Brief Report

Diseases that precede disability among latter-stage elderly individuals in Japan

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Summary	Understanding causes of disability among elderly individuals is an important public health issue, particularly because of the increasing rate of disabled elderly individuals and the social costs in a rapidly aging society. Accordingly, we aimed to describe the diseases that precede disability and investigate the types of diseases that are related to severe disability among Japanese elderly individuals aged over 75 years. Using claim data from the latter-stage elderly healthcare system and long-term care insurance system, we identified 76,265 elderly individuals over 75 years old who did not qualify as disabled on April 1, 2011. Among them, 3,715 elderly individuals who had been newly qualified as disabled between April 1, 2011 and March 31, 2012 were selected. Disease codes from the medical claim data in the 6 months prior to disability were collected. All descriptions were developed separately for six groups divided by gender and disability level (low, middle, and high). The results of the ordinal logistic analysis including sex and age revealed that men tended to have significantly higher levels of disability ($\beta = 0.417$, $p < 0.001$) than women. Cerebrovascular disorder (CVD) was the most common disease in almost all age and disability level groups. In low-level disability groups, cancer in men (12.8%) and arthropathy and fracture in women (11.9% and 13.5%, respectively) were as common as cerebrovascular disorder (12.2% and 9.7%, in men and women, respectively). Stroke was the most common disease for all genders and disability levels. The diseases preceding low-level disability differed by gender. This study demonstrated the need to consider arthropathy and fracture as well as CVD in order to prevent disability.

Keywords: Disability, disease, potential risk factors for disability, aging, long-term care

1. Introduction

Understanding the cause of disability and factors that precede it among elderly individuals is important to ensure both prevention of disability and cost saving in care for disabled persons. In Japan, disabled elderly individuals are supported by the long-term care insurance system (*1*), which covers long-term care services including home visits and institutional care service. In March 2014, about 53% of disabled persons who received long-term care services were mildly disabled (care levels 1-3 in the Japanese long-term care insurance system), while 47% were severely disabled (care level 4 or 5).

Cerebrovascular disorder (CVD), including stroke, has been reported as the most common disease among disabled persons. Adamson and colleagues found that the effect of CVD on disability was greater than that of other chronic diseases among UK adults (*2*). In the US, stroke is a leading cause of disability (*3*). Further, in a nationwide self-reported survey, over 33.0% of disabled people recognized that the direct cause of their disability was CVD (*4*).

However, in Newman and Brach's (*5*) review, arthritis was reported as the greatest cause of disability among elderly individuals because it limits their everyday activities. While the impact of arthritis on disability severity might be smaller than that of CVD, from a public health perspective, the benefit of preventing mild disability among elderly individuals might be comparable

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to that related to preventing CVD.

Objective data collection instruments are preferred in measuring disability; however, the majority of studies rely on self-report measures of disability (5). This might lead to problems of reliability in measuring disability and detecting disabled elderly individuals. In Japan, claim data from the long-term care insurance system can provide objective information on who is disabled among elderly individuals, when s/he became disabled, and how severely s/he is disabled. Further, other claim data from the healthcare system (latter-stage elderly healthcare system) can provide objective information about disease among disabled elderly individuals. If we merge the two types of claim data, we can determine the diagnosed disease that preceded disability. This study aimed to describe the kinds of diseases that preceded disability and investigate the types of diseases that are related to severe disability among Japanese elderly individuals. Because of data availability, we targeted individuals aged at least 75 years.

2. Methods

2.1. *Definition of disability*

We referred to the qualification of the long-term care insurance system for service use as a disability index. It ranged in terms of support level from care level 1 to 5, which indicate increasing difficulty and need for assistance with activities of daily living. Care level 1 indicates "having difficulty in independent walking or daily activity, but not chair bound," care levels 2 and 3 mean "almost chair bound, but not bedridden," and care levels 4 and 5 indicate "almost or completely bedridden." For ease of understanding, care levels 1, 2/3, and 4/5 were categorized as low, middle, and high disability, respectively.

The certification was based on the clients' or their families' proposal to local governments, and the certification level was determined based on two perspectives: the standardized statistical algorithm for estimating the amount of care requirements and a local committee of specialists (*i.e.* physicians, public health nurses, social workers, and so on).

Elderly individuals were considered "newly disabled" when they had not been certified for more than 2 months, and then certification was detected in the next month based on receipt data. In the Japanese certification system, disabled individuals rarely distinguish their certification in 1 month due to any systematic errors. We consulted with two specialists on a local committee, and this algorithm was considered valid to detect disabled elderly individuals.

