

Original article

Cost of shifting from healthcare to long-term care in later life across major diseases: analysis of end-of-life care during the last 24 months of life

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Abstract

Aim: To evaluate the costs associated with healthcare and long-term care during the last 24 months before death according to major disease groups.

Methods: Individual data regarding healthcare and long-term care costs according to public insurance schemes during the last 24 months before death among all decedents older than 75 years reported in a city in Japan between April 1, 2010 and March 31, 2014 were identified; the data for nine major diseases were then analyzed.

Results: For the 2149 decedents studied, the average healthcare costs per capita in the last 24 months of life for moderately-old (75 to 84 years) and extremely-old (85 years and older) decedents was 4,135,467 JPY and 2,493,001 JPY, respectively, while the average long-term care costs per capita for 24 months was 1,300,710 JPY and 2,723,239 JPY, respectively. The total costs (healthcare and long-term care combined) ranged from 9,169,547 JPY for chronic kidney disease to 5,023,762 JPY for ischemic heart disease. In all the diseases studied, the moderately-old decedents incurred higher healthcare costs while the extremely-old decedents incurred higher long-term care costs. However, for the care costs of chronic lower respiratory diseases, this pattern was not observed.

Conclusion: A shift in expenditure from healthcare to long-term care as the decedents' age increased was observed in major diseases, with some exceptions.

Key words: end-of-life, cost, healthcare, long-term care, Japan

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Introduction

People incur healthcare and/or long-term care costs at the end of life and our society bears the expenses. An understanding of the costs incurred at the end of life both in healthcare and long-term care is imperative because they are utilized interchangeably or simultaneously depending on the elderly individuals' situation. However, compiling such information is a challenging task because healthcare and long-term care services are covered by two independent insurance schemes, health insurance and long-term care insurance. Prior studies on the costs of end-of-life care have mostly focused on healthcare or long-term care separately^{1,2} or have only considered the patterns of costs for a single disease at a time^{3–5}.

Decisions on the choices and combinations of care at the end-of-life are generally made according to the applicability of medical care for recovery, and social and economic needs and preferences for home care and institutional care. The applicability of medical interventions for elderly patients generally declines according to age^{6,7} and several aspects of end-of-life care appear to be associated with age⁸, although there are variations regardless of age. What is absent from the literature is a clear discussion of how healthcare and long-term care costs at the end of life are influenced by age and disease.

In the backdrop of a rapidly aging demographic with comprehensive yet individualized needs, we evaluated the patterns of both healthcare and long-term care costs incurred in the last 24 months of life through a complete

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enumeration of decedents in a study area. We compared the healthcare and long-term care costs between those who were moderately-old (75 to 84 years) and extremely-old (85 years and above) at the time of death, for decedents of all causes as well as according to major disease categories. The aim of this study was to evaluate the costs associated with healthcare and long-term care during the last 24 months before death according to major disease groups.

Methods

Study design and subjects

A retrospective cohort study was conducted to examine the costs of healthcare and long-term care in the last 24 months before death using insurance data of city A. City A is located in a suburban area of Shizuoka prefecture with a population of about 88,000 in 2015. The proportion of the elderly who were 75 years or older and 85 years or older in the city was 10.2% and 3.3%, which were slightly lower than the nationwide proportion of 12.8% and 3.9%, respectively^{9, 10}.

Eligible samples were those who died between April 1, 2010 and March 31, 2014 at the age of 75 years old or above in city A. All the samples in this age group were enrolled in the latter-stage elderly health insurance program, which covers all individuals aged 75 years and older and long-term care insurance program, which covers all individuals aged 65 years and older. An anonymous list of decedents merged with latter-stage elderly health insurance records for 24 months prior to individual's death and long-term care insurance records for 24 months prior to individual's death was used in this study. This allowed the analysis of expenditure of both healthcare and long-term care by individuals in the last 24 months of life.

