

summary scores ranging from 0 (total disability) to 20 (no disability).<sup>12</sup> The interview with participants also included questions about using care services, including day-care service, which includes day care and day rehabilitation, visiting nurse service, and home-help service programs, as well as medical services. In addition, the weekly frequency with which clients used these services was obtained.

Information obtained from care-managing center records included data on the following physician-diagnosed chronic conditions: ischemic heart disease, congestive heart failure, cerebrovascular disease, diabetes mellitus, dementia, cancer, and other diseases comprising the Charlson comorbidity index,<sup>13</sup> which represents the sum of a weighted index that takes into account the number and seriousness of preexisting comorbid conditions.

Data were also obtained from caregivers concerning their own personal demographic characteristics and their subjective burden as assessed by the Japanese version of the Zarit Burden Interview (ZBI),<sup>14</sup> which is a 22-item self-report inventory that examines the burden associated with functional behavioral impairments in the home care situation.

For the analysis, 136 of the original 1875 participants were excluded because of missing data regarding service use or confounding/intermediary variables, leaving 1739 in the analysis. Of these 1739 participants, 412 could not complete the GDS-15 because of severe cognitive impairment or communication impairment. Also, among the 1739 older participants, 1442 participants had primary caregivers. Of these 1442 caregivers, 289 could not or refused to complete the ZBI.

We defined three types of care facilities providing LTCI as LTC facilities: nursing homes, care health facilities for the elderly, and group homes for elders with dementia. We assessed LTC placement over 36 months using event reports at 3-month intervals. LTC placement was confirmed by visiting nurses or care-managing center records. Placement time was defined as the number of months (3-month intervals) between the baseline interview and the event report of LTC placement. We censored participants living at home after 36 months of follow-up ( $n = 773$ ), at death ( $n = 401$ ), or at dropout ( $n = 248$ ).

### Statistic analysis

The Student's  $t$ -test and  $\chi^2$  test were used to compare differences at baseline between users and nonusers of day-care service. To create ideal model, we first evaluated the association between each covariate and LTC placement using univariate Cox proportional hazards model. LTC placement over 36 months was estimated for each group (day-care service use once or multiple times per week, and nonusers) using the Kaplan–Meier

method. We then evaluated the impact of day-care service use and weekly frequency of service use on the overall model with a series of Cox proportional hazards models, which included gender, age, ADL status, presence or absence of dementia, and caregiver's sex, age and ZBI score. The risk of a variable was expressed as a hazard ratio (HR) with a corresponding 95%CI. All analyses were performed using the SPSS v. 11 (Chicago, IL, USA).  $P \leq 0.05$  was considered significant.

## Results

When the baseline characteristics were compared between day-care service users and nonusers, older age, a higher Charlson comorbidity index, and a lower GDS-15 score were observed in day-care service users than in nonusers (Table 1). Higher prevalence rates of cerebrovascular disease and dementia were also observed in day-care service users. The rates of nursing service use, home-help service use and living alone among day-care service users were lower than those of nonusers. Among caregivers' variables, the rate of male caregivers was significantly lower for day-care service users than nonusers. Higher ZBI score was detected in users' caregivers.

Among the 1739 participants, 217 participants were institutionalized at LTC facilities during the 36-month follow-up period. A higher rate of LTC placement was observed in day-care service users than in nonusers ( $n = 143$ , 18.5% vs.  $n = 74$ , 7.7%,  $P < 0.001$ ) (Table 1). Among the 1327 participants who could complete the GDS-15, 150 participants were institutionalized at LTC facilities during the 36-month follow-up period. Of the 412 who could not perform the GDS-15, 67 were institutionalized at LTC facilities during the 36-month follow-up period. A higher LTC placement rate was observed in the participants who could not complete GDS-15 test than in those who could (16.3% vs. 11.3%,  $P = 0.008$ ). There were no significant differences in LTC placement rate between participants living alone and those living with others (12.8% vs. 12.4%,  $P = 0.802$ ). Furthermore, there was no significant difference in the LTC placement rate between participants living with caregivers who completed the ZBI and those who did not (13.0% vs. 11.1%,  $P = 0.375$ ).

### Cox hazard regression and Kaplan–Meier models

Table 2 shows the results of the unadjusted univariate Cox hazard regression analysis, which suggested that LTC placement within the 36-month follow-up period was associated with older age, a lower function of basic ADL, day-care service use, and the presence of dementia (Table 2). Among caregivers' variables, only higher care burden was associated with LTC placement. Figure 1A shows Kaplan–Meier curves exploring the

**Table 1** Baseline characteristics of the 1739 care recipients and the 1442 caregivers

	Day-care service		P-value
	User	Nonuser	
Care recipients ( <i>n</i> = 1739)			
Men/women (% of men/total)	256/518 (33.1)	319/646 (33.1)	0.994
Age, years (mean, SD) <sup>†</sup>	81.4 (7.7)	80.2 (7.5)	0.002
Basic ADL, range: 0–20 (mean, SD) <sup>†</sup>	13.0 (5.9)	13.5 (6.7)	0.099
Charlson comorbidity index, range: 0–35 (mean, SD) <sup>†</sup>	2.2 (1.5)	1.8 (1.6)	<0.001
GDS-15 (range: 0–15), mean (SD) <sup>†‡</sup>	6.1 (3.6)	6.8 (3.7)	0.002
Chronic diseases (% of total)			
Ischemic heart disease	12.4	12.0	0.809
Congestive heart failure	8.7	8.4	0.845
Cerebrovascular disease	42.8	27.6	<0.001
Diabetes mellitus	12.4	11.7	0.659
Dementia	44.2	22.6	<0.001
Cancer	8.0	10.1	0.142
Visiting nurse service use (% of total)	38.1	54.0	<0.001
Home-help service use (% of total)	42.4	50.5	0.001
Regular medical checkups (% of total)	55.3	60.7	0.023
Living alone (% of total)	17.3	28.1	<0.001
Hospitalization during 36-month follow-up (% of total)	42.5	41.0	0.537
Long-term care placement during 36-month follow-up (% of total)	18.5	7.7	<0.001
Caregiver variables ( <i>n</i> = 1442)			
Men/women (% of men/total)	137/553 (19.9)	217/535 (28.9)	<0.001
Age (years), mean (SD) <sup>†</sup>	63.4 (12.3)	64.3 (12.4)	0.177
Relationship to care recipient (% of total)			
Spouse	35.4	42.8	
Child	35.8	37.1	<0.001
Daughter-in-law	25.7	15.4	
Others	3.2	4.7	
ZBI score, range: 0–88 (mean, SD) <sup>†§</sup>	30.1 (16.8)	26.8 (17.0)	0.001

<sup>†</sup>Student's *t*-test, others were analyzed by  $\chi^2$  test (user vs. nonuser). <sup>‡</sup>GDS-15, geriatric depression scale, *n* = 1327. <sup>§</sup>ZBI, the Zarit Burden Interview. *n* = 1153.

association between weekly frequency of day-care service use and time to LTC placement (3-month intervals). The risk of LTC placement was higher for participants who used day-care service more frequently than those who used it less frequently.

Table 3 shows the results of the series of Cox proportional hazards models that examine the HR of day-care service use to LTC placement during the 36-month follow-up period. The sequential adjustment had minor influences on the association between day-care service use and LTC placement during the 36-month follow-up period. The HR for the fully adjusted models was 2.34 (95%CI = 1.60–3.41).

In the Cox regression model adjusted for potential confounders, participants with more frequent use of day-care service had a significantly higher relative HR than participants with less frequent use of the service (Fig. 1B). Although there was no significant association between using day-care service once per week and the

risk of LTC placement, participants using a day-care service two or more times per week had a significantly higher relative HR than participants not using the service.