2.2. *Design and data collection*

We used claim data from the latter-stage elderly

healthcare system and the long-term care insurance system in Fukui prefecture, Japan. The data from the latter-stage elderly healthcare system was provided by the Fukui Latter-Stage Elderly Healthcare System Association, and the data from the long-term care insurance system was provided by the Fukui National Health Insurance Organization. Two types of claim data were managed by the different organizations; however, we can merge them and identify the same individuals with a common ID. Using the merged data, we can determine each person's medical and long-term care insurance service consumption volume, disability level, disease code, and region for each month.

This study was conducted under a large collaborative study called the Fukui Gerontology Study of Fukui prefecture and Institute of Gerontology, The University of Tokyo. In this study, Fukui prefecture, the Fukui National Health Insurance Organization, the Fukui Latter-Stage Elderly Healthcare System Association, and the University of Tokyo collaborated from April 2011 to March 2015. All data were provided for researchers in the form of anonymous electric data. The Ethics Committee of the Graduate School of Medicine at the University of Tokyo approved this study.

2.3. *Subjects*

First, elderly individuals aged 75 years or older who were insured by the Fukui latter-stage elderly healthcare system from April 1, 2011 through March 31, 2012 were detected. On April 1, 102,450 elderly individuals were observed. Between April 1 and March 31, 1,627 elderly individuals (1.6%) dropped out after moving or for other unknown reasons, and 6,411 (6.4%) had deceased. We excluded 1,627 individuals who dropped out, leaving a total of 100,823 elderly individuals. Among them, 24,558 were already disabled with low- (5,920; 24.1%), middle- (10,166; 41.4%), and high-level disabilities (8,392; 34.1%), and 80 (0.3%) had been certified as low- or middle-level disability in February or March, but not in April 2011. Thus, there were 76,265 elderly individuals that remained non-disabled on April 1, 2011. We followed up their claim data and detected newly disabled persons between April 2011 and March 2012 ($n = 3,715$), whose data were then analyzed.

2.4. *Definition of the disease preceding disability*

For newly disabled elderly individuals, we observed the disease code in the latter-stage elderly healthcare system claim data over the 6 months preceding disability. The latter-stage elderly healthcare system claim data includes five separate types of medical consumption data for elderly individuals: admission to hospital, outpatient, dentistry, pharmacy, and home-visiting nursing. We included all types of data and investigated

the diseases that were coded in the 6 months preceding disability.

We focused on nine types of diseases as predisposing factors for disability: (1) cancer (C00-97 in ICD-10); (2) CVD (I60, 61, 63, 69.0, 69.1, 69.3); (3) arthropathy (M15-19); (4) fracture (S02, S12, S22, S32, S42, S52, S62, S72, S82, S92 T02, T08, T10, T12); (5) pneumonia J12-18); (6) chronic obstructive pulmonary disease (COPD, J41-44); (7) dementia (F01, F03, G30); (8) psychiatric disorder (F20-48); and (9) neurological disorder (G00-29, G31-99). If one or more corresponding code for each of these nine diseases was detected in 6 months, the person was considered to have the disease. Other types of individual information, including age at certified month and sex, were collected from receipt data.

2.5. *Analysis*

First, a *t*-test compared the mean age of certified month between men and women. Second, we separately summarized percentages of each disease according to sex and disability level (low, middle, high). To determine the age-adjusted differences of disability level among men and women, multivariate ordinal logistic analysis for disability level (1 = low, 2 = middle, 3 = high) was conducted. Lastly, in order to investigate the types of diseases associated with severe disability, multivariate ordinal logistic regression analysis for disability level was conducted for men and women separately, with age and nine types of diseases included as independent variables. SPSS version 22.0 for Windows was used for all analysis, and $p < 0.05$ was defined as significant.

3. Results and Discussion

The mean age of certified month was 84.2 years (standard deviation (SD) = 5.1; range: 75-103). Men were younger at first certified age (83.5 (SD = 4.8) in men and 84.8 (SD = 5.1) in women, $p < 0.001$. In Table 1, among all newly disabled elderly individuals, low-level disability was present in 1,705 (45.9%) participants, and high-level disability was present in 681 (18.3%). These percentages

were quite different from the cross-sectional prevalence of disability level in April 2011: 24.1%, 41.4%, and 34.1% for low-, middle-, and high-level disability, respectively. This difference suggests that about half of latter-stage elderly individuals have low-level disabilities initially, but then ultimately progress to higher stages of disability.