Variables

Demographic variables: The age at the time of death and gender were compiled for the analysis. The subjects were divided into two age groups: moderately-old (75 to 84 years) and extremely-old (85 years and above) according to the age at the time of death.

Disease categories: Disease names on health insurance claims were categorized according to the codes of the International Classification of Diseases, Tenth Revision (ICD-10). Nine major disease categories were selected for the present analysis, based on the major causes of death of the Japanese population (malignant neoplasms, ischemic heart disease, cerebrovascular disease, pneumonia, chronic lower respiratory diseases, and chronic kidney disease) and diseases with an increasing prevalence in recent years (diabetes, dementia, mental disorders)¹¹. When different disease names were reported for one individual in monthly insur-

ance claims, all disease names were filed individually.

Healthcare variables: Monthly inpatient healthcare cost (c_{Hi}), monthly outpatient healthcare cost (c_{Ho}), monthly days of hospitalization (d_i), and monthly days of outpatient care (d_o) for individual subjects for each month from 24 months prior to death to the month of death were compiled.

The c_{Hi} covers medical procedures for diagnosis, treatment, and rehabilitation; regular hospital beds; consultations and services by health professionals during hospitalization; and hospital meals. The c_{Ho} covers medical procedures for diagnosis, treatment, and rehabilitation; consultations and services by health professionals at outpatient or home visits settings; prescriptions; and prescribed medicines.

For the calculation of c_{Hi} and c_{Ho} , claim points denoted in individual health insurance claims were used and one claim point was converted to 10 Japanese Yen, according to the regular conversion rate. This conversion reflects a total of the cost reimbursed from the insurer and the cost paid by the insured (co-payment), according to the regular payment scheme.

To estimate the total inpatient healthcare cost (C_{Hi}), total outpatient healthcare cost (C_{Ho}), and total days of hospitalization (D_i) for 24 months, the month of death was designated as month 0, and the sum of each outcome variable (i.e., $C_{Hi} = \sum c_{Hi}$, $C_{Ho} = \sum c_{Ho}$, and $D_i = \sum d_i$) from month 0 to month 24 was calculated for each individual. Total cost for healthcare (C_H) was defined as a sum of (C_{Hi}) and (C_{Ho}). Inpatient and outpatient healthcare cost per treatment dates (C_{Hi/D_i}) and (C_{Ho/D_o}) were calculated according to the following equations: ($C_{Hi/D_i} = (C_{Hi}) / (D_i)$) for inpatient healthcare cost per treatment date and ($C_{Ho/D_o} = (C_{Ho}) / (D_o)$) for outpatient healthcare cost per treatment date.

Long-term care variables: Monthly institutional long-term care cost (c_{Li}) and monthly home-based long-term care cost (c_{Lh}) for individual subjects for each month from 24 months prior to death to the month of death were compiled.

The (c_{Li}) covers care of the elderly at institutions including nursing homes, long-term care facilities, and community daily long-term care homes for dementia patients, upon nursing care certification. The (c_{Lh}) covers care services for the elderly residing in their home upon nursing care certification with or without families, including help in daily activities by home-visit caregivers, nursing care by home-visit nurses, rehabilitation and care services at day care centers, and short overnight stay services.

For the calculation of (c_{Li}) and (c_{Lh}), claim units denoted in individual long-term care insurance claims were used and one claim unit was converted to 10 Japanese Yen, according to the regular conversion rate. This conversion reflects a total of the cost reimbursed from the insurer and the cost paid by the insured (co-payment), according to the regular

payment scheme.

To estimate the total institutional long-term care cost (C_{Li}) and total home-based long-term care cost (C_{Lh}) for 24 months, the month of death was designated as month 0, and the sum of each of cost variable, from month 0 to month 24 was calculated for each individual (i.e., $C_{Li} = \sum c_{Li}$ and $C_{Lh} = \sum c_{Lh}$). Total cost for long-term care (C_L) was defined as a sum of (C_{Li}) and (C_{Lh}).

