Asia-Pacific Journal
of Health Management ACHSM

RESEARCH ARTICLE

AGING AND DIVERSITY OF MEDICAL NEEDS: COST OF ILLNESS OF CEREBROVASCULAR DISEASE IN EACH PREFECTURE OF JAPAN

Tomonori Hasegawa, Kunichika Matsumoto, Koki Hirat
Toho University School of Medicine

Correspondence: tommie@med.toho-u.ac.jp

ABSTRACT

BACKGROUND:

Aging in Japan is advancing most rapidly in the world and is expected to increase demand for medical services in the near future. Aging is uneven and progress of aging varies from regions resulting in great differences in medical needs. In order to supply the needs for medical services, theJapanese government developed the "Regional Medical Vision", which estimates the near future requirements for medical resources. However, this is a plan for redistribution of medical resources taking into account future changes of a population composition based on the current situation. In fact, each region has a diversity of medical needs, and it is difficult to use average medical needs even if they are adjusted by population structures.

In consideration of such situation, we tried to estimate the social burden of major diseases of each region in order to estimate the medical needs. We picked up cerebrovascular diseases (CVD, ICD10 code: I60 - I69) and dementia (ICD10 code: F01, F03, G30), and calculated their social burden of all 47 prefectures in Japan that have authority for health policy.

METHOD:

Modifying the COI method developed by Rice D, we newly defined and estimated C-COI of CVD (ICD10 code: I60 - I69) and dementia (ICD10code: F01, F03, G30). C-COI consists of five parts; direct cost (medical), morbidity cost, mortality cost, direct cost (long term care (LTC)) and informal care cost (family's burden). Direct cost (medical) is medical cost of each disease. Morbidity cost is opportunity cost for inpatient care and outpatient care. Mortality cost is measured as the loss of human capital

(human capital method). These three costs are known as components of original cost of illness by Rice D. Direct cost (LTC) is long term care insurance benefits. Family's burden is "unpaid care cost" by family, relatives and friends in-home and in-community (opportunity cost). We calculated such costs at 2013/2014 prices using Japanese official statistics.

RESULTS:

The total C-COI of CVD in Japan was about 6,177 billion JPY, the maximum was 621 billion JPY in Tokyo and the minimum was 33 billion JPY in Tottori (Tokyo/Tottori=18.8), whereas the total C-COI of dementia was 3,778 billion JPY, the maximum was 341 billion JPY in Tokyo and the minimum was 22 billion JPY in Tottori (Tokyo/Tottori=15.5). The C-COI per capita of CVD in Japan was about 48 thousand JPY, the maximum was 66 thousand JPY in Kagoshima and the minimum was 38 billion JPY in Saitama (Kagoshima/Saitama=1.7), whereas the total C-COI of dementia was 3,778 billion JPY, the maximum was 46 thousand JPY in Shimane and the minimum was 22 thousand JPY in Chiba (Shimane/Chiba=2.1).

CONCLUSION:

We substantiated a method to calculate the social burden of medical care and LTC care for each prefecture using C-COI methods. In both diseases, a large difference was found in total costs per capita and components ratio between prefectures. The situations of social burden of diseases has diversity among prefectures. When estimating the future medical needs of each region, it is necessary to take each regional condition into account.

INTRODUCTION

There are several definitions of the elderly, and 60 and over or 65 and over are commonly used. Recently, based upon the findings about the prevalence of disability and fragility, and the change of industry, where specialist and management skills are becoming predominant, the new definition of the elderly is defined as aged 75 and over, is gradually becoming popular.

In Japan 65 years old and over people already occupies 27.7% of the population, and 75 and over elderly occupies 13.8% of the population. Moreover, percentage of 75 and over elderly is predicted to become 25% in 2060. This increase of the elderly population will result in expansion of demand for medical and long-term care (LTC) services.

However, the ageing rate of society is unequal among regions, and speed of ageing is also unequal. Japanese government structure has 3 tiers, 1 central government, 47 prefectures, and about 1900 municipalities. In Japan prefectures are commonly used as units of regional analysis, because prefectures have not changed their administrative divisions for 130 years, and they have responsibility for health services and public health administration. Ageing speed is unequal among such prefectures.[1] In the near future the speed of ageing within prefectures which already have high aging rate will be low, however, the speed of metropolitan suburban prefectures will be quite high and the demand for medical services and LTC services is predicted to increase (Fig. 1). About 60 % of increasing numbers of elderly from 2015 to 2025 are estimated to be concentrated in the top 10 prefectures with big cities (Fig. 2).

