)
T3	190 (57.4)	141 (42.6)	52.0	52 (17–92)	140 (63.6)	80 (36.4)	54.6	56 (19–91)
T4	40 (13.5)	256 (86.5)	45.0	49 (15–71)	22 (11.6)	167 (88.4)	46.7	50 (17–72)
Present T1	86 (74.1)	30 (25.9)	32.1	27 (13–51)	121 (77.6)	35 (22.4)	30.1	23 (9–48)
T2	79 (64.2)	44 (35.8)	32.1	28 (10–54)	110 (65.5)	58 (34.5)	35.3	29 (13–56)
T3	68 (50.4)	67 (49.6)	31.5	23 (11–49)	121 (61.7)	75 (38.3)	30.4	23 (13–42)
T4	36 (21.2)	134 (78.8)	27.1	25 (8–40)	58 (25.6)	169 (74.4)	29.1	26 (10–45)

Time (T)1 = 10–12 months before death, T2 = 7–9 months before death, T3 = 4–6 months before death, T4 = 1–3 months before death. LTC = long-term care.

The risk of receiving hospital inpatient care non-linearly increased as time of death approached. However, significantly fewer total HBD were present during the last 3-month period of life than during the 10–12-month period before death. Based on the two-part model, the estimated number of HBD during each 3-month period increased as death approached in all age groups for both sexes (Fig. 1). Thus, the impact of approaching death on the risk of receiving hospital inpatient care was relatively greater than on the number of HBD. Similar to the results regarding age and use of hospital inpatient care of previous studies carried out in Western countries, the expected number of HBD increased as death approached.[24] Additionally, our finding that the risk of receiving hospital

Table 4 Factors associated with receiving hospital care and the number of hospital bed days during each 3-month period in the last year of life (results from the two-part model)

	First model†				Second model‡			
	Receiving hospital inpatient care during each quarterly period (analyzable data: n = 3528)				No. hospital bed days during each quarterly period (analyzable data: n = 1554)			
	Odds ratio	95% confidence interval		P-value	Risk ratio	95% confidence interval		P-value
Sex								
Men	1.000				1.000			
Women	0.808	0.651	1.002	0.052	1.057	0.966	1.157	0.227
Age								
For a 1-year increase	0.974	0.961	0.988	<0.001	1.002	0.996	1.008	0.509
LTC insurance certification								
Absent	1.000				1.000			
Present	1.166	0.955	1.423	0.133	0.614	0.565	0.667	<0.001
Proximity to death								
10–12 months before death (T1)	1.000				1.000			
7–9 months before death (T2)	1.503	1.286	1.756	<0.001	0.948	0.853	1.054	0.317
4–6 months before death (T3)	2.421	2.024	2.897	<0.001	0.995	0.894	1.107	0.926
1–3 months before death (T4)	16.323	13.091	20.352	<0.001	0.874	0.792	0.963	0.007

†First model: generalized linear model for data distributed under a binomial distribution with a log-link function. ‡Second model: generalized linear model for data distributed under a gamma distribution with a log-link function. LTC, long-term care; T, time

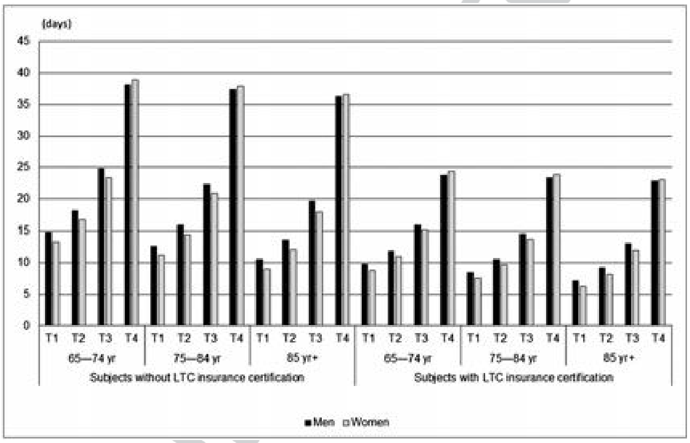

Figure 1 Predicted values of the total number of hospital bed days per 3-month period in the last year of life by sex, age and long-term care (LTC) insurance certification status. T1, 10–12 months before death; T2, 7–9 months before death; T3, 4–6 months before death; T4, 1–3 months before death.

inpatient care during the last 3-month period in the last year of life was higher than that of home care was consistent with that of a Swedish study.[22]

LTC insurance certification was not significantly associated with receiving hospital inpatient care, but was significantly associated with 39% fewer HBD during each quarter in the last year of life, compared with not having LTC insurance certification. Contrary to the initial expectation that older patients with some disability would have a higher risk of both receiving hospital inpatient care and using greater resources than those without disabilities, participants with LTC insurance certification in the present study were more likely to have fewer total HBD during each quarterly period than those without certification.[17,25] We must recognize that participants without LTC insurance certification are not necessarily without disabilities. Thus, the present study results do not necessarily show that older adults with disabilities were more likely to spend less time in the hospital than those without disabilities. Because older adults with some disability, but without certification, were likely in very poor health, it might have been difficult to discharge them from the hospital and to use services covered by LTC insurance at either their homes or LTC facilities, which resulted in more HBD.

The present study had certain limitations. First, we could not identify cumulative HBD during a 365-day period before the death date, because insurers generated the claims data on a monthly basis rather than retrospective from the date of death. The impact of date of death on resource use during the last 3 months of life was not negligible, because the date of death varied from the first to last day of the month (difference of ~30 days). Therefore, we used cumulative HBD during each 3-month period in the last year of life. Second, employee health insurance plan claims data were not used, because they were not available at the local government level. Finally, the cumulative number of HBD in the last year of life might not generalize to all of Japan, because hospital inpatient care use might vary substantially by region within prefectures.[26] However, the results could be extrapolated to a city in Japan with similar healthcare resource use and sociodemographic status.

In conclusion, the findings regarding the risk of hospital inpatient care and total number of HBD in the last year of life help to understand resource use among older dying adults. Analysis of linked claims and death certificate data provides insightful information, and could facilitate evidence-based healthcare policies in an aging society.

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TI was responsible for study concept and design. TI, MS and RT contributed to acquisition of participants and data. TI, MS, HF, EHO, CS, TM, HM and RT carried out analysis and interpretation of data. TI and MS were responsible for preparation of the manuscript.

Disclosure statement

The authors declare no conflict of interest.

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