Total combined care cost variables: Total combined cost during the last 24 months of life (C_{H+L}) was defined as a sum of (C_H) and (C_L).

Analysis

Mean and standard deviation of age, proportion of female decedents, and summary statistics of (C_{H+L}), (C_H), and (C_L) among all decedents, and decedents reported with specific major disease were calculated. Mean, standard deviation, median, Q1, and Q3 among all decedents and those categorized in specified disease categories were calculated. In the case of reports of multiple disease categories, the subjects were counted in all reported disease categories.

According to a hypothesis that healthcare cost and long-term care cost during the last 24 months of life are different according to the age at death, the average of (C_{H+L}), (C_H), (C_L), (C_{Hi}), (C_{Ho}), (C_{Li}), and (C_{Lh}) for moderately-old and extremely-old decedents were calculated separately, and compared. The analysis was made for all decedents aged 75 years and over and those with each of the 9 major disease categories. The average cost for disease category X was calculated as the sum of the specified costs of all decedents with a diagnosis of X divided by the total number of decedents with a diagnosis of X. The results of (C_H) and (C_L) were presented in a chart and the other results were presented in Table 2. Comparisons of the costs for moderately-old and extremely-old decedents were made for total combined cost (C_{H+L}) and subcategories of healthcare costs (C_{Hi}) and (C_{Ho}) and long-term care costs (C_{Li}) and (C_{Lh}). The analysis was made for all decedents aged 75 years and over and those with each of the 9 major disease categories.

Additionally, comparisons of days spent for treatment and costs per treatment day for moderately-old and extremely-old decedents were made by age and disease categories. To describe patterns of comorbidities, number of decedents was counted by disease categories with or without comorbidities. Cost statistics with or without comorbidities were calculated with each of the major disease categories.

The distribution of the costs, number of days for healthcare, and cost per day were positively skewed with a long right tail; therefore, the Wilcoxon rank-sum test was used to determine the differences in the costs, number of days for healthcare, and cost per day between the two age groups,

with statistical significance set at $p < 0.05$. SPSS (version 22.0, Armonk, NY: IBM Corp) was used for all the analyses.

Results

Cohort characteristics and healthcare and long-term care cost by disease categories

Table 1 shows the characteristics of cohorts in the study and healthcare and long-term care cost at the end of life. Data included 2149 decedents from April 1, 2010 to March 31, 2014, who were aged 75 years or older. Of these, the number of decedents with at least one of the selected 9 major diseases was 1711. The mean age of decedents aged 75 years or older was 86.5 years, and 52.6% were female. For all the subjects studied, the total cost per capita in the last 24 months before death was 5,307,531 JPY. Disease-wise, the average total costs for all decedent ages ranged from 9,169,547 JPY for chronic kidney disease to 5,023,762 JPY for ischemic heart disease. Mean, median, Q1, and Q3 statistics indicated skewed distribution of total cost, total healthcare cost, and total long-term care cost among all decedents and those categorized in specified disease categories.

Healthcare and long-term care cost by age and disease categories

Figure 1 compares the costs of healthcare and long-term care in the last 24 months of life between the moderately-old and extremely-old decedents. In all the diseases studied, healthcare costs decreased and long-term care costs increases as decedents become older. As exceptions, there were no significant differences between the two age groups in the healthcare and long-term care costs for mental disorders and in the healthcare costs for chronic lower respiratory diseases.

Table 2 shows the costs of inpatient and outpatient healthcare, institutional long-term care, home-based long-term care, and total costs in the last 24 months of life by age and disease. There were significant differences in the total costs between the moderately-old and extremely-old decedents for malignant neoplasms, dementia, pneumonia, and chronic lower respiratory diseases.

For most diseases, the moderately-old decedents incurred significantly higher inpatient and outpatient healthcare costs than did the extremely-old decedents. In contrast, the extremely-old decedents incurred significantly higher institutional long-term care costs and home-based long-term care costs than the moderately-old decedents did. However, there were no differences in the healthcare costs between the two age groups with chronic lower respiratory diseases, and no differences in the long-term care costs between the two age groups with mental disorders.