The Japanese government has carried out 2 regional plans for medical services with estimated medical demand in each region. The first plan is a "regional medical care plan," which started in 1985.[2] This plan determines the target number of beds which is calculated by current number of beds, discharge rate, population by sex and age, average length of stay in hospital, and so on. In 1985 Japan was still in the situation of population increase, and the ageing of society had increased the demand for medical services. The regional medical plan restricted new hospitals to under-serviced areas, however, there were no impact on existing hospital beds.

The second plan was "regional medical vision" which was formulated in 2015.[2] The regional medical vision was the plan for preparing medical delivery system in the near future where the population and the demand for acute care will be shrinking. The vision estimates medical care demand in 2025 using 2025 population structure and inpatients/outpatients rates of 2013. For promoting specialization and cooperation among hospitals, the vision estimated required number of beds classified by 4 bed types, that is, advanced acute care, acute care, recovery care, and chronic care beds. In 2015 Japan was already in the situation of population decrease, and the situation was estimated to shrink the demand for medical services in near future. In this vision, prefectures are expected to facilitate cooperation with financial incentives.

This regional medical vision adopted the estimation of required number of beds classified by their functions; however, it was based on nation-wide inpatients/outpatients' rates of 2013. Regional diversity of medical needs was not taken into account. So, it can be said that this is limited to the estimation from the point of view of the supply side. There is diversity of structure of diseases as well as structure of population among regions, and we need the estimation from the point of view of the demand side. In this study we tried to develop the method to estimate the burden of diseases, which shows diversity of structure of diseases among prefectures. We calculated the comprehensive cost of illness (C-COI) of cerebrovascular disease and dementia among prefectures. Incidence of the two diseases is high among elderly people and the cost structure seems to differ; both acute care and LTC care are needed for cerebrovascular disease, and mainly LTC care will be needed for dementia.

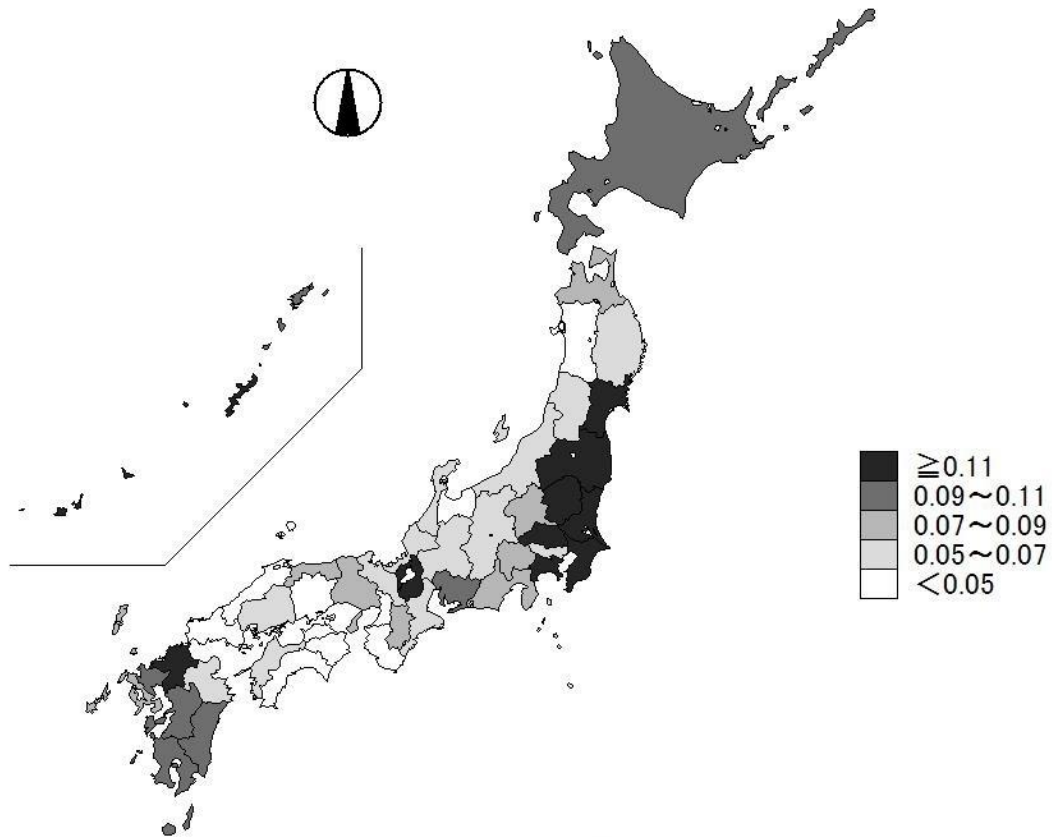**FIGURE 1. INCREASE OF 65 AND OVER POPULATION (2015-2025)**