## Discussion

In the present study we demonstrated that day-care service use was associated with LTC placement during the 36-month study period among community-dwelling frail elderly using various community-based services under the LTCI program in Japan. Many previous studies have examined predictors of LTC placement in study samples, but these have been limited to people with dementia and there have been fewer evaluations of risk factors for LTC placement in community samples.<sup>15–19</sup> Few studies have comprehensively investigated how both caregiver and recipient characteristics influence LTC placement.<sup>19</sup> Previous observations

**Table 2** Univariate Cox proportional hazards model to identify predictors of long-term care placement over 36 months

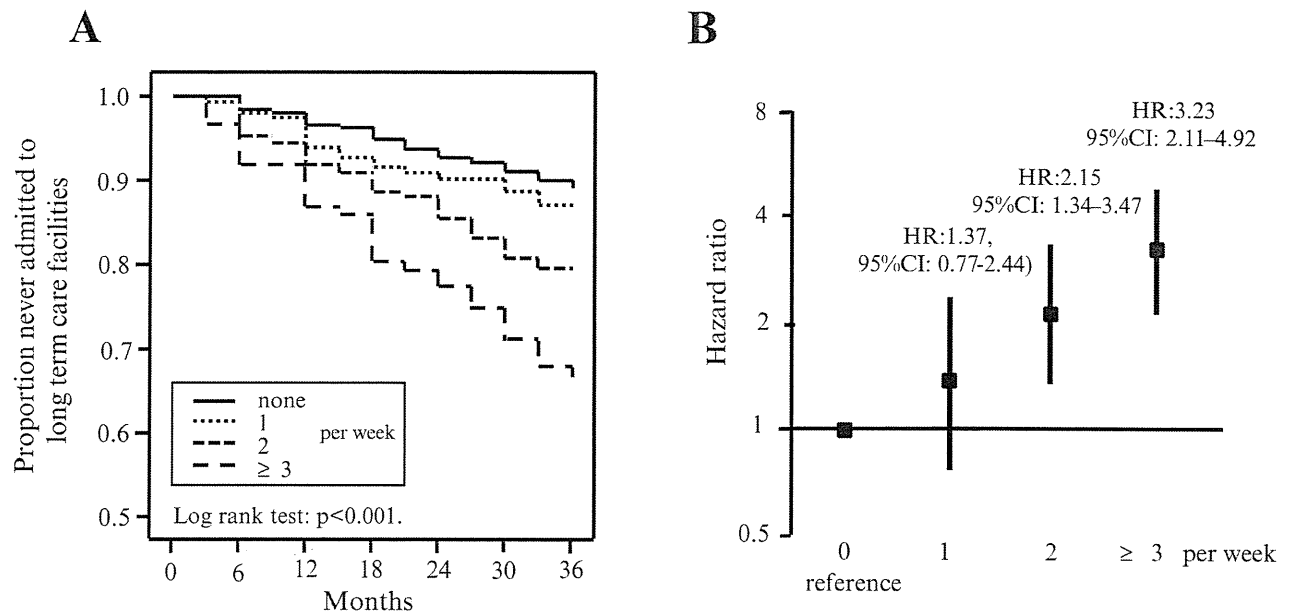
Variable	Univariate HR <sup>†</sup>	95% CI	P-value
Care recipients ( <i>n</i> = 1739)			
Men (vs. women)	0.75	0.56–1.02	0.067
Age (continuous)	1.04	1.03–1.06	<0.001
Living with someone (vs. living alone)	1.02	0.74–1.39	0.920
Basic ADL (range: 0–20) (continuous)	0.97	0.95–0.99	0.001
Regular medical checkups per month (no regular checkup)	1.19	0.90–1.56	0.214
Formal care use (vs. nonuse)			
Visiting nurse	1.15	0.88–1.51	0.295
Day-care service	2.42	1.83–3.21	<0.001
Home helper	0.71	0.81–1.37	0.714
Charlson comorbidity index (continuous)	1.04	0.95–1.13	0.375
GDS-15 (continuous) <sup>†</sup>	1.01	0.96–1.05	0.762
Presence of chronic diseases (vs. absence)			
Ischemic heart disease	1.02	0.68–1.53	0.926
Congestive heart failure	1.16	0.73–1.84	0.523
Cerebrovascular disease	1.00	0.76–1.32	0.986
Diabetes mellitus	0.78	0.50–1.22	0.272
Dementia	3.00	2.29–3.92	<0.001
Cancer	0.84	0.49–1.44	0.520
Hospitalization during 36-month follow-up (vs. never admitted)	1.08	0.82–1.42	0.576
Caregiver variables ( <i>n</i> = 1442)			
Men (vs. women)	0.95	0.67–1.33	0.752
Age (continuous)	1.01	1.00–1.02	0.059
Character of caregiver (vs. child)			
Spouse	0.90	0.64–1.28	0.555
Daughter-in-law	1.29	0.88–1.88	0.189
Others	1.21	0.60–2.43	0.596
ZBI score(continuous) <sup>‡</sup>	1.03	1.02–1.04	<0.001

<sup>†</sup>GDS-15, geriatric depression scale, *n* = 1327. <sup>‡</sup>ZBI, the Zarit Burden Interview. *n* = 1153. HR, hazard ratio.

demonstrated that common risk factors of LTC placement of community-dwelling elderly were older age, presence of dementia, and caregiver's burden.<sup>16,18,19</sup>

Although one of the aims of day-care service is to minimize or delay the possibility of institutionalization and maximize the potential for care recipients to maintain an independent life in the community, only a limited number of studies have examined the impact of day-care service on LTC placement among community-dwelling older adults – and most of these have targeted demented patients. Previous studies targeting dementia have demonstrated that day-care use is associated with nursing home placement in persons with Alzheimer's disease.<sup>7,8</sup> We expanded the target group and demonstrated a striking association between day-care service use and the risk of LTC placement for community-dwelling dependent elderly patients with various chronic diseases, even after adjusting for the presence of dementia and caregiver's burden. We clearly showed,

after adjusting for potential confounders, that the frequency of day-care service use had a negative impact on LTC admission with the 36-month follow-up period. The use of day-care service two or more times per week negatively affected LTC placement, but there was no significant association between institutionalization and the use of day-care service once a week. It is possible that participants with more comorbidities and a more depressive mood use day-care service more frequently; thus, participants using a day-care service two or more times per week were more likely to be placed in LTC facilities. However, even if comorbidity index score and GDS-15 score were included in the analysis, the association between LTC placement and the use of day-care service two or more times per week persisted (data not shown). This contrasts with our recent report that the risk of 21-month mortality among community-dwelling elderly was reduced significantly with frequent use of day-care service.<sup>6</sup> The complex decision to place older



**Figure 1** (A) Kaplan–Meier estimates of long-term care (LTC) placement over 36 months according to the frequency of day-care service use (times per week). The log-rank test:  $P < 0.001$ . (B) Risk of LTC placement based on the frequency of day-care service use (times per week), adjusting for potential confounders (recipient’s gender, age, ADL status, presence or absence of dementia, caregiver’s gender, age, and Zarit Burden Interview score). The y-axis is the adjusted hazard ratios (HR) on a log scale. Black squares are point estimates from a Cox proportional hazards model adjusting for potential confounders. The error bars represent 95%CI. A simple black square without confidence intervals represented the referent group, nonusers.

**Table 3** Hazard ratios for long-term care placement associated with day-care service use (multivariate models)

Models	Hazard ratio	95% CI	P-value
Model 1 ( $n = 1739$ )	2.32	1.75–3.08	<0.001
Model 2 ( $n = 1739$ )	1.96	1.47–2.62	<0.001
Model 3 ( $n = 1150$ )	2.34	1.60–3.41	<0.001

Model 1 includes recipient gender and age. Model 2 includes recipient gender, age, ADL score, and presence or absence of dementia. Model 3 includes variables used in model 2 and caregiver’s gender, age and Zarit Burden Interview score.

people in LTC is based on care recipient and caregiver characteristics and the sociocultural context of the recipient and caregiver. We do not know the exact reason for this negative effect of day-care service on LTC placement. There are conflicting findings in regard to the effect of day-care service on caregivers’ stress, depression, subjective or objective burden, and physical and emotional well-being,<sup>9,10</sup> although a recent relatively large study demonstrated that day-care service had a beneficial effect on restricting caregiving time and providing respite to caregivers.<sup>9,10</sup> It is possible that day-care service alone cannot satisfy the complex needs of caregivers and care recipients sufficiently to enable continued home care, and it is unlikely to change the caregiver’s preference for institutional placement.<sup>21</sup> Although we still do not know whether the character-

istics of caregivers and recipients, or day-care service use itself, increase the risk of LTC placement, the relief and improved mental and physical well-being of caregivers following day-care service use may enhance the willingness of caregivers to consider LTC placement. Caregivers who use day-care service or other respite services may become more aware of their level of stress and more willing to consider LTC placement as an acceptable option, especially if the service experience is positive or if the caregiver receives encouragement to institutionalize from professionals or other caregivers.<sup>22</sup>

This study has important limitations. First, the study was not a randomized intervention trial. Japan has introduced the LTCI program, which provides various services, including day-care services, according to clients’ preferences. Therefore, we could not randomize the use

of this service. Because of the observational design of the present study, differences in unmeasured factors including the severity of patients' chronic diseases, caregivers' health conditions, and quality of services may account in part for the findings. Those who use formal services may have greater need for caregiving than those who do not use formal services. The unmeasured needs that contribute to day-care service use may be stronger than the positive effects of service. Other aspects of the present study should also be considered. In the analysis, baseline data of service use was included, but changes in service use during the follow-up period were not considered. Our results may not be representative of the Japanese frail elderly in the community as a whole because the subjects in this study represented an urban population. In addition, these findings may not be generalizable to other populations given that local health practices, a variety of social and economic factors, ethnic attitudes about caring for very old people, and cost/access to day-care centers may have influenced these results.