Table 1 Number of decedents, age, female proportion, and cost statistics by disease categories; 75 years and older; April 1, 2010-March 31, 2014

Major Disease Categories (ICD-10)	N	Female		Cost of care (Thousand JPY)					
		Age	proportion	Total cost (C_{H+L})		Healthcare cost (C_H)		Long-term care cost (C_L)	
		Mean (SD)	(%)	Mean (SD)	Median (Q1; Q3)	Mean (SD)	Median (Q1; Q3)	Mean (SD)	Median (Q1; Q3)
All	2149	86.5 (5.3)	52.6	5,308 (3,649)	5,053 (2,452; 7,370)	3,175 (3,528)	2,041 (781; 4,210)	2,133 (2,560)	789 (0; 4,057)
Malignant Neoplasms* (C16, C18-19, C22, C34, C50, C53-54, C81-86)	534	83.3 (5.3)	32.8	5,185 (3,537)	4,572 (2,628; 6,968)	4,345 (3,359)	3,555 (1,969; 5,846)	840 (1,599)	30 (0; 810)
Diabetes* (E10-14)	233	84.9 (5.9)	48.1	5,528 (3,227)	5,187 (3,000; 7,544)	3,763 (3,027)	3,083 (1,607; 4,853)	1,765 (2,146)	781 (0; 3,146)
Dementia* (F00-01)	222	87.4 (5.9)	59.0	5,960 (2,931)	6,459 (3,987; 7,580)	2,851 (2,949)	1,940 (856; 3,794)	3,109 (2,564)	2,905 (587; 5,648)
Mental Disorders* (F20, F32)	89	86.0 (5.7)	59.6	5,835 (3,045)	6,373 (3,563; 7,707)	3,579 (3,057)	2,764 (1,245; 5,286)	2,257 (2,216)	1,673 (68; 4,213)
Ischemic Heart Disease* (I20-25)	625	86.5 (6.3)	49.0	5,024 (3,645)	4,330 (2,182; 7,117)	3,441 (3,440)	2,316 (1,136; 4,323)	1,583 (2,047)	560 (0; 2,663)
Cerebrovascular Disease* (I60-63)	565	86.3 (6.3)	50.8	6,243 (3,401)	6,527 (3,555; 8,374)	3,675 (3,474)	2,569 (1,113; 4,955)	2,569 (2,601)	1,776 (23; 4,627)
Pneumonia* (J12-18)	321	86.5 (6.3)	42.4	5,699 (3,502)	5,378 (3,163; 7,706)	3,604 (3,145)	2,838 (1,587; 4,711)	2,095 (2,186)	1,254 (31; 3,992)
Chronic Lower Respiratory Diseases* (J40-45)	169	85.1 (6.0)	33.1	5,089 (3,220)	4,368 (2,636; 6,818)	3,719 (2,941)	3,180 (1,597; 4,893)	1,371 (1,868)	516 (0; 2,309)
Chronic Kidney Disease* (N17-19)	84	84.4 (5.9)	40.5	9,170 (6,217)	7,565 (4,078; 13,477)	8,011 (6,339)	6,541 (2,533; 12,171)	1,159 (1,604)	306 (0; 1,534)
Decedents with at least one of the above major disease categories	1711	86.1 (6.4)	48.9	5,449 (3,612)	5,053 (2,670; 7,516)	3,556 (3,507)	2,483 (1,146; 4,630)	1,893 (2,378)	642 (0; 3,450)

*One subject can be included in multiple disease categories.

For both inpatient and outpatient healthcare, the number of days of care and cost per day in the last 24 months of life were significantly higher among moderately-old than extremely-old decedents of all disease categories (Supplementary Table 1: online only). Similar patterns with total inpatient cost by disease categories were observed for the number of inpatient healthcare days except for ischemic heart disease. The moderately-old decedents incurred higher inpatient cost per day for malignant neoplasms, ischemic heart disease, and chronic lower respiratory diseases than did the extremely-old decedents (Supplementary Table 1).