Legend:
≧0.11
0.09～0.11
0.07～0.09
0.05～0.07
＜0.05

Fig. 1 Increase of 65 and over population (2015→2025)

0   400km

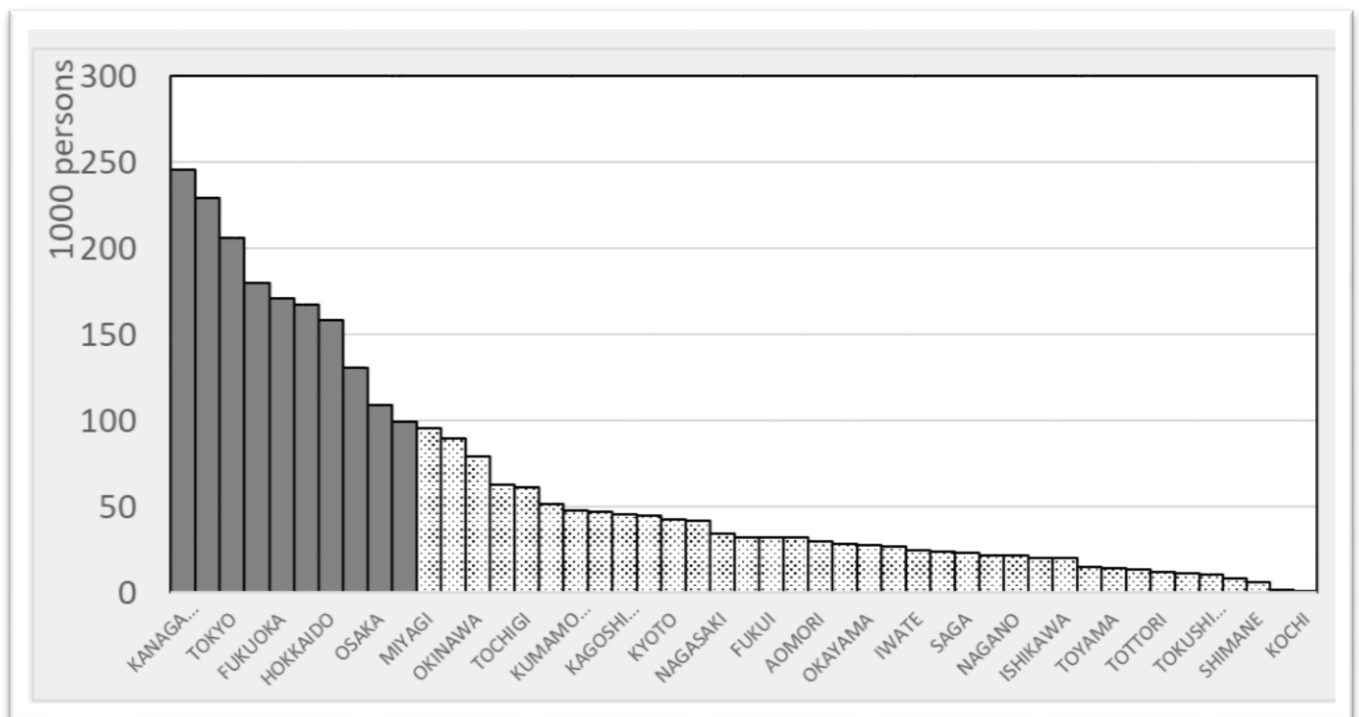**FIGURE 2. INCREASE OF 65+ POPULATION (2015→2025)**
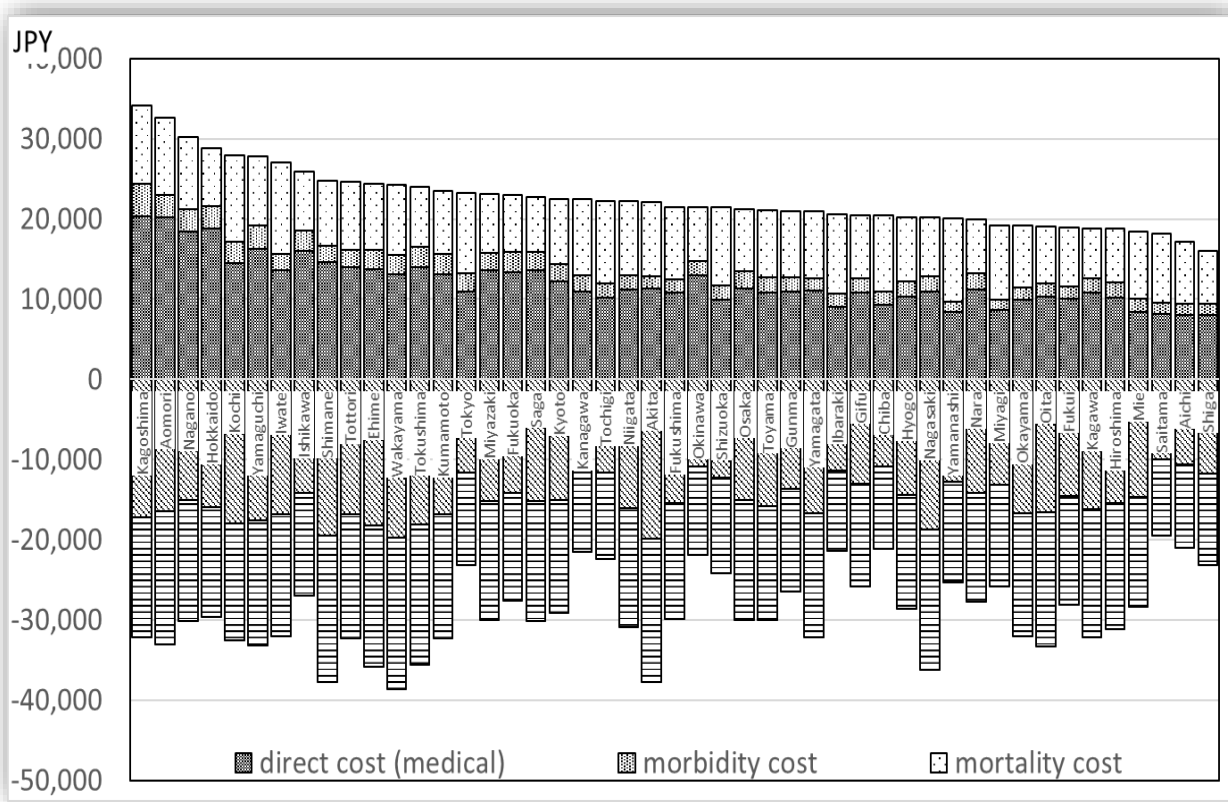