For men, there were 617 (39.8%) individuals with low-level disability and 327 (21.1%) with high-level disability. For women, 1,088 (50.2%) individuals had low-level disability, and 354 (16.3%) had high-level disability. The results of the ordinal logistic analysis including sex and age revealed that men tended to have significantly higher levels of disability (β = 0.417, $p <$ 0.001) than women. These results can be understood from two perspectives. First, men tend to be disabled more severely initially, or second, men tend to avoid filing their qualification for long-term care insurance until their disability worsens. The former is supported by the disease distribution presented in Table 2. Ordinal logistic analysis including age and disease showed that there were no sex differences in the relationship between disease and disability severity. In both men and women, cancer, CVD, fracture, pneumonia significantly related to higher levels of disability, and arthropathy and dementia significantly related to lower levels of disability. In men, CVD and cancer are the most common diseases at all disease levels (12.2%, 15.9%, and 27.8% for CVD and 12.8%, 18.8%, 16.8% for cancer for low, middle, and high levels, respectively). On the other hand, arthropathy and fracture were more common in low- and middle-level disabled women than they were in men (11.9% *vs.* 7.1% and 10.9% *vs.* 6.0% for arthropathy among low- and middle-level disability, respectively; 8.2% *vs.* 4.7% and 17.2% *vs.* 6.3% for fracture among low- and middle-level disability, respectively). With regard to diseases that precede disability, these results imply that men tend to have a higher number of diseases that are associated with severe disability, than women. This may be because of the age-specific rate of stroke is higher in men generally (*6*), and thus, men could be considered to have a greater risk for more severe disability.

Table 1. Frequency of disease and disability level (*n* = 3,715)

Items	Total	Low	Middle	High
Total	3,715 (100.0%)	1,705 (45.9%)	1,329 (35.8%)	681 (18.3%)
Cancer	410 (11.0%)	138 (8.1%)	179 (13.5%)	93 (13.7%)
CVD	507 (13.6%)	180 (10.6%)	159 (12.0%)	168 (24.7%)
Arthropathy	306 (8.2%)	174 (10.2%)	102 (7.7%)	30 (4.4%)
Fracture	343 (9.2%)	118 (6.9%)	142 (10.7%)	83 (12.2%)
Pneumonia	111 (3.0%)	31 (1.8%)	51 (3.8%)	29 (4.3%)
COPD	68 (1.8%)	28 (1.6%)	28 (2.1%)	12 (1.8%)
Dementia	284 (7.6%)	207 (12.1%)	63 (4.7%)	14 (2.1%)
Psychiatric	158 (4.3%)	92 (5.4%)	49 (3.7%)	17 (2.5%)
Neurological disorder	208 (5.6%)	103 (6.0%)	76 (5.7%)	29 (4.3%)

Values are presented as *n* (%); CVD, cerebral vascular disorder; COPD, chronic obstructive pulmonary disease.

Table 2. Frequency of disease and disability level by sex (*n* = 3,715)

Items	Total	Low	Middle	High	B*	*p*
Men	1,549 (100.0%)	617 (39.8%)	605 (39.1%)	327 (21.1%)		
Cancer	248 (16.0%)	79 (12.8%)	114 (18.8%)	55 (16.8%)	0.286	0.029
CVD	262 (16.9%)	75 (12.2%)	96 (15.9%)	91 (27.8%)	0.766	< 0.001
Arthropathy	90 (5.8%)	44 (7.1%)	36 (6.0%)	10 (3.1%)	- 0.512	0.015
Fracture	96 (6.2%)	29 (4.7%)	38 (6.3%)	29 (8.9%)	0.561	0.004
Pneumonia	73 (4.7%)	19 (3.1%)	36 (6.0%)	18 (5.5%)	0.470	0.036
COPD	55 (3.6%)	20 (3.2%)	23 (3.8%)	12 (3.7%)	0.159	0.538
Dementia	98 (6.3%)	60 (9.7%)	32 (5.3%)	6 (1.8%)	- 0.951	< 0.001
Psychiatric	55 (3.6%)	28 (4.5%)	19 (3.1%)	8 (2.4%)	- 0.410	0.125
Neurological disorder	91 (5.9%)	37 (6.0%)	38 (6.3%)	16 (4.9%)	- 0.106	0.607
Women	2,166 (100.0%)	1,088 (50.2%)	724 (33.4%)	354 (16.3%)		
Cancer	162 (7.5%)	59 (5.4%)	65 (10.7%)	38 (11.6%)	0.626	< 0.001
CVD	245 (11.3%)	105 (9.7%)	63 (10.4%)	77 (23.5%)	0.645	< 0.001
Arthropathy	216 (10.0%)	130 (11.9%)	66 (10.9%)	20 (6.1%)	- 0.428	0.003
Fracture	247 (11.4%)	89 (8.2%)	104 (17.2%)	54 (16.5%)	0.588	< 0.001
Pneumonia	38 (1.8%)	12 (1.1%)	15 (2.5%)	11 (3.4%)	0.727	0.017
COPD	13 (0.6%)	8 (0.7%)	5 (0.8%)	0 (0.0%)	- 0.581	0.332
Dementia	186 (8.6%)	147 (13.5%)	31 (5.1%)	8 (2.4%)	- 1.284	< 0.001
Psychiatric	103 (4.8%)	64 (5.9%)	30 (5.0%)	9 (2.8%)	- 0.381	0.070
Neurological disorder	117 (5.4%)	66 (6.1%)	38 (6.3%)	13 (4.0%)	- 0.288	0.130

Values are presented as *n* (%); CVD, cerebral vascular disorder; COPD, chronic obstructive pulmonary disease; *B, partial regression coefficient in the ordinal regression analysis for disability level (1 = low, 2 = middle, 3 = high), adjusted with age.