Proportions of decedents of each disease categories reported without other major disease ranged from 16.7% (diabetes) to 41.0% (dementia) (Supplementary Table 2: online only). Comorbidities with malignant neoplasms, ischemic heart disease, or cerebrovascular disease were frequently reported (Supplementary Table 2).

Cost statistics varied among those with and without comorbidities (Supplementary Table 3: online only). Healthcare cost of decedents having two or more diagnoses was

generally higher than that of those without comorbidities. Exceptions were for mental disorders, chronic lower respiratory diseases, and chronic kidney disease (Supplementary Table 3).

Discussion

In our knowledge, this is the first study that analyzes the costs of end-of-life care through a complete enumeration of healthcare and long-term care data from a population-based sample according to major diseases. Our results showed that for most diseases, moderately-old decedents incurred more costs for healthcare, while extremely-old decedents incurred more costs for long-term care. As the age at death increases, there is an overall shift in spending from healthcare to long-term care.

A different pattern was seen for chronic lower respiratory diseases, where the healthcare costs of extremely-old decedents did not decrease compared to that of moderately-old decedents. This disease category includes diseases of

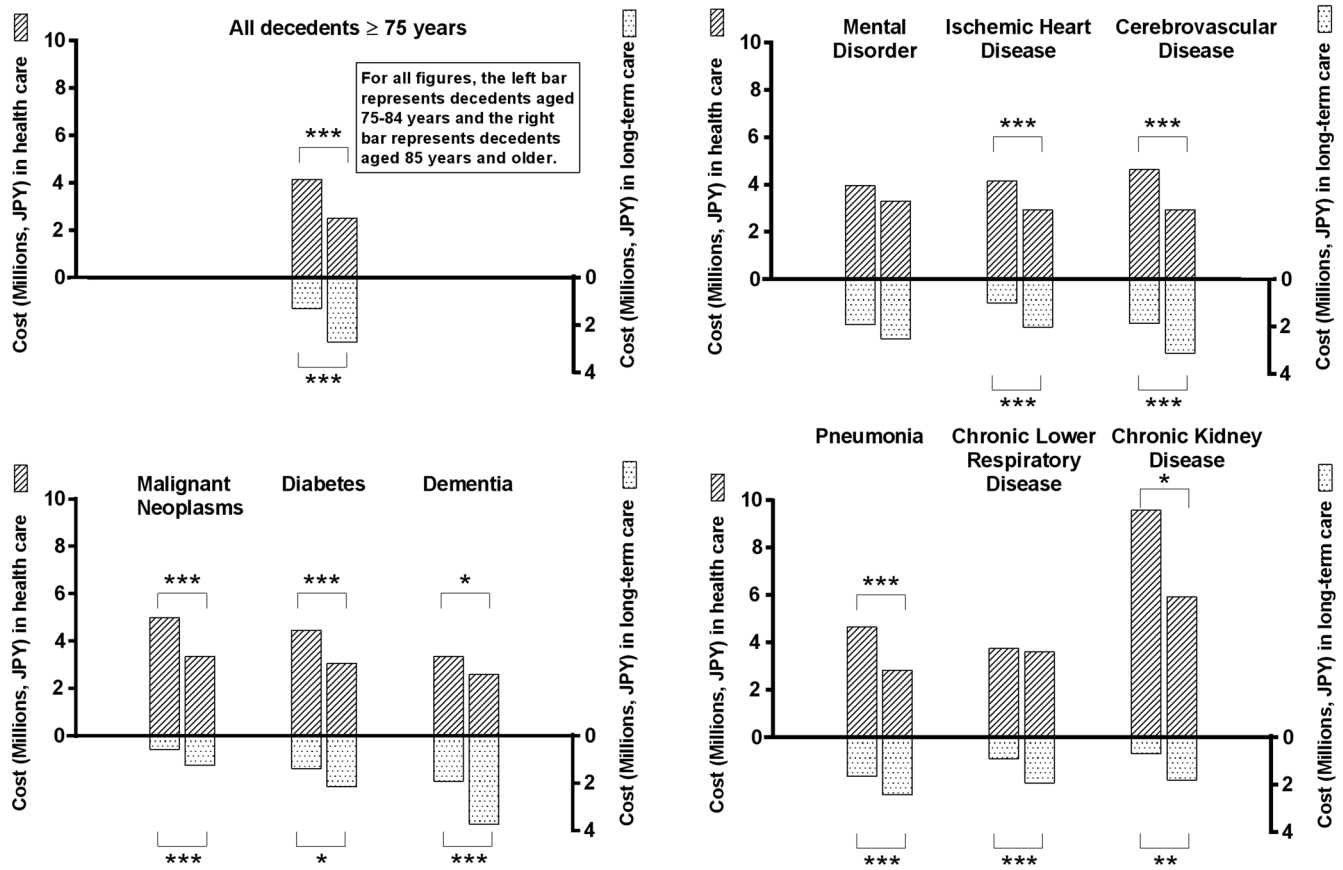


Figure 1 Comparison of healthcare and long-term care costs in the last 24 months of life between decedents aged 75–84 years and 85 years or older. The statistical difference in healthcare costs/long-term care costs between decedents aged 75–84 years and 85 years or older: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the lower respiratory tract characterized by obstructive air flow limitation, one of the most common being chronic obstructive pulmonary disease (COPD), where patients in advanced stages require long-term oxygen therapy for the relief of symptoms such as dyspnea. One possible explanation for this finding is that in Japan, elderly patients requiring long-term care with this disease