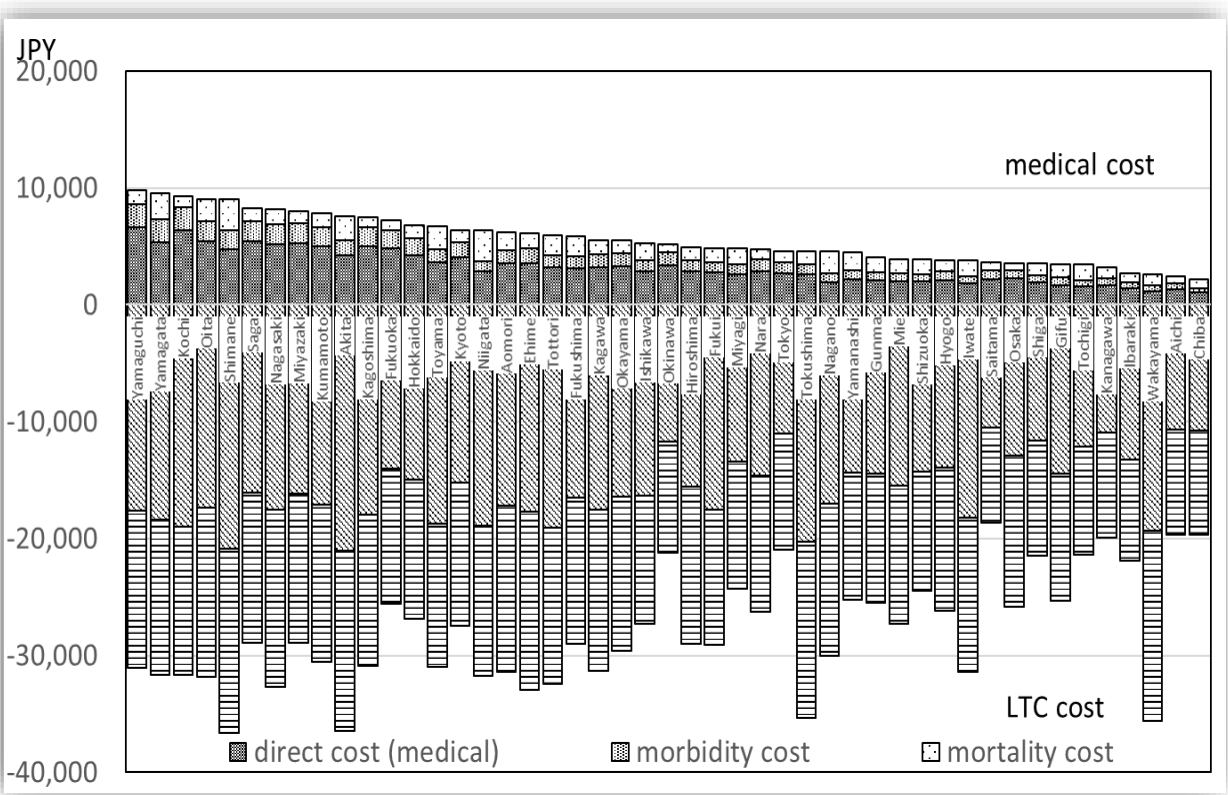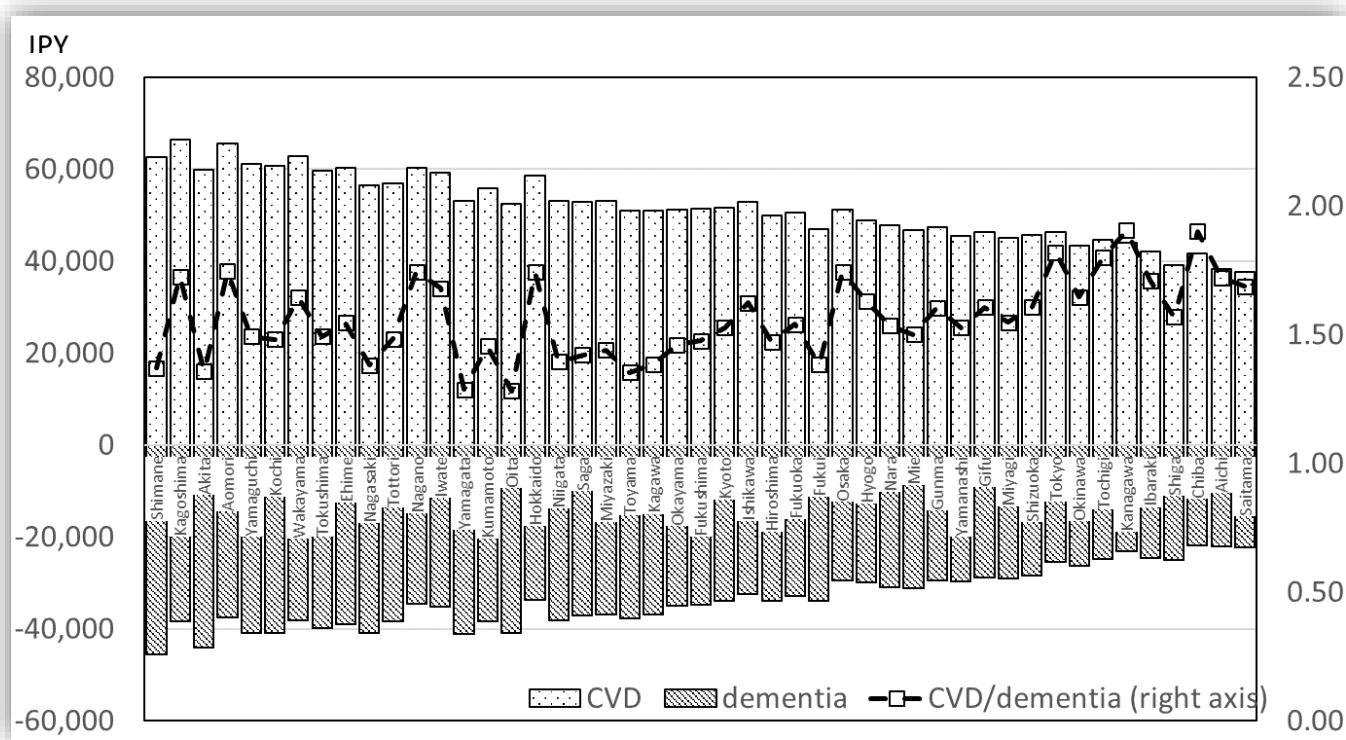
FIGURE. 3 C-COI PER CAPITA OF CVD (2014)