In the present study, we showed that day-care service does not achieve the LTCI program aim of reducing the use of institutional care services of elderly people to enable them to maintain their lives at home. It may be possible that the respite for caregivers provided by day-care service is not enough to continue caregiving at home. As is true for any observational study, we cannot firmly establish a cause-and-effect relationship between day-care service use and LTC placement. In addition, the present study could not evaluate the exact reasons for the unfavorable effect of this service on LTC placement. Further studies are needed to determine why caregiving families decide to use day-care services, reasons for LTC placement, and whether day-care services meet the needs of families and care recipients throughout the caregiving career. In addition, future research should assess the quality of day-care programs and examine whether the quality of day-care services affects the LTC placement of clients. Health-care providers and care managers should recognize that day-care service use may augment LTC placement in dependent older people. Policy makers and practitioners should consider implementing a multidimensional support program to reduce caregivers' willingness to consider LTC placement.

## Acknowledgments

The authors wish to thank all the patients, caregivers and the many nurses participating in the study as well as the Nagoya City Health Care Service Foundation for Older People for its vigorous cooperation. This work was supported by a Grant-in-Aid for Comprehensive Research on Aging and Health from the Ministry of Health, Labour and Welfare of Japan and a grant from the Mitsui Sumitomo Insurance Welfare Foundation.

## Disclosure statement

The authors have no conflicts of interest with any of the manufacturers of medications evaluated in this paper.

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**PROCESS OF PHYSICAL DISABILITY  
AMONG OLDER ADULTS  
— CONTRIBUTION OF FRAILITY  
IN THE SUPER-AGED SOCIETY**

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**ABSTRACT**

One of the critical issues that Japan, well known for the world's highest proportion of older adults, a super-aged society, is currently confronting is how to prevent physical disability in old age. This issue is particularly important not only from a medical perspective such as functional prognoses but also from a socio-economic angle in view of reducing the rapid rise in the cost of medical and long-term care insurance services. Functional decline in old age results not only from acute diseases but also from frailty. Such a common and important syndrome that is increasingly prevalent with advancing age can be the cause. The present article intends to review what is known about frailty, including its definition, epidemiology, and pathophysiology, and to examine potential areas of future research.

Key Words: Frailty, Elderly, Physical disability

**INTRODUCTION**

Japan is at the forefront of population aging. As of 2010, the number of people age 65 or over was 29.6 million, constituting 23.1 percent of the total population and marking record highs in terms of both number and percentage.<sup>1,2)</sup> This figure is the highest in the world. The speed of aging among Japan's population is much faster than that in any of the advanced Western European countries or the U.S.A. Although the elderly population of Japan accounted for only 7.1 percent of the total population in 1970, 24 years later in 1994 it had almost doubled in scale to 14.1 percent. A comparison with other countries clearly highlights the rapid progress of demographic aging in Japan.

During society's aging process, the proportion of dependent older people and long-term care (LTC) users are increasing in developed countries. In fact, Japan had more than 4,500,000 LTC users in 2008.<sup>1)</sup> There is a projected trend toward a reduced capacity of institutional care, which in turn will increase the number of severely disabled people living in the community. There is a great deal of public policy and clinical interest in effective and efficient ways to help disabled elderly individuals continue living in community settings.

As the number of elderly people with disabilities or requiring support in their activities of daily

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living increases, the demand for LTC services has also increased. Consequently, expenditures for the LTC system are growing steadily, threatening the financial sustainability of the system. To better cope with the accelerated aging of Japanese society and the growing need for nursing care of the elderly, Japan introduced a public LTC insurance (“*Kaigo Hoken*”) system in 2000.<sup>3,4)</sup> This program enrolled all Japanese nationals aged 65 and older under the coverage of its insurance scheme, creating a radical change from the traditional family-based care toward the socialization of elderly care and the integration of medical care and welfare services. The aims of LTC insurance-based home care programs were not only to reduce the care burden of caregivers but also to maintain and improve functional abilities and well-being of older people, to minimize the use of institutional care services, and to reduce mortality. Under the LTC insurance program, older people who are certified as being either “assistance required” (*yo-shien*) or “care required” (*yo-kaigo*) could be provided with any community-based services depending on the certification of care need levels along with a 10% co-payment for services received.

The number of certified older adults has kept increasing, currently reaching more than 4,500,000. According to data from the Ministry of Health, Labour and Welfare, the proportion of disabled older people estimated by the rate of older adults who were judged as requiring support/care at any levels based on the certificates of LTC insurance was 9.9% when LTC insurance system was inaugurated (April, 2000). Nevertheless, certified users of LTC insurance have increased constantly, so that by 2006 the figure had increased to 16.3%.<sup>5)</sup> Accordingly, the expenditures of LTC insurance had grown in parallel with the constant increase in beneficiaries, threatening the financial sustainability of the system. To maintain that system and to increase the quality of life for older people, it is crucial to prevent disabilities and maintain the status of their daily living activities.

#### REASONS FOR LONG-TERM CARE INSURANCE SERVICE USE IN OLDER PEOPLE

As shown in Fig. 1, among the younger LTC insurance beneficiaries, stroke is a major cause of eligibility for LTC insurance (*yo-kaigo*) according to the Comprehensive Survey of Living Conditions conducted by the Ministry of Health, Labour and Welfare.<sup>6)</sup> However, the percentage of strokes declines as age increases. The percentages of arthropathy, cardiovascular

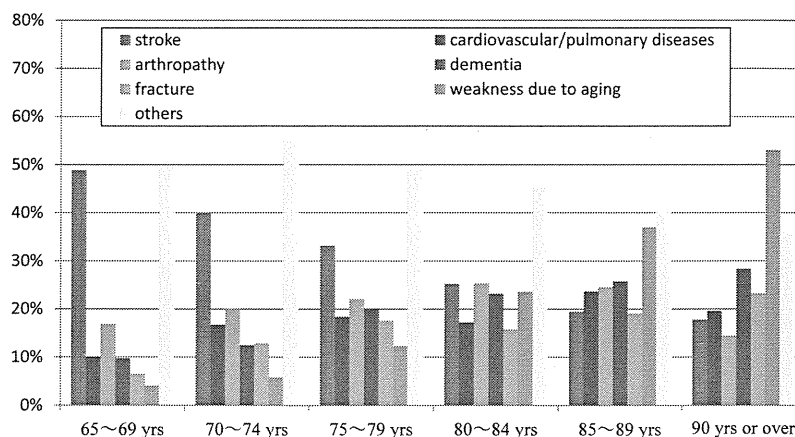


Fig. 1 Major causes of long-term care insurance eligibility (*yo-kaigo*).



## FRAILITY IN THE SUPER-AGED SOCIETY

and pulmonary diseases, dementia, and fractures as causes of eligibility for LTC insurance are gradually increasing as the applicants become older. In contrast, a rapid increase was observed in the percentage of “weakness due to aging” as age increases, exceeding 50% of total applicants above age 90 or over. According to the survey, “weakness due to aging” accounts for physical dependence in 26.5% of those aged 65 or over, in 30.8% of those aged 75 or over, and 43.9% of those aged 85 or over respectively. As of 2007, it was reported that the total number of older adults certified as requiring care (*yo-kaigo*) was estimated to be about 4,400,000, which comes to a total of 1,170,000 who were certified as *yo-kaigo* due to “weakness with aging” in Japan. These data suggest that weakness as a major cause of disability in Japan’s super-aged society has already emerged.