The latter perspective is supported by previous studies regarding underuse of services. Elderly individuals and their caregivers have been reported to underuse long-term care services until informal care arrangements become unmanageable (*7*). In Japan, the most common primary caregivers are cohabitant spouses (26.2% in 2013) and women (68.7%) (*4*). Because healthy life expectancy is longer in women than it is in men (*8*), men might be able to depend on their wives for caregiving. On the other hand, women might not be able to depend on their husbands. In addition to a shorter healthy life expectancy, male caregivers require more formal help (*9*). The difference in intention to recruit outside support might relate to differences in disability level among newly qualified elderly individuals differently by gender.

For the total sample, the most frequent disease was CVD (13.6% of all newly disabled elderly individuals). The association between stroke and disability has been examined in several reviews. In the Global Burden of Disease Study, Murray and Lopez (*10*) estimated that, in developed regions, the leading causes of loss of disability-adjusted life years include CVD. In the Japanese nationwide survey "Comprehensive Survey of Living Conditions," participants living with disabled persons were asked about the direct cause of disability, and the most common disease among highly disabled persons is CVD (about 30–35% of participants) (*4*). Because these were the results of caregiver self-reports, under-reporting or over-reporting is a possibility. Our findings show the same trend for CVD, supporting the suggestion that CVD is the most common disease directly preceding disability in elderly individuals.

Our results further provide evidence for the effect of arthropathy, fracture, and dementia on incidence of disability. For women, these diseases accounted for about 10% of low-level disabled women (Table 2). This percentage was about the same as CVD. Because about half of newly disabled elderly individuals had difficulty with daily living as a result of low-level disability, prevention of low-level disability could have a substantial effect on extending healthy life expectancy. In order to prevent low-level disability, especially among women, it is important to address arthropathy, fracture, and dementia in addition to CVD.

Because our analysis was conducted retrospectively, we could not detect the exact risk of having each disease on disability. In order to better demonstrate the importance of disease prevention, prospective observations are necessary. Further, the data were obtained from one prefecture, and thus, we cannot apply the findings to other Japanese regions or other countries.

In conclusion, we found that CVD was the most common disease in the 6 months preceding disability among elderly individuals across most age and disability groups. In low-level disabled women, arthropathy and fracture were as common as CVD was. Because the frequency of low-level disability was three times greater than that of high-level disability in women, this finding emphasizes the need to consider arthropathy and fracture as well as CVD in order to prevent disability.

Acknowledgements

References

1. Tsutsui T, Muramatsu N. Japan's universal long-term care system reform of 2005: Containing costs and realizing a vision. J Am Geriatr Soc. 2007; 55:1458-1463.
2. Adamson J, Beswick A, Ebrahim S. Is stroke the most common cause of disability? J Stroke Cerebrovasc Dis. 2004; 13:171-177.
3. American Stroke Association. About stroke. *http://www.strokeassociation.org/STROKEORG/AboutStroke/About-Stroke_UCM_308529_SubHomePage.jsp* (accessed March 30, 2015).
4. Ministry of Health, Labour and Welfare. Comprehensive Survey of Living Conditions (2013). *http://www.mhlw.go.jp/toukei/saikin/hw/k-tyosa/k-tyosa13/* (accessed March 30, 2015).
5. Newman AB, Brach JS. Gender gap in longevity and disability in older persons. Epidemiol Rev. 2001; 23:343-350.
6. Reeves MJ, Bushnell CD, Howard G, Gargano JW, Duncan PW, Lynch G, Khatiwoda A, Lisabeth L. Sex differences in stroke: Epidemiology, clinical presentation, medical care, and outcomes. Lancet Neurol. 2008; 7:915-926.
7. Kadushin G. Home health care utilization: A review of the research for social work. Health Soc Work. 2004; 29:219-244.
8. Liu Y, Arai A, Obayashi Y, Kanda K, Boostrom E, Lee RB, Tamashiro H. Trends of gender gaps in life expectancy in Japan, 1947-2010: Associations with gender mortality ratio and a social development index. Geriatr Gerontol. 2013; 13:92-97.
9. Naruse T, Nagata S, Taguchi A, Murashima S. Classification tree model identifies home-based service needs of Japanese long-term care insurance consumers. Public Health Nurs. 2010; 28:223-232.
10. Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. Lancet. 1997; 349:1498-1504.