have difficulties in finding an institution where long-term oxygen use is permitted¹². Long-term care institutions are operated by a limited number of medical personnel who are able to respond to medical emergencies pertaining to oxygen use or assist in changing oxygen tanks in the night and weekends¹³. Furthermore, because long-term oxygen therapy is a medical service covered by health insurance, patients on long-term oxygen therapy require monthly checkups at designated medical facilities. This is a difficult requirement for patients in long-term care institutions to fulfill because of the added medical fees that would be required by the institution to pay, which will not be reimbursed under long-term care insurance. In this case, an extremely-old COPD patient who requires long-term ox-

xygen therapy and assistance in activities of daily life would need to receive care under health insurance.

For total cost, malignant neoplasms, dementia, pneumonia, and chronic lower respiratory diseases had significant differences between the two age groups. For malignant neoplasms, the total costs of the moderately-old decedents were significantly higher than that of the extremely-old decedents. The long-term care cost of the extremely-old decedents was higher than that of the moderately-old decedents, but was the lowest in all diseases studied in the same age group. One possible explanation is that the total cost for extremely-old decedents was the lowest in all diseases studied, and that there is a significant difference between the total cost of the moderately-old and extremely-old decedents in this disease group. Because of the nature of this disease, which involves a rapid decline in health status, and because the certification process for long-term care eligibility requires, on average, over a month to complete¹⁴, those waiting to be certified in the last stages of malignancies may have to depend on services provided under health insurance instead of long-term

Table 2 Costs of healthcare (inpatient, outpatient) and long-term care (institution, home care) in the last 24 months of life by age and disease categories (ICD-10)