### DEFINITION OF FRAILITY

In the field of geriatric medicine, the term “frailty” has long been acknowledged among those who are engaged/involved in the care of older people. In recent years particularly since the definition has been established and become widespread, the concept of frailty has begun to draw growing attention among researchers and clinicians. Frailty may now be regarded as a geriatric syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems, and leading to adverse health outcomes including physical disability, falls, hospitalization, institutionalization and mortality. This would imply that a common underlying biologic process may be responsible for such a development. Concepts focusing on inflammatory processes, changes in hormonal environment and body composition support this hypothesis. This writer considers that “weakness due to aging” as described above as the major cause of *yo-kaigo* is equivalent to “frailty due to aging.”

Although there is still a lack of consensus on the definition of frailty, it has been generally accepted that it is distinct from disability and comorbidity, and that it characterizes the weakest and most vulnerable subset of older people due to the declining functions of their multiple organs. As the term “frail” has not yet achieved relevant vernacular meanings given its rather obscure definitions, it covers a wide range of common phenotypes including muscle weakness, bone fragility, very low body mass index, susceptibility to falling, vulnerability to trauma, vulnerability to infection, high risk of delirium, and severely diminished physical capabilities.

There are various proposed phenotypes of frailty among older people. Different definitions of frailty have included a variety of components including weakness, fatigue, weight loss, decreased balance, low levels of physical activity, impaired mobility and performance, and social withdrawal. In 2001, Fried *et al.* developed screening criteria for frailty as a syndrome requiring the presence of a critical mass ( $\geq 3$ ) of the following clinical manifestations: weakness, weight loss, slow walking speed, fatigue, and low levels of activity.<sup>7)</sup> That phenotype has been found to predict a variety of poor clinical outcomes, including falls, physical disability, hospitalization, and mortality.<sup>7)</sup> Others have also reported that a combination of inactivity and weight loss is a significant predictor of disability and mortality.<sup>8)</sup> Based on those observations, a consensus report from a group of Italian and American geriatricians has been published advocating that any criteria used to define physical frailty be based on impairments in physiological domains that include mobility, balance, muscle strength, motor processing, cognition, nutrition status including weight change, endurance (including feelings of fatigue and exhaustion), and physical activity.<sup>9)</sup> The validity of those factors as components of frailty is provided by studies showing that in older, non-disabled persons, individual components are associated with geriatric syndromes such as falls, depression, urinary incontinence and functional impairment, which are all strong and

independent risk factors for disability and/or death.

The investigation, treatment and care of older people who are both frail and disabled constitute much of the work of geriatric assessment units. However, despite the frequency with which frailty and disability coexist, they are in fact quite separate concepts. Disability indicates a loss of function, and may arise from accidents such as a stroke or hip fracture which therefore require sustained medical care (medical or disease models of disability, see Figs. 2A and 3). Frailty

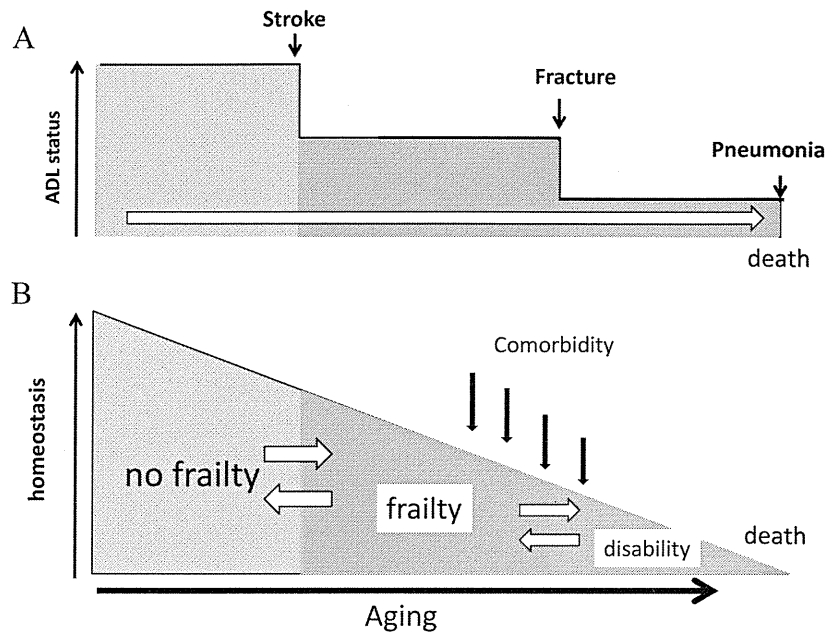


Fig. 2 Disability models for the elderly. A: Medical (disease) model of disability. B: Frailty model of disability.

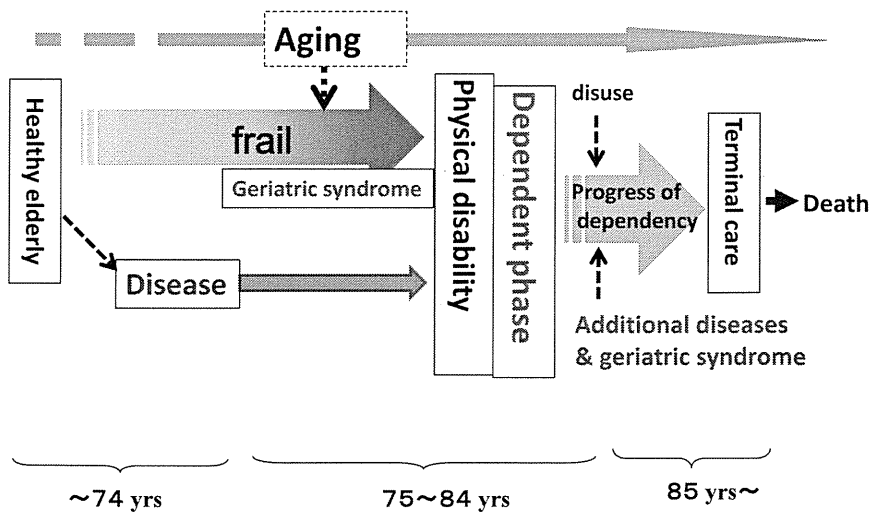


Fig. 3 Potential causes of disability and time course of death.

## FRAILITY IN THE SUPER-AGED SOCIETY

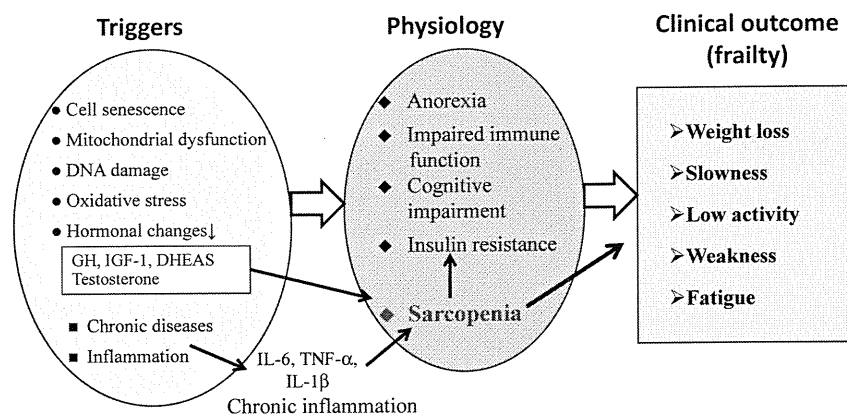
indicates instability and the risk of current or further loss of function, another model of disability for the elderly (frail model, see Figs. 2B and 3). Frailty is the root cause of unstable disability and an appropriate focus for prevention, rehabilitation and public health programs in old age.