FIGURE. 4 C-COI PER CAPITA OF DEMENTIA (2014)

METHOD

Modifying the cost of illness (COI) method developed by Rice D3-6), was used to define and estimate comprehensive cost of illness (C-COI) of cerebrovascular disease (CVD) (ICD10 code: I60 - I69) and dementia (ICD10 code: F01, F03, G30). The comprehensive cost of illness (C-COI) was defined as follows;

C-COI = medical direst cost (MDC) + formal care cost (FCC)

+ morbidity cost (MbC) + mortality cost (MtC) + informal care cost (ICC)

MDC is the medical cost directly related to the disease, and includes costs associated with treatment, hospitalization, testing and drugs. In Japan almost all medical expenses are covered by the national medical insurance, and so we can calculate MDC by the data collected in the Survey of National Medical Care Insurance Services. MbC is the opportunity cost lost resulting from hospitalization and outpatient visits. MtC is measured as the loss of human capital (human capital method), which we got by multiplying the number of deaths from the disease by the lifetime labor value per person. These three costs are known as components of original cost of illness. [7-11]

Original COI method has been well described as a way to measure the social burden of disease, however, it has the disadvantage that it cannot adequately measure the burden of chronic diseases whose LTC costs account for a significant portion of the social burden. C-COI method includes such LTC costs. LTC costs can be divided into 2 parts; formal care cost (FCC) and informal care cost (ICC). FCC is the LTC cost covered by public LTC insurance which was introduced in 2000. ICC is the cost to the family resulting from LTC. ICC can be estimated by 2 different methods; opportunity cost approach (OCA) and replacement approach (RA). OCA uses family member's opportunity cost lost resulting from giving care, whereas RA uses market price of care worker's wage. Generally, the cost measured by OCA is lower than the cost measured by RA, because family caregivers are sometimes old whose labor value at market is low. In this study we used OCA. [12,13]

The detailed calculation method is shown in Table 1. All calculation was done using governmental data.

RESULT

Figure 3 showed C-COI per capita of CVD of all prefectures. Vertical axis meant C-COI per capita; above 0-line bars were medical costs and below 0 bars were LTC costs. The bars were arranged in descending order of medical costs. The highest was 66,315 JPY (Japanese Yen) of Kagoshima prefecture and was 1.8 times of the lowest prefecture (Saitama prefecture, 377,706 JPY). Average percentage of LTC costs to C-COI was about 56%. There was no correlation between medical costs and LTC costs, and breakdowns of C-COI were different among prefectures (Table 2).