	N	Total Cost (C_{H+L}) Mean (SD) in Thousand JPY	Healthcare cost Mean (SD) in Thousand JPY		Long-term care cost Mean (SD) in Thousand JPY	
			Inpatient (C_{Hi})	Outpatient (C_{Ho})	Institution (C_{Li})	Home care (C_{Lh})
All decedents ≥ 75 years						
≤ 84 years	892	5,436 (4,178)	2,844 (3,439)	1,291 (2,072)	739 (1,947)	562 (1,100)
≥ 85 years	1257	5,216 (3,221)	1,751 (2,638)***	742 (1,103)***	1,844 (2,798)***	879 (1,379)***
Malignant Neoplasms (C16, C18-19, C22, C34, C50, C53-54, C81-86)						
≤ 84 years	323	5,567 (3,724)	3,371 (2,817)	1,623 (2,214)	186 (870)	387 (907)
≥ 85 years	211	4,599 (3,149)**	2,194 (2,369)***	1,156 (1,247)***	630 (1,729)***	619 (1,115)**
Diabetes (E10-14)						
≤ 84 years	119	5,844 (3,511)	3,220 (3,230)	1,230 (802)	539 (1,477)	854 (1,244)
≥ 85 years	114	5,198 (2,880)	2,104 (2,237)**	941 (771)***	1,341 (2,428)*	811 (1,204)*
Dementia (F00-01)						
≤ 84 years	76	5,262 (3,447)	2,515 (3,152)	834 (790)	1,218 (2,281)	694 (1,065)
≥ 85 years	146	6,324 (2,561)**	1,984 (2,795)*	608 (503)*	2,779 (2,815)***	953 (1,369)***
Mental Disorder (F20, F32)						
≤ 84 years	38	5,870 (3,562)	2,591 (3,091)	1,370 (2,000)	1,122 (2,060)	785 (1,104)
≥ 85 years	51	5,809 (2,633)	2,559 (2,651)	734 (675)*	1,367 (2,122)	1,150 (1,337)
Ischemic Heart Disease (I20-25)						
≤ 84 years	262	5,139 (4,104)	2,610 (3,245)	1,538 (2,093)	406 (1,398)	586 (1,044)
≥ 85 years	363	4,940 (3,277)	2,003 (2,520)**	927 (1,272)***	952 (1,970)***	1,057 (1,439)***
Cerebrovascular Disease (I60-63)						
≤ 84 years	246	6,490 (3,671)	3,472 (3,512)	1,155 (1,585)	968 (2,047)	895 (1,344)
≥ 85 years	319	6,053 (3,170)	2,301 (3,100)***	639 (575)***	2,160 (2,933)***	953 (1,412)***
Pneumonia (J12-18)						
≤ 84 years	135	6,312 (4,195)	3,399 (2,978)	1,266 (2,410)	875 (1,980)	773 (1,222)
≥ 85 years	186	5,255 (2,827)*	2,088 (1,977)***	747 (546)***	1,164 (2,028)	1,257 (1,541)***
Chronic Lower Respiratory Diseases (J40-45)						
≤ 84 years	90	4,653 (3,050)	2,249 (2,312)	1,511 (1,489)	311 (1,258)	582 (1,008)
≥ 85 years	79	5,586 (3,353)*	2,461 (3,155)	1,210 (951)	776 (1,718)*	1,139 (1,435)**
Chronic Kidney Disease (N17-19)						
≤ 84 years	48	10,256 (7,215)	5,405 (6,017)	4,169 (4,343)	128 (745)	555 (901)
≥ 85 years	36	7,720 (4,441)	3,824 (3,421)	2,102 (2,799)**	648 (1,585)	1,146 (1,474)**

Differences in cost were calculated between the age groups ≤ 84 years and ≥ 85 years using the Wilcoxon rank-sum test: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

care insurance¹⁵).

For the total cost of dementia, the extremely-old decedents incurred significantly higher cost than did the moderately-old decedents. The extremely-old decedents with dementia incurred the highest cost for institutional long-term care in all the diseases studied, which may explain the highest total cost of this age group. An analysis of Medicare costs for patients with dementia in the last five years of life in the United States found that the average total costs as well as the out-of-pocket costs per decedent with dementia was greater than that of those with heart disease or cancer, with the main determinant of these costs being nursing home and

implicit costs of informal care¹⁶). Another study calculated the annual cost for dementia care purchased in the market place to be similar to direct healthcare expenditures for heart disease and significantly higher than that for cancer, with nursing home and home care (formal and informal) representing 75–84% of attributable costs¹⁷).