## FRAILITY AND SARCOPENIA

Aging is associated with significant changes in body composition, with a substantial reduction in both fat-free mass and muscle mass together with an increase in visceral fat. Sarcopenia is a syndrome characterized by a progressive and generalized loss of skeletal muscle mass and strength entailing a risk of adverse outcomes such as physical disability, poor quality of life and eventual death. Although the definition of sarcopenia remains controversial, its prevalence among older adults under the age of 70 is roughly 25% and increases to 40% in adults 80 years or older.<sup>10</sup> Recently, a joint European Working Group on Sarcopenia in Older People (EWGSOP) proposed a working definition.<sup>11</sup> According to EWGSOP, sarcopenia was diagnosed by the presence of low muscle mass plus either low muscle strength or low physical performance. Sarcopenia represents a risk factor for frailty, loss of independence, and physical disability.<sup>12</sup> Impaired mobility resulting from muscle loss is predictive of major physical disability and mortality, and is associated with poor quality of life along with social and health care needs.<sup>13</sup> Several mechanisms may be involved in the onset and progression of sarcopenia. Its possible causes are multi-factorial and can include disuse, changing endocrinal functions, chronic diseases, inflammation, insulin resistance, and nutritional deficiencies. Sarcopenia is thus rightly considered a major component in the pathway leading to frailty (Fig. 4).<sup>14</sup>

## CAUSES OF FRAILITY

There is currently no exact universally accepted consensus concerning the causes of frailty, which probably reflects the complexity of multiple interconnected physiological processes which become dysregulated with age. Those physiological processes/pathways include immune/inflammatory processes, neuroendocrine deregulation, mitochondrial dysfunction, hormonal changes, oxidative stress, and metabolic alterations (Fig. 4).



**Fig. 4** Conceptual framework of specific physiological system changes that may contribute to underlying vulnerability and clinical manifestations of frailty.

In particular, evidence has been presented that supports a significant role of inflammation in the process of frailty. It has been suggested that during the aging process, a primary dysregulation of the mechanisms that initiate, modulate and block an inflammatory response often occurs. In fact, it has been demonstrated that among the elderly there are high plasma levels of circulating pro-inflammatory cytokines, including tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-6 (IL-6), and interleukin-1 (IL-1) in older persons.<sup>15)</sup> Such pro-inflammatory mechanisms have also been suggested to be implicated in the development of sarcopenia due to the effects of increased cytokines on reduced muscle protein synthesis and increased protein degradation (Fig. 4).

Several age-related hormonal changes have been linked to the frailty syndrome and to its components (Fig. 4). Among the latter, the hormonal relationship with the decrease in muscle strength has received the most attention. While testosterone, growth hormone (GH) and insulin-like growth factor I (IGF-1) were most intensely studied in this context, open questions still remain with regard to the clinical relevance and the effect of replacement therapy.

While a proposal for the involvement of a molecular and physiological pathway sounds attractive, it requires further substantiation. We also need to continue studying the role of other potential components that contribute to the frailty that comes with aging. It is possible that the biological, psychological, social and environmental factors that interact across the course of life are determinants of the onset of frailty. The components of frailty may include those identified by Fried (decreased physical activity, weakness, diminished endurance, slowness, undernutrition) along with added cognitive, psychological and perhaps social components. The pathway from frailty to its adverse outcomes is also affected by various biological, psychological, social and societal modifiers.

## CLINICAL ASPECTS OF FRAILITY

The concept of the presence of a frailty phase during the aging process seems to be quite important, since a considerable number of older people become physically disabled through their frailty status rather than through an abrupt onset of acute medical conditions such as strokes and hip fractures as described above. This process, unique to older individuals, is not observed in younger people. However, the working definition of frailty, based on Fried's criteria,<sup>7)</sup> is only based on physical symptoms and signs. It neglects other potentially important components of the syndromes such as mood, cognitive, sensory impairments and the socioeconomic aspects of older adults' lives. It is unsatisfactory to define frailty in the physical domain alone, since there are several other phenomena that are yet to be examined but that are commonly observed in the state of frailty.

Gill *et al.* have demonstrated that frailty is a dynamic process characterized by frequent transitions among frailty states (nonfrail, prefrail, and frail) over time (Fig. 2B).<sup>16)</sup> This may illustrate the usefulness of the frailty concept for clinical practice. Some physicians may even regard frailty as an example of the medicalization of old age and be suspicious about its prevention. However, the overall consequences are that the frail elderly are at higher risk of accelerated physical and cognitive decline, disability, and finally death. Needless to say, from a practical point of view, the early identification of a propensity to frailty would prove useful in preventing or delaying its more severe clinical consequences.

From a clinical perspective, two issues are particularly important: first, the identification of the causes of frailty and its association with chronic inflammation and other factors; and second, the development of substantiated strategies for the prevention of frailty. Interventions have been made among older adults that targeted correlates or specific components of frailty. First-line treatments

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for primary frailty include an adequate diet with sufficient protein, vitamins and mineral intake, regular physical exercise such as stretching, walking, and lifting weights to preserve and increase muscle mass and strength.

## CONCLUSION AND REMARKS

In conclusion there is a growing consensus that frailty is a syndrome that can be identified and measured clinically, and that it is distinct from disability and comorbidity. Frailty is a state of reduced homeostasis leading to increased vulnerability and the risk of adverse outcomes. It results from the impact of multiple system impairment with critical changes in its reserve capacities, especially in its metabolic, cardiovascular, musculoskeletal, immunologic and neurologic systems. It represents a dynamic, complex interaction of biological, psychological, cognitive and social factors as well as a complex interplay of assets and deficits.

Prevention must not only focus on diseases but also on the frailty that is crucial to the well-being of older people in a super-aged society. To establish better strategies for preventing frailty, it is also essential to improve our understanding of the causes and trajectory of frailty in the context of the demography and epidemiology of an older population.

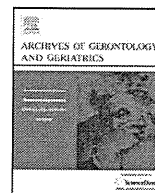
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# Impact of informal care levels on discontinuation of living at home in community-dwelling dependent elderly using various community-based services

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## ARTICLE INFO

## Article history:

Received 25 August 2009

Received in revised form 19 February 2010

Accepted 25 February 2010

Available online 25 March 2010

## Keywords:

Informal care

Mortality

Hospitalization

Living at home

Caregiver

## ABSTRACT

The aim of the study was to examine the effect of informal care levels on overall discontinuation of living at home, all-cause death, hospital admission, and long-term care placement for community-dwelling older people using various community-based services during a 3-year period. Prospective cohort study of 1582 community-dwelling disabled elderly and paired informal caregivers was conducted. Baseline data included the recipients and caregivers' demographic characteristics, comorbidities, informal care levels (sufficient, moderate, and insufficient care), which were evaluated by trained visiting nurses, and the level of formal community-based service use. Among 1582 participants, 97 died at home, 692 were admitted to hospitals, 318 died during their hospital stay, and 117 were institutionalized in long-term care facilities during 3 years of follow-up. A multivariate Cox hazard model demonstrated that when compared with a sufficient informal care level, an insufficient informal care level was associated with overall discontinuation of living at home, all-cause mortality, hospitalization, and institutionalization during 3 years of follow-up (hazard ratio: 1.65, 95% confidence interval: 1.15–2.36; 1.98, 1.17–3.34; 1.56, 1.04–2.35; 2.93, 1.25–6.86, respectively). The results suggested that informal caregiving is an important factor in the prevention of overall discontinuation of living at home in a population of disabled older people.

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## 1. Introduction

The proportion of older people and long-term care use are increasing in developed countries. There is a projected trend toward reduced institutional care that will increase the number of severely disabled people living in the community. There is a great deal of public policy and clinical interest in effective and efficient ways to help disabled elderly individuals to continue to live in community settings. A number of previous reports demonstrated the risk factors for each type of event by which stable living at home is discontinued, including all-cause death, hospital admission, and long-term care placement (Shugarman et al., 2002; Ishizaki et al., 2006; Muramatsu et al., 2007; Beswick et al., 2008). However, only limited data are available regarding the risk factors for all-inclusive discontinuation of living at home (Beswick et al., 2008).

A number of studies have demonstrated the association between the inadequate provision of care (unmet care needs) and adverse health outcomes for the community-dwelling elderly

(Gaugler et al., 2005; Sands et al., 2006). In most prior studies, unmet needs have been defined as the absence of informal assistance, formal services, or some combination of both accompanied by ADL needs (Gaugler et al., 2005; Sands et al., 2006). However, the care needs of older disabled people living in the community are not only related to ADL tasks but also various other domains including psychological, behavioral, and social domains (Georges et al., 2008). No study has investigated the effect of the overall informal care levels provided by family on adverse outcomes for care recipients in terms of continuation of living at home.