Figure 4 showed C-COI per capita of dementia of all prefectures. The highest was 45,634 JPY of Shimane prefecture and was 2.1 times of the lowest prefecture (Chiba prefecture, 21,853 JPY). As same as CVD there was no correlation between medical costs and LTC costs, and breakdowns of C-COI were also different among prefectures (Table 3).

Figure 5 showed summation of C-COI of both diseases arranged in descending order. The line graph showed the ratio of C-COI of CVD to that of dementia. The highest was 1.91 of Kanagawa prefecture, whereas the lowest is 1.28 of Oita prefecture. There was diversion in not only the level of C-COI but also the ratio of each disease among prefectures.

TABLE 1 COST CALCULATION

	Calculation Method
Direct cost	
Medical DC	Annual medical expenses based on reimbursement data＊.
Formal Care Cost	LTC cost covered by public LTC insurance
Indirect cost	
Morbidity cost	(Total person–days of hospitalization× One day labor–value) +(Total person–days of outpatient× One day labor–
Informal Care Cost	number of family caregivers× average time for care a day × 1–hour labor value per person × 365
Mortality cost	Number of death× Life time labor–value per person

1.Benchmark discount rate was 3%.

2. One day labor-value was referred from the national survey of 2014.

3.Life time labor-value was calculated summing up the income which patient could have earned in the future if they had not died.

TABLE 2 C-COI PER CAPITA OF CVD: AVERAGE, MAX AND MIN

	C-COI	direct (Med)	morbidity	mortality	direct (LTC)	family`s burden
AVG (JPY)	51,664	12,090	2,025	8,388	14,998	14,164
SD (JPY)	7,223	3,032	518	1,217	2,557	2,329
MAX (JPY)	66,315	20,363	3,965	11,487	19,844	18,941
	Kagoshima	Kagoshima	Kagoshima	Iwate	Akita	Wakayama
MIN (JPY)	37,706	8,045	1,335	6,310	10,035	9,507
	Saitama	Shiga	Yamanashi	Kagawa	Saitama	Saitama
MAX/MIN	1.8	2.5	3.0	1.8	2.0	2.0

TABLE 3 C-COI PER CAPITA OF DEMENTIA: AVERAGE, MAX AND MIN

	C-COI	direct (Med)	morbidity	mortality	direct (LTC)	family`s burden
AVG (JPY)	33,493	3,216	1,062	1,264	15,745	12,207
SD (JPY)	6,219	1,451	455	475	2,869	2,027
MAX (JPY)	45,634	6,589	1,991	2,623	21,068	16,308
	Shimane	Yamaguchi	Yamaguchi	Niigata	Akita	Wakayama
MIN (JPY)	21,853	1,079	348	616	10,490	8,194
	Chiba	Chiba	Chiba	Osaka	Saitama	Saitama
MAX/MIN	2.1	6.1	5.7	4.3	2.0	2.0

DISCUSSION

The results of the study would intensify the diversity of ageing and corresponding burden of major diseases among prefectures. In an ageing society, local level health policy will become more important using detailed data of each prefecture.

In this study we could estimate regional burden of diseases using C-COI method. C-COI of both CVD and dementia varied widely, moreover the breakdowns of costs also varied widely among prefectures. In addition to these, the ratio of C-COI of CVD to that of dementia also showed difference, and there was no correlation between C-COIs of two diseases. It was suggested that the structures of the burden of diseases differ with regions.

Our study had several limitations. First, the data we used were governmental aggregated data, so we could not get the information about number of persons requiring care classified by major causes. In this study we used proportion of persons requiring care whose major cause was CVD or dementia to whole persons requiring care and multiplied the proportion by the number of persons requiring care of each prefecture. Second, persons requiring care were classified by only major causes, we could not consider the burden of comorbidities. Elderly people commonly have several diseases, and two diseases could contribute to lower ADLs. Our C-COI might be under-estimated since the contribution of two diseases as comorbidities were not taken into account. Finally, our C-COIs were calculated for only 2014 year. Time series analysis and future projection should be next issues.

Despite such limitations, we expect that our measurement of burden of diseases in prefectures using C-COI method helps to estimate regional medical demand. More detailed analysis using governmental individual data is needed.

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