The results of longer days of care and higher cost per day among the moderately-old than extremely-old decedents supported their higher total healthcare cost in the last 24 months of life. Contribution of longer days of inpatient care or higher cost per day varied according to disease categories. For ischemic heart disease, inpatient days were rela-

tively shorter and similar for both age categories but cost per day was higher for the moderately-old decedents. For chronic lower respiratory diseases, the extremely-old decedents stayed longer but incurred lower cost per day. Reasons behind high or low healthcare cost, either relating to longer days needed for treatment or higher cost spent per day, should be understood by disease categories.

Care during the final years of life can take different courses according to the different health conditions involved, as well as individual needs and preferences. For example, studies have indicated differing preferences among the general population between hospital and home-based care for terminal cancer or heart disease or for choosing to initiate or forgo gastric tube feeding for those with dysphagia, which is commonly seen in patients with dementia or cerebrovascular disease¹⁸). As diseases at the end of life become diverse, it is useful to understand the costs incurred for different diseases at this stage of life.

The need for the coordinated and comprehensive provision of health and long-term care is addressed for the care of the elderly in recent years. The “community-based integrated care system” recommended in Japan emphasizes the provision of comprehensively coordinated services, from acute medical care to long-term care at home or institutions in one’s residential community¹⁹). Although the choice of healthcare or long-term care services depends on needs of healthcare or long-term care services, availabilities of resources and financial acceptability that are subject to the health insurance and long-term care insurance policies, and personal preferences, it is worth noting that the general shift from healthcare to long-term care services was observed in later life. Our study showed that the use of healthcare and long-term care services generally differ according to age. Future needs of required services for healthcare and long-term care at different time points should be discussed by taking account of disease patterns and age of the elderly based on population estimates. Population-based needs of shifting from healthcare to long-term care according to the population ages should be reflected in regional healthcare and long-term care plans. Plans for healthcare and long-term care should be discussed simultaneously and regional-based seamless plan for healthcare and long-term care for elderly are needed.

Our study has several limitations. First, data from health insurance claims only provided disease names for decedents; clinical information such as disease severity or functional status as well as information about quality of services were not available.

Second, we used the “principal diagnosis” indicated on the health insurance claims for the calculation of cost by disease group. Since 2002, medical facilities are required

to indicate a principal diagnosis per health insurance claim, which is decided by the treating physician as the most appropriate as per medical standards²⁰). However, there is a possibility that the principal diagnosis is not indicated on the claims and decided arbitrarily by the insurance coders or designated automatically as the first disease name out of a list of all diseases on the insurance claim^{21, 22}). Because our study took information of diagnosis in all 24 months before death, information bias to represent diseases suffered by individual deceased persons could have been minimized. Taking the reported principal diagnosis of the 24-month period into analysis, the data showed that a high proportion of comorbidities and cost statistics varied among those with or without comorbidities. Despite these limitations, we observed that the cost in the last 24 months varied according to the major diseases treated in that period. Considering the high proportion of comorbidity, particularly among older adults, application of a methodology to use all disease names relating to treatment or cohort analysis are recommended in future studies.

Third, this study analyzed data from a city. The results may have been influenced by the availability of healthcare and long-term care services in this particular city and its surrounding areas. Analysis of the data from other areas and the influence of service availabilities based on data from multiple areas will help generalize the conclusions widely.

Conclusion

Among decedents older than 75 years who died between 2010 and 2014 in a city in Japan, the total costs (healthcare and long-term care combined) per capita was the highest for decedents with chronic kidney disease and lowest for decedents with ischemic heart disease. Across major diseases, a general shift in expenditure from healthcare to long-term care was observed as the age at death increased. However, an exception was seen for chronic lower respiratory diseases, where extremely-old decedents aged 85 years and older incurred higher costs and more days of inpatient care than did moderately-old decedents aged 75 to 84 years.

Conflict of Interest: The authors declare no conflicts of interest.

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