In developed countries, varying community-based formal services are available to help the disabled elderly living in the community to continue living in the community. Although these services intend to reduce hospital and nursing-home admission, and mortality, a substantial number of studies have examined the effects of these programs on older people living in the community; the findings have been inconsistent. Recent meta-analysis has revealed the limited effect of complex intervention packages targeting disabled elderly individuals living in the community on mortality, hospital and nursing-home admissions (Beswick et al., 2008).

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In contrast, much less attention has been paid to the impact of the level of informal care mainly provided by relatives to allow the continuation of living at home. Concern that formal services might substitute for informal care is not borne out by the available evidence (Greene, 1983; Denton, 1997; Penning, 2002).

Japan introduced a universal-coverage long-term care insurance (LTCI) program in 2000 (Tsutsui and Muramatsu, 2005). This program induced a radical change from traditional family-based care toward the socialization of elderly care and the integration of medical care and welfare services. The aims of the LTCI home care programs are not only to reduce the care burden of caregivers but also to maintain and improve the functional abilities and well-being of elderly people, to reduce the use of institutional care services, and to reduce mortality. Under the LTCI program, older people who are eligible for the LTCI program can choose any community-based service with a 10% co-payment for services received.

The goal of this research was to examine the effect of informal care levels on overall discontinuation of living at home and on each event leading to the discontinuation of living at home, including all-cause death, hospital admission, and long-term care placement, during a 3-year period for community-dwelling older people using various community-based services under the LTCI program.

## 2. Subjects and methods

In the present study we employed baseline data on the participants in the Nagoya Longitudinal Study for Frail Elderly (NLS-FE) and data on the mortality, hospitalization, institutionalization, and any events which blocked the continuation of living at home of these participants during the 3-year follow-up period. Details of the participants ( $n = 1875$ , age range: 65–104) and the NLS-FE have been published elsewhere (Kuzuya et al., 2006a,b). The participants were eligible for the LTCI program, lived in Nagoya City, and were provided various kinds of community-based services by the Nagoya City Health Care Service Foundation for Older People, which has 17 visiting nursing stations associated with care-managing centers. These NLS-FE participants, who were enrolled between 1 December 2003 and 31 January 2004, were scheduled to undergo comprehensive in-home assessments by trained nurses at the baseline and at 6, 12, and 24 months. At 3-month intervals, data were collected regarding any important events in the lives of the participants, including admission to the hospital for acute illness and mortality during the 3-year follow-up.

Written informed consent for participation was obtained from the participants, care recipients and caregivers, or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian) according to procedures approved by the institutional review board of Nagoya University Graduate School of Medicine. Since the 293 participants who had no caregivers at baseline were excluded, the study population consisted of 1582 community-dwelling disabled elderly (562 men and 1022 women, age 65 years or older).

### 2.1. Data collection

The data were collected at the clients' homes from standardized interviews with patients or surrogates and caregivers, and from care-managing center records taken by trained nurses. The data included clients' demographic characteristics, depressive symptoms as assessed by the short version of the Geriatric Depression Scale (GDS-15) (Yesavage, 1988), and a rating for ten basic activities of daily living (bADL) (feeding, mobility on bed, bathing, grooming, dressing, using the toilet, walking inside and outside, transferring, and using stairs) using a summary score ranging from

0 (total disability) to 20 (no disability). The interview with participants also included questions about the utilization of a total of seven community-based services available under LTCI programs, including the day-care service, visiting nurse service, home-help service, visiting bathing service, visiting rehabilitation, assistive device leasing, and nursing-home respite stay (overnight respite, temporary stays at nursing facilities).

Information on the following physician-diagnosed chronic conditions was obtained from care-managing center records: ischemic heart disease, congestive heart failure, cerebrovascular disease, diabetes mellitus, dementia, chronic obstructive pulmonary disease, cancer, hypertension, and other diseases comprising the Charlson comorbidity index (CCI) (Charlson et al., 1987), which represents a sum of weighted indexes, taking into account the number and seriousness of preexisting comorbid conditions (range: 0–19, with a higher value indicating higher comorbidity). It should be noted that clients eligible for LTCI have their own primary care physicians, since the physician needs to submit a report on their clinical status every 6 months. The economic status of care recipients, divided into three categories (enough: enough financial resources; moderate: no need for financial support from relatives; poor: need for financial support from relatives), was also obtained from care recipients or their surrogates.

Data were also obtained from caregivers concerning their own personal demographic characteristics, the relationship to the patient, the degree of help from other relatives (divided into three categories), preference for care at home, and their subjective burden as assessed by the Japanese version of the Zarit Burden Interview (ZBI) (Arai et al., 1997), which is a 22-item self-reported inventory that examines the burden associated with functional behavioral impairments in the home care situation. Information on the living arrangement and economic status category of the care recipients was recorded based on interviews with caregivers. The primary caregivers were also asked to rate their current overall health using three categories of subjective health status (poor, fair, good to excellent).

### 2.2. Informal and formal care levels

Quality of care is multidimensional and determining the need for care is a complex process. In the present study, to assess the informal care levels, trained visiting nurses subjectively evaluated the informal care levels for the care recipients provided by family caregivers and categorized them into three groups: sufficient care, moderate care, and insufficient care. This subjective evaluation was a matter of determining the assistance levels of caregivers for care recipients who live in need of physical, mental, and social assistance at home. The level of formal community-based service use under the LTCI program does not matter. The formal care levels were evaluated by two methods: the number of regular uses of the three major community-based care services, namely the visiting nurse service, day-care service, and home-help service, per month at the baseline and the number of uses of community-based service at the baseline among the seven services provided under the LTCI program described above.

### 2.3. Statistical analysis

Analysis of variance with a Bonferroni correction and the chi-squared test were used to compare differences among participants receiving sufficient, moderate, or insufficient informal care levels at baseline.

Univariate and multivariate logistic regression models were used to assess the association between insufficient informal care levels (vs. sufficient levels) and the characteristics of care recipients and caregivers at baseline. The following baseline data

**Table 1**  
Baseline characteristics of participants according to informal care levels, mean  $\pm$  S.D.

Variables	Informal care level			p
	Sufficient	Moderate	Insufficient	
Care recipients (n = 1582)	815	627	140	
Men/women, n	315/500	199/428	46/94	0.020
(% of men)	38.7	31.7	32.9	
Age (years)	81.4 $\pm$ 7.9	80.8 $\pm$ 7.7	79.1 $\pm$ 7.1	0.004
Basic ADL (range: 0–20)	11.5 $\pm$ 6.8	12.1 $\pm$ 6.5	12.6 $\pm$ 6.6	0.076
CCI <sup>a</sup>	2.1 $\pm$ 1.6	2.0 $\pm$ 1.6	2.1 $\pm$ 1.6	0.626
Chronic diseases (% of total)				
Congestive heart failure	8.4	7.9	10.6	0.621
Cerebrovascular disease	39.9	35.7	35.8	0.268
Dementia	43.0	38.1	31.4	0.016
Cancer	8.6	8.6	9.8	0.904
Number of regular uses of seven services,	2.3 $\pm$ 1.2	2.3 $\pm$ 1.2	2.5 $\pm$ 1.2	0.240
Regular medical checkups (%)	58.2	62.0	66.4	0.109
Living alone (%)	7.2	12.2	19.3	<0.001
Economic status (%)				
Enough	29.1	19.7	15.0	
Moderate	68.0	74.1	63.6	<0.001
Poor	2.8	6.1	21.4	
Caregiver (n = 1582)				
Men/women, n	165/650	184/443	50/90	<0.001
(% of men)	20.2	29.3	35.7	<0.001
Age (years)	64.0 $\pm$ 11.7	63.8 $\pm$ 13.0	65.3 $\pm$ 15.2	0.477
Spouse caregiver (%)	39.7	40.8	45.7	<0.001
ZBI score (range: 0–88) <sup>b</sup>	27.9 $\pm$ 16.7	30.3 $\pm$ 17.2	29.5 $\pm$ 18.5	0.064
Subjective health status (%)				
Good to excellent	44.1	40.0	34.1	
Moderate	48.8	45.9	24.0	<0.001
Poor	7.2	14.1	41.9	

Notes: ANOVA, others were analyzed by  $\chi^2$  test.

<sup>a</sup> Charlson comorbidity index.

<sup>b</sup> The Zarit Burden Interview, n = 1253.

were used in univariate analysis: the gender, age, ADL status, CCI, living arrangement, and economic status of the care recipient; the number of uses of community-based service at the baseline among the seven services provided under the LTCI program; and the caregiver's gender, age, relationship to the recipient, subjective health status, and ZBI score. The covariates included in the multivariate analysis were variables to be associated with insufficient informal care levels with  $p < 0.05$  in univariate analysis.

Cox proportional hazard models were also used to determine the association of informal care levels at baseline with the discontinuation of living at home or any event which blocked the continuation of living at home, including 3-year all-cause mortality, hospitalization, and institutionalization. To create an ideal model for multivariate models, we first evaluated the association between each covariate and each adverse outcome during the 3-year period using the univariate Cox proportional hazard model. The covariates included in the multivariate analysis were variables to be associated with each adverse outcome with  $p < 0.05$  in univariate analysis. The risk of a variable was expressed as an odds ratio (OR) and a hazard ratio (HR) with a corresponding 95% confidence interval (CI). All analyses were performed using the Statistical Package for the Social Sciences (SPSS) Version 15.0. A probability value of  $<0.05$  was considered significant.

### 3. Results

#### 3.1. Baseline characteristics of participants

Out of 1582 care recipients and matched caregivers, a sufficient informal care level was found in 815 pairs, while moderate and insufficient informal care levels were found in 627 and 140 pairs,

respectively. There were differences among these three groups in the recipients' gender distribution, age, living arrangement, and economic status, and in the caregivers' gender and subjective health status and the rate at which the caregiver was the recipient's spouse (Table 1). It should be noted that 10.3% of caregivers did not live in the same household as the recipient. The highest rate of living alone was observed among care recipients with insufficient informal care levels (19.3%).

#### 3.2. Factors associated with insufficient care levels

When insufficient care levels with sufficient levels were compared, multivariate logistic regression analysis revealed that recipients receiving insufficient informal care were less likely to be male, more likely to be living alone, more likely to have a poor economic status, and more likely to have a male caregiver and a caregiver with poor subjective health status (Table 2). The higher ZBI score was not associated with insufficient informal care levels in univariate analysis OR (95%CI) = 1.01 (0.99–1.02).

#### 3.3. Cox proportional hazard analysis for discontinuation of living at home

Among the 1582 participants, 906 experienced at least one event which led to the discontinuation of living at home during the 3-year study period. Among these 906 participants, 97 died at home, 692 were admitted to an acute-treatment hospital, and 117 were institutionalized in long-term care facilities as the first event causing a disturbance of stable living at home during the 3-year follow-up. Of 692 participants who were admitted to a hospital, 318 died during their hospital stay.



**Table 2**  
Logistic regression analysis to identify the factors associated with insufficient informal care levels (vs. sufficient).

Variables	Multivariate <sup>a</sup>	
	OR	95%CI
Care recipients		
Men (vs. women)	0.55	0.31–0.96
Age (years) (continuous)	0.96	0.93–0.99
Living arrangement (vs. living with two or more)		
Living alone	2.88	1.39–5.96
Living with one person	1.03	0.61–1.75
Economic status (vs. enough)		
Moderate	1.40	0.78–2.53
Poor	7.80	3.32–18.30
Caregiver		
Men (vs. women)	1.99	1.15–3.42
Age (years) (continuous)	1.00	0.98–1.02
Subjective health status (vs. excellent)		
Moderate	0.77	0.44–1.37
Poor	10.31	5.53–19.21

<sup>a</sup> All the listed variables which were  $p < 0.05$  in univariate analysis were entered into the analysis.

To identify the factors associated with the discontinuation of living at home over the 3-year follow-up, Cox proportional hazard models were conducted. Multivariate analysis using covariates which were associated with the discontinuation of living at home in univariate analysis revealed that the following characteristics were associated with overall discontinuation of living at home: male, older, lower ADL status, presence of cancer, higher ZBI score, and moderate to insufficient informal care level (Table 3).

**Table 3**  
Cox proportional hazard analysis for discontinuation of living at home during 3-year follow-up.

Variables <sup>a</sup>	Univariate		Multivariate <sup>a</sup>	
	Hazard ratio	95%CI	Hazard ratio	95%CI
Care recipients				
Men (vs. women)	1.21	1.05–1.38	1.26	1.04–1.53
Age (years) (continuous)	1.02	1.01–1.03	1.03	1.02–1.04
Basic ADL (continuous)	0.86	0.84–0.88	0.97	0.96–0.99
Presence of chronic diseases (vs. absence)				
Congestive heart failure	1.29	1.03–1.63	1.05	0.79–1.40
Dementia	1.45	1.28–1.66	1.12	0.94–1.33
Cancer	1.66	1.33–2.06	1.72	1.34–2.22
Regular medical checkups (vs. absence)	1.34	1.17–1.54	1.11	0.93–1.32
Living arrangement (vs. living alone)				
Living with one person	1.25	0.97–1.60	0.75	0.51–1.12
Living with two or more	1.40	1.10–1.78	0.89	0.62–1.29
Number of regular uses of seven services (continuous)	1.24	1.18–1.30	1.08	0.99–1.17
Caregiver				
Men (vs. women)	0.92	0.79–1.07	1.04	0.84–1.29
Age (years) (continuous)	1.01	1.00–1.02	1.00	0.99–1.01
ZBI score (continuous)	1.01	1.01–1.02	1.01	1.01–1.02
Informal care level (vs. sufficient)				
Moderate	1.06	0.93–1.22	1.19	1.01–1.42
Insufficient	1.32	1.05–1.67	1.65	1.15–2.36
Subjective health status (vs. excellent)				
Moderate	1.39	1.21–1.61	1.19	0.98–1.43
Poor	1.57	1.28–1.93	1.12	0.84–1.50

<sup>a</sup> Listed are caregiver's gender and variables with  $p < 0.05$  in univariate analysis.

<sup>a</sup> All the listed variables were entered in the analysis.

### 3.4. Association between various types of events and levels of informal care

To examine the associations between various types of events which blocked the continuation of living at home during the 3-year follow-up and the levels of informal care, Cox proportional hazard models were used (Table 4). In crude models, compared with a sufficient informal care level, insufficient informal care level was associated with hospital admission, but not with institutionalization and all-cause death during the 3-year follow-up. In the full-adjusted models, insufficient informal care levels were strongly associated with all-cause mortality, hospital admission, and institutionalization in long-term care facilities during the 3-year follow-up.

## 4. Discussion

In the present study we identified the factors associated with events leading to the discontinuation of living at home, including all-cause death, hospital admission, and long-term care placement, for a 3-year period in community-dwelling disabled older people using LTCI programs. The results suggested that the following factors were identified as predictors of the discontinuation of living at home in a multivariate model: for the care recipients, male gender, lower ADL status, and the presence of cancer at baseline; and for the caregivers, higher caregiver burden and an insufficient level of informal care. The HR of insufficient informal care levels for the discontinuation of living at home was comparable to that of the presence of cancer.

In most of the prior studies, insufficient care levels (unmet care needs) were defined as the absence or insufficiency of informal (usually family caregiver) or formal (paid caregiver) assistance in combination with ADL needs (Gaugler et al., 2005; Sands et al., 2006). However, needs for personal assistance services are not only for older people with difficulty in performing ADL tasks but also for

**Table 4**  
Associations between various types of events and levels of informal care—Cox proportional hazard models.

	Informal care level (vs. sufficient)			
	Moderate		Insufficient	
	Hazard ratio	95%CI	Hazard ratio	95%CI
All death				
Unadjusted	0.85	0.69–1.04	1.10	0.78–1.54
Full-adjusted <sup>a</sup>	1.06	0.81–1.37	1.98	1.17–3.34
Hospital admission				
Unadjusted	1.07	0.92–1.26	1.38	1.07–1.79
Full-adjusted <sup>b</sup>	1.18	0.97–1.44	1.56	1.04–2.35
Institutionalization				
Unadjusted	1.40	0.96–2.04	1.35	0.69–2.65
Full-adjusted <sup>c</sup>	1.46	0.94–2.27	2.93	1.25–6.86

<sup>a</sup> Adjusted for care recipient's gender, age, bADL score, the presence or absence of heart failure, dementia, and cancer, regular medical checkups, living arrangement, number of service uses, and caregiver's gender, age, the ZBI score, and subjective health status.

<sup>b</sup> Adjusted for care recipient's gender, age, bADL score, the presence or absence of cancer, regular medical checkups, living arrangement, number of service uses, caregiver relationship, and caregiver's gender, age, the ZBI score, and subjective health status.

<sup>c</sup> Adjusted for care recipient's gender, age, bADL score, the presence or absence of dementia, number of service uses, and the caregiver's gender, age, ZBI score, and subjective health status.

those with hearing or visual problems, cognitive impairment, incontinence, falls, and behavioral symptoms with dementia (Georges et al., 2008). Therefore, due to the difficulty of objectively evaluating informal care levels provided by relatives, in this study we used the subjective evaluation of informal care levels by visiting nurses who often visited the clients' homes, contacted the recipients and their caregivers at home, and knew their care environment well.

Although the accuracy and reliability of the subjective evaluation was not evaluated in this study, there were more family members living with care recipients, a lower rate of dissatisfaction with the help provided by other relatives (data not shown), and more caregivers who preferred to care for the patient at home (data not shown) in the group with a sufficient informal care level compared with those in the insufficient group. Previously, using the same cohort, we reported that a lack of medication assistance for community-dwelling disabled older people among those needing medication support was associated with a higher risk of hospitalization (Kuzuya et al., 2008). Among participants who reported difficulty with self-medication ( $n = 1085$ ), 497 (84.1%) of 591 participants with sufficient informal care levels received medication assistance from caregivers. On the other hand, 328 (79.0%) of 415 participants with moderate informal care levels, and 45 (57.0%) of 79 with insufficient informal care levels received medication assistance from caregivers ( $p < 0.001$ , the chi-squared test). These results indicate that this subjective evaluation by visiting nurses seems to be closely related to the actual informal care level. It should be noted that higher ZBI scores were not associated with insufficient informal care levels in the present study, suggesting that caregiver burden does not contribute to the care levels provided by the caregivers.

We observed that poor levels of informal care were associated with poor economic status. However, when economic status was included in the multivariate model, poor informal care levels were still a strong risk factor for the discontinuation of living at home for community-dwelling elderly (data not shown). In addition, we demonstrated that poor informal care levels were associated with all-cause death, hospital admission, and long-term care placement after adjusting for confounders. These associations persisted even after adjusting for the number of uses of formal care under the LTCI program.

A number of studies have demonstrated the association between the following characteristics of caregivers and recipient long-term care placement: higher burden (Yaffe et al., 2002),

nonspouse caregiver (Kesselring et al., 2001), and poor relationship between caregiver and recipient (Spruytte et al., 2001). However, only limited data are available on the effect of caregiver characteristics and living arrangement on the adverse health outcomes of care recipients, including hospital admission and mortality. It has been demonstrated that care recipients whose caregiver is a spouse have a significantly lower risk of mortality (Temkin-Greener et al., 2004), and that living arrangement affects the mortality of community-dwelling older people (Kandler et al., 2007). It is possible that these factors may affect the association between informal care levels and long-term care placement as well as adverse health outcomes including all-cause death and hospitalization in the present study. However, these associations persisted even after adjusting for these parameters in our multivariate models, suggesting that these confounders are not a major reason for this association.

What makes our results particularly interesting is that the participants used various community-based services under the LTCI program to maintain stable living at home. The association between caregiver care levels and poor outcomes with regard to continuous living at home persisted even after adjustment for the number of formal services used. In addition, the present study did not reveal a beneficial effect of the number of regular uses of seven community-based services or the number of uses of three major services per month (data not shown) on stable living at home, suggesting that informal community-based services were not able to substitute for informal care.

This study has various limitations. The subjective evaluation of informal care levels by visiting nurses may not be accurate or reflect precise care levels. Because of the observational design of the present study, differences in unmeasured factors, including the severity of chronic diseases suffered by the recipients, the health conditions of the caregivers during the study period not at baseline, and the length of caregiving may account in part for the findings. In addition, these findings may not be generalizable to other populations, given that they may have been influenced by health practices, a variety of social and economic factors, ethnic attitudes about caring for very old people, and cost.

## 5. Conclusions

The results suggest that informal caregiving is an important factor not only in the prevention of long-term care placement but also in the prevention of adverse health outcomes including hospital admission and all-cause death in a population of disabled

older people using various community-based services under the LTCI program. Family members and friends provided care for the majority of older patients in need, even providing nursing and personal care, which require skills on the part of the caregiver. Informal caregiving has an incremental positive effect on the health of care recipients. Although there is some evidence that caregiver training intervention appeared to be effective in improving the psychological health and quality of life of caregivers (Hepburn et al., 2001; Belle et al., 2006), it is not apparent that the caregiver training intervention has any positive effect on stable living at home for disabled community-dwelling older people. Future interventions for family caregivers should focus not only on caregiver health but also on stable living at home for disabled community-dwelling older people by providing adequate help to meet care recipients' needs.

### Conflict of interest statement

The authors have no conflicts of interest with the manufacturers of any drug evaluated in this paper.

### Acknowledgments

The authors wish to thank all the patients, caregivers and the many nurses participating in the study, and the Nagoya City Health Care Service Foundation for Older People for their vigorous cooperation. Financial disclosure: This study was supported by a Grant-in Aid for the Comprehensive Research on Aging and Health from the Ministry of Health, Labor, and Welfare of Japan, and a grant from Mitsui Sumitomo Insurance Welfare Foundation.

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# 要介護高齢者の経口摂取困難の実態ならびに 要因に関する研究\*

keywords: 高齢者、経口摂取、低栄養

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目的：在宅ならびに特別養護老人ホーム(以下、特養と略)に入所中の要介護高齢者を対象に経口摂取困難者の実態ならびに、経口摂取困難者の背景を明らかにすることを目的とした。

対象及び方法：名古屋市在住の在宅要介護高齢者(n=1,112, 81.3±8.1(SD) 歳)、ならびに特養入所者(n=655, 85.2±7.9(SD) 歳)を対象とした。

結果：在宅要介護高齢者のうち、栄養摂取ルートは経口94.7%、経管栄養4.9%、経静脈栄養0.4%であった。特養入所者では経口摂取は91.8%、経管栄養は8.2%で、経静脈栄養利用者はいなかった。経口摂取者のうち、嚥下障害を有する割合は在宅33.7%、特養で38.6%と高率であった。経管栄養利用者ならびに嚥下障害者では栄養不良の割合が正常者に比較し高率であった。経管栄養利用者ならびに嚥下障害者に関連する因子として日常生活障害、認知症、神経変性疾患などが抽出された。

結論：在宅ならびに特養における要介護高齢者には多くの経口摂取困難者が存在し、正常に経口摂取できる対象者と比較し栄養不良が多く存在していた。

## 背景

要介護高齢者では低栄養のリスクが高く、報告によっては要介護高齢者の低栄養の頻度は40%に及ぶとされている。高齢者の低栄養は健康障害に直結するため、迅速にリスクを把握し、介入することが求められる<sup>1)</sup>。高齢者栄養障害の要因の一つに摂食嚥下障害がある。高齢者の経口摂取困難は栄養障害、新たな疾病、障害発生、患者の生命予後や生活の質(以後、QOLと略)の低下のみならず介護者のQOLの低下につながる<sup>2)</sup>。要介護高齢者のうち、どれほどの割合で経口摂取困難者がいる

か、経口摂取困難者のうちどれほどが経管栄養療法を受けているのか、さらにはどのような要因で経口摂取困難に至ったのか、など要介護高齢者における経口摂取困難の実態は多くが不明である。今後さらなる高齢社会が予測されている我が国にとって、できるだけ経口摂取を維持し、低栄養の予防に努めることは生命予後の改善をもたらす。さらに、身体機能障害予防、要介護者、主介護者のQOLの向上にもつながるため、医療政策上もきわめて重要といえる。

本研究では、在宅で様々な介護サービスを使用して在宅療養を継続している要介護高齢者、ならびに特別養

\*Prevalence of oral intake difficulty and associated factors in disabled elderly  
受付日：2011年3月7日 採用決定日：2